Cardiovascular risk in adult Melbourne Chinese

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Abstract: Chinese migrants have low cardiovascular mortality, particularly in their first 10 years of residence in Australia. The apparent increase in cardiovascular deaths among Asian migrants who have lived in Australia for more than 10 years suggests that cardiovascular risk transition may occur soon after migration. In this descriptive study, we found that Melbourne Chinese were not low in cardiovascular risk factors as usually defined. The prevalence of hyperlipidaemia (7.7 per cent for men and 5.2 per cent for women) was similar to the prevalence for other Australians (6.8 per cent for men and 4.4 per cent for women). In spite of low mean blood pressure (systolic blood pressure 114±23 mmHg (mean±standard deviation) and diastolic blood pressure 67.3±10.6 mmHg), Melbourne Chinese women were hypertensive as often as their Australian counterparts. The prevalence of cigarette smoking in men (26.9 per cent) was also comparable to prevalence for Australian males (24.1 per cent). Being slim is the only recognised cardiovascular protection that Melbourne Chinese may have. A high waist-to-hip ratio (0.91±0.054 for men and 0.88±0.077 for women), however, may outweigh the potential benefit of a lower prevalence of overweight (17.7 per cent for men and 14.1 per cent for women). Melbourne Chinese men had a multiple risk-factor profile similar to their Australian counterparts. Differences in multiple risk factors in women were attributable to fewer Chinese women having a single risk factor (15.4 per cent versus 30.1 per cent). While cardiovascular mortality and risk-factor prevalence is declining in Australia, our study suggests that migrants such as Melbourne Chinese may not share the same health improvement. (*Aust J Public Health* 1993; 17: 306–13)

The Australian population is culturally diverse. One in every five Australians was born overseas.[1] The wellbeing of immigrants to Australia will therefore have a significant impact on the national health profile. Immigrants may be highly selected; they are young and healthy at the time of arrival. Australians born in Southern Europe, East and Southeast Asia, and Central and South America have a much lower coronary and all-cause mortality in their first 10 years of residence in Australia compared to the native-born, but their mortality then rises.[2] At the same time, in Australia, coronary heart disease mortality and cardiovascular risk-factor prevalence have declined in the past decade.[3,4] The apparent health advantage in cardiovascular mortality in some migrant populations and its potential contribution to the national mortality trend, however, has been poorly evaluated. Cardiovascular disease is still the leading cause of death in Australia today.

Ethnic Chinese have a long history of immigration to Australia. They are of non-English-speaking background and represent an important non-Caucasian immigrant group. They have featured prominently in Australia's history of food and nutrition, but their health status and social impact on Australian society requires better documentation.[5–7] In a cross-sectional study of food habits and cardiovascular risk, we have been interested in whether or how an apparent relative cardiovascular health advantage is maintained by ethnic Chinese. We report here on the cardiovascular risk profile of a representative adult Melbourne Chinese population, along with their sociodemographic characteristics.

Methods

Study design and subjects

This was an epidemiological study of cross-sectional design. Ethics approval for the study was granted by Monash University and a consent form was signed by all participants. The study aimed to collect baseline information related to cardiovascular disease risk factors in Melbourne Chinese Australians. Where appropriate, the National Heart Foundation (NHF) Risk Factor Prevalence Survey (RFPS) methodology was used to collect comparable data.[8,9] Subjects were permanent residents of Australia, of Chinese ethnicity, and aged 25 years and over at the time of contact. 'Chinese ethnicity' is a self-imposed identity and may include individuals with one Caucasian parent or grandparent.[10,11] Subjects were recruited from households using a sampling method developed for the study.[10] This study achieved a household participation rate of 72.6 per cent. Almost all eligible individuals living in each household were interviewed.

The conduct of the survey and risk-factor assessment

Information was obtained from both self-administered questionnaires and the interview. The purposes of the interview were to obtain information for anthropometry, blood pressure, blood lipids and glycaemic status, and to check the questionnaires. Subjects received a set of questionnaires by mail and were interviewed at home, as individuals, during a single visit. A one-to-one interview had been arranged for those who were illiterate. Interviews were conducted in a dialect or language familiar to the subject. The questionnaires had been pilot tested and were bilingual, with Chinese and English set side by side. The Chinese version was certified by an interpreter. For the cardiovascular risk-factor assessment, we adapted the questionnaire developed for the 1983 NHF survey.[8] Dietary intake was assessed using a food-frequency questionnaire method. The method and its validation have been reported elsewhere.[12]

The measurements took about 20 minutes and were taken by a single, trained observer. A non-stretch measuring tape was used to measure stature

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and abdominal circumferences and a digital scale was used to measure weight. Stature and weight were measured twice using the 1983 NHF survey procedures.[9] The body mass index (BMI), an indicator of total body fatness, was calculated as body weight in kilograms divided by stature squared in metres. The classifications for underweight (BMI less than 20), acceptable weight (BMI 20 to 25), overweight (BMI over 25 to 30) or obese (BMI over 30) recommended by the Australian National Health and Medical Research Council were used to estimate the prevalence of overweight or obesity.[13,14] The 'waist' girth was measured at the level of umbilicus and the 'hip' girth was measured at the level of the gluteal protrusion with light clothes on and the subject standing in an upright position.[15,16] Both were measured twice to the nearest millimetre. The waist-to-hip circumference ratio (WHR), an indicator of abdominal fatness, was calculated as the circumference at the level of umbilicus divided by the maximum hip circumference.

A random zero sphygmomanometer was used to measure blood pressure. Cuffs of three sizes (adult, large arm and child) were used. Cuff size and room temperature were recorded. Two measurements (later averaged) were taken from the right arm, five minutes apart, with the subject resting in the sitting position. The Korotkoff phase I and V were recorded for systolic and diastolic pressure, respectively. 'Hypertension' was defined in accordance with that reported in the 1989 NHF survey.[9] 'Diastolic' and 'combined' hypertension were further categorised into treated and controlled, treated and uncontrolled, and untreated, using the criteria shown in Table 1.

Capillary blood was collected for fasting lipid concentration measurements and whole blood glucose level. Fasting for at least 12 hours was confirmed and recorded. Multiple finger pricks were performed to collect a 1 ml blood sample. The plasma was stored in a cool room at 4–10°C prior to the analysis. Plasma total cholesterol (CHOL), triglyceride (TRIG) and high density lipoprotein cholesterol (HDLC) concentrations were analysed using the Kone Progress selective chemistry analyser and the Australian lipid standardisation program calibrators at the Department of Chemical Pathology, Prince Henry's Hospital. The low-density lipoprotein cholesterol (LDLC) level was calculated based upon the Friedewald formula.[17] The prevalence of hyperlipidaemia (CHOL 6.5 mmol/L or higher and TRIG 2.0 mmol/L or higher) was assessed using the NHF criteria.[9]

The whole-blood fasting glucose level was calibrated on a Boehringer Mannheim Reflolux II device and later validated employing the YSL glucose analyser (model 23AM). The mean glucose levels calibrated by the two methods did not differ significantly and the Pearson correlation coefficient (r) was 0.99 ($P < 0.0001$).

The presence of multiple risk factors was also assessed using the 1989 NHF classification criteria.[9] Individuals were categorised as having zero to three risk factors.

Use of the NHF 1989 Risk Factor Prevalence Survey as a reference population

The 1989 NHF RFPS makes available cardiovascular risk profiles of Australian electors in the catchment area and is the only national reference on adult cardiovascular risk-factor prevalence.[9] The survey was carried out during the period when the current study was near completion, with four months' overlap. The population age range differed from the current study in that it included those aged 20 to 24 years and excluded those over the age of 70 years. Each sample included equal numbers in each age stratum. While the waist circumference was mentioned in the NHF survey report, no reference was made to the precise location of the measurement. The prevalence of abdominal obesity was not readily available from the NHF report. Where the Melbourne Chinese cardiovascular disease risk-factor prevalence was compared with that of the NHF, the estimates (not the observed frequency) were used to enumerate a national population equivalent. Only those aged 25 to 69 years were included in the analyses.

Statistics

This is a descriptive study. Where appropriate, a percentage is presented for categorical variables, and the mean, standard deviation, and percentiles are presented for continuous variables. The Pearson's correlation coefficient was used to assess the relationship between whole-blood fasting glucose levels measured by the Reflolux II device and the YSL analyser. The Kolmogorov-Smirnov asymptotic statistic was used to test the representativeness of the study population. The empirical distribution of the study population was compared with that of the 1986 census Chinese population. A test of differences in proportions was used to determine differences in risk-factor prevalence between the Melbourne Chinese Health Study (MCHS) population and Australians at large (the NHF survey). The significance level was set at five per cent. Where the population mean is mentioned in the text, the standard deviation of the mean is presented in the parenthesis. The con-

Table 1: Hypertension categories

	'Diastolic' hypertension	'Combined' hypertension
Treated and controlled	On blood pressure tablets and and diastolic blood pressure <95 mmHg	On blood pressure tablets and diastolic blood pressure <95 mmHg and systolic blood pressure <160 mmHg
Treated and uncontrolled	On blood pressure tablets and and diastolic blood pressure ≥95 mmHg	On blood pressure tablets and diastolic blood pressure ≥95 mmHg and systolic blood pressure ≥ 160 mmHg
Untreated	Not on blood pressure tablets and diastolic blood pressure ≥95 mmHg	Not on blood pressure tablets and diastolic blood pressure ≥95 mmHg and/or systolic blood pressure ≥160 mmHg

ventional mean plus or minus one standard deviation is also used.

Results

Study population characteristics

In 1988 and 1989 we interviewed 547 adult ethnic Chinese (271 men and 276 women). All had completed questionnaires, anthropometry and blood pressure measurements. One man and one woman did not wish to have blood taken but 545 subjects had blood sampled and all confirmed the fasting requirement. Geographically, the study population was representative of Melbourne Chinese living in the seven Melbourne statistical regions (Table 2). The study population was a representative sample of adult Melbourne Chinese Australians. This is evident from the empirical age distribution of the study population which did not differ significantly from that of the 1986 census Chinese population. More than 95 per cent of the study population were born outside of Australia. The percentage of study subjects born in China, Hong Kong, Malaysia or Singapore also matched the 1986 census adult Chinese population, particularly for men. The average age was 44.7 (standard deviation 12.5) years for men and 42.4 (standard deviation 12.6) years for women. The average length of stay in Australia was 12 (standard deviation 8.98) years for men and 8.8 (standard deviation 5.83) years for women. Other characteristics of the study population are shown in Table 2.

Table 2: Percentages of the study population ($n=547$) and persons of Chinese ancestry ($n=46\ 241$) living in each Melbourne statistical region

	MCHS[a]	ABS[b]
Western	13.7	12.2
Inner	14.1	21.9
North eastern	4.2	7.1
Inner eastern	39.3	30.2
South	11.5	13.1
Outer eastern	4.6	5.1
Mornington Peninsula	12.6	10.2
Significance level for nonparametric test=0.94[c]		

Notes: (a) the Melbourne Chinese Health Study population
(b) Australian Bureau of Statistics Chinese population, 1986
(c) Kolmogorov-Smirnov asymptotic statistic=0.53

Table 3: Characteristics of the study population by gender (%)

	Men ($n=271$)	Women ($n=276$)
Age in years[a]		
25 to 34	23.2	34.4
35 to 44	35.1	33.0
45 to 54	22.9	15.2
55 to 64	10.3	9.4
65 and over	8.5	8.0
Length of stay in Australia in years		
0 to 4	11.2	22.8
5 to 9	36.3	40.8
10 to 14	26.3	24.8
15 to 19	9.3	6.7
20 to 29	10.0	4.9
30 or more	6.1	0.8
Marital status		
Married	86.7	78.6
Never married	9.6	12.0
Others	3.7	9.5
Country of birth[b]		
Australia	4.4	3.3
China	24.0	23.6
Hong Kong	11.1	13.4
Malaysia or Singapore	27.3	22.1
Vietnam	24.0	26.8
Others	9.2	10.9
Education level in years		
0 to 6	12.2	28.7
7 to 9	22.5	17.8
10 to 12	19.9	27.9
13 or more	45.4	25.7
Occupational status		
Professional	28.8	24.3
Administrative, clerical and sales	24.0	18.9
Trades and services	43.9	32.9
Domestic duties	3.3	23.9
Gross yearly household income in $		
0 to 6 000	3.4	5.9
6 000 to 12 000	5.6	8.1
12 001 to 22 000	20.9	24.5
22 001 to 40 000	35.4	35.9
40 000 or more	34.7	25.6

Notes:
(a) The distributions did not differ significantly from the Chinese population in Victoria, according to the 1986 ABS census (table CX4137)
(b) The distribution of those born in China, Hong Kong, Malaysia and Singapore did not differ from that of the Chinese population in Victoria, according to the 1986 ABS census (table CX 0001)

Cardiovascular risk-factor profile

The percentiles for measurements related to cardiovascular disease risk-factor profile are shown in Table 4. Melbourne Chinese had a fairly low mean blood pressure (SBP 117±17.6 mmHg for men and 114±23 mmHg for women; DBP 73±10.3 mmHg for men and 67±10.6 mmHg for women) and body mass index (22.7±2.96 for men and 21.8±3.24 for women). There were no differences in plasma lipid concentration and whole blood glucose level between women not now taking and women now taking the oral contraceptive pill.

More than 10 per cent of Melbourne Chinese had been told they had high blood pressure and 5.5 per cent of men and 9.8 per cent of women reported having received a high blood pressure treatment (Table 5). More men (12.9 per cent) reported having a medical history for high blood cholesterol or triglycerides compared to women (4 per cent). Melbourne Chinese largely had an acceptable weight for their height (64.2 per cent for men and 52.4 per cent for women). More than 50 per cent of men reported smoking at some time in their lives and about half of them had stopped smoking; 26.2 per cent smoked cigarettes regularly at the time of interview. Of the 7.6 per cent of females who had ever smoked, more than 50 per cent (4 per cent of the total population) had given up smoking. The cardiovascular risk-factor profile for the Melbourne Chinese is shown in Table 5.

Comparisons with the 1989 NHF national estimates

As evidenced by BMI, the prevalence of overweight or obesity in the general Australian population was

Table 4: Percentile distributions for anthropometry, blood pressure, fasting plasma lipids and fasting whole blood glucose level, by gender

	n	Mean	Standard deviation	5%	25%	50%	75%	95%
Stature (cm)								
Men	271	167.3	6.1	156.5	163.0	167.5	172.0	176.0
Women[a]	269	156.2	5.8	146.0	152.5	146.0	159.5	166.0
Weight (kg)								
Men	271	63.2	9.3	49.5	57.5	62.5	68.0	79.0
Women[a]	269	53.3	8.5	40.0	47.0	52.5	58.5	68.5
Body mass index (kg/m^2)								
Men.	271	22.7	3.0	18.2	20.6	22.5	24.0	27.6
Women[a]	269	21.8	3.2	17.1	19.6	21.6	23.9	27.2
Waist circumference (mm)								
Men	271	843	85	690	773	833	890	968
Women[a]	269	814	104	660	733	813	885	990
Hip circumference (mm)								
Men	271	916	55	835	882	913	945	1015
Women[a]	269	921	65	823	875	920	958	1035
Waist–hip ratio								
Men	271	0.91	0.054	0.82	0.87	0.91	0.95	0.99
Women	269	0.88	0.077	0.76	0.83	0.88	0.93	1.01
Systolic blood pressure (mmHg)								
Men	271	117	17.6	96	104	114	126	153
Women	276	114	23.0	89	100	108	124	161
Diastolic blood pressure (mmHg)								
Men	271	73	10.3	57	67	74	80	88
Women	276	67	10.6	50	60	67	73	85
Total cholesterol (mmol/L)								
Men	270	5.54	1.05	4.0	4.9	5.5	6.1	7.5
Women	275	5.30	1.16	3.8	4.5	5.1	5.9	7.4
—not now taking oral contraceptive	244	5.36	1.19	3.9	4.6	5.2	6.0	7.5
—now taking oral contraceptive	31	4.82	0.73	3.7	4.2	4.7	5.4	6.3
HDL cholesterol (mmol/L)								
Men	270	1.33	0.34	0.86	1.08	1.29	1.53	1.97
Women—total	275	1.52	0.39	0.99	1.24	1.50	1.76	2.25
—not now taking oral contraceptive	244	1.54	0.39	0.99	1.26	1.51	1.79	2.25
—now taking oral contraceptive	31	1.45	0.33	1.03	1.21	1.39	1.60	2.11
LDL cholesterol (mmol/L)[b]								
Men	270	3.51	0.94	2.21	2.84	3.48	3.95	5.12
Women—total	275	3.20	1.05	1.86	2.52	3.04	3.70	4.99
—not now taking oral contraceptive	244	3.25	1.09	1.86	2.56	3.07	3.84	5.03
—now taking oral contraceptive	31	2.81	0.54	2.03	2.40	2.78	3.36	3.60
Triglycerides (mmol/L)								
Men	270	1.55	1.01	0.6	0.9	1.2	2.0	3.2
Women—total	275	1.25	0.82	0.5	0.7	1.0	1.5	2.7
—not now taking oral contraceptive	244	1.26	0.84	0.5	0.7	1.0	1.5	2.7
—now taking oral contraceptive	31	1.21	0.61	0.6	0.7	1.0	1.6	2.0
Fasting whole blood glucose (mmol/L)								
Men	270	4.41	1.24	3.6	4.0	4.3	4.6	5.3
Women—total	275	4.54	1.58	3.3	3.9	4.3	4.7	5.8
—not now taking oral contraceptive	244	4.59	1.66	3.3	3.9	4.3	4.7	5.8
—now taking oral contraceptive	31	4.17	0.53	3.2	3.8	4.2	4.6	5.0

Notes: (a) Excludes seven pregnant women. (b) LDL is estimated using the Friedewald formula.[17]

more than twofold that of Melbourne Chinese. The prevalence of overweight differed in the two populations ($P < 0.0001$) for both men and women. Regrettably, there was no corresponding waist measurement in the Chinese and NHF studies to say whether BMI for WHR was comparable in the two study populations. Hypertension was less prevalent in Melbourne Chinese men than in Australian males at large (diastolic blood pressure 6.6 per cent versus 18.1 per cent or combined hypertension 8.6 per cent versus 19.8 per cent, $P < 0.05$). The difference was attributable to a larger percentage of Australian males having untreated hypertension (diastolic hypertension 1.9 per cent versus 8.5 per cent or combined hypertension 3.9 per cent versus 10.2 per cent). There was no significant difference in the prevalence of hypertension (as defined) between the Melbourne Chinese women and their Australian counterparts. For both men and women, the prevalence of treated and controlled hypertension was similar in the two populations (diastolic hypertension 3.5 per cent versus 6.3 per cent or combined hypertension 3.5 per cent versus 5.4 per cent for men and diastolic hypertension 9.0 per cent versus 8.8 per cent or combined

Table 5: Cardiovascular risk factor prevalence of the Melbourne Chinese, by gender (%)

	Men (n=271)	Women (n=276)
Self-reported medical history		
High blood pressure	11.4	13.4
High cholesterol or triglycerides	12.9	4.0
Angina	1.8	1.8
Diabetes	1.8	4.3
Receiving treatment for cardiovascular disease risk		
High blood pressure	5.5	9.8
High blood fat	1.8	1.1
Angina	0.7	1.4
Diabetes	1.8	5.1
Oral contraceptive use		
Now taking	-	11.6
Not now taking	-	40.8
Never used	-	47.6
Overweight or obese[a]		
Underweight	17.3	31.2
Acceptable weight	64.2	52.4
Overweight	17.7	14.1
Obese	0.7	2.2
Hypertensive, defined by diastolic blood pressure and treatment[b]		
On blood pressure tablets and DBP<95 mmHg	4.4	9.4
On blood pressure tablets and DBP≥95 mmHg	1.1	0.4
Not on blood pressure tablets and DBP≥ 95 mmHg	2.2	0.4
Total	7.7	10.1
Hypertensive, defined by diastolic blood pressure, systolic blood pressure and treatment[b]		
On blood pressure tablets, DBP<95 mmHg and SBP<160 mmHg	4.1	6.9
On blood pressure tablets, DBP≥95mm Hg and/or SBP≥160 mm Hg	1.5	2.9
Not on blood pressure tablets and DBP≥95mm Hg and/or SBP≥160 mm Hg	4.4	2.2
Total	10.0	11.2
Hyperlipidaemia[b]		
Cholesterol≥5.5 mmol/L	52.2	37.8
Cholesterol≥6.5 mmol/L	16.3	14.2
Triglyceride≥2.0 mmol/L	25.2	14.2
Cholesterol≥6.5 mmol/L and triglyceride≥2.0 mmol/L	7.8	5.1
Smoking status		
Cigarette smoker	26.2	3.6
Cigar and/or pipe only	1.1	0.0
Ex-smoker	24.0	4.0
Never smoked regularly	48.7	92.4
Multiple risk factors[b]		
No risk factors	60.5	82.6
One risk factor	33.2	16.3
Two risk factors	6.3	1.1

Notes:
(a) Uses the classification recommended by the NHMRC;[13,14] excludes seven pregnant women
(b) Uses the classification of the 1989 NHF RFPS report[9]

hypertension 6.7 per cent versus 7.6 per cent for women). Melbourne Chinese had a prevalence of hyperlipidaemia similar to that of their Australian counterparts (7.7 per cent versus 6.8 per cent for men and 5.2 per cent versus 4.4 per cent for women). Melbourne Chinese women had a higher prevalence of hypertriglyceridaemia ($P < 0.05$) and a much lower prevalence of cigarette smoking ($P < 0.0001$) than the general Australian female population. Melbourne Chinese men had a comparable multiple risk-factor profile while Melbourne Chinese women had a significantly lower prevalence of one risk factor (15.4 per cent versus 30.1 per cent, $P < 0.0001$) than their Australian counterparts (Table 6).

Discussion

Blood pressure and treated hypertension

High blood pressure is an established risk factor for coronary heart disease and stroke.[18–23] In this study, we found that the mean blood pressure in the Melbourne Chinese was relatively low compared to the national average. Similar observations have been made in studies where Chinese have been shown to have a lower blood pressure than Americans,[24] Germans[25] and their Malay and Indian counterparts in Singapore.[26] Additionally, it has been reported that hypertension is more prevalent in populations of Western culture than those of Asian culture,[24,27,31] yet we found that the prevalence of treated hypertension in women was similar to that among their Australian counterparts. There is no evidence that a random zero sphygmomanometer used in this study would produce a higher reading than other sphygmomanometers.[32,33] The fact that Melbourne Chinese women had a relatively low mean blood pressure does not imply a lower prevalence of hypertension. Among those defined as hypertensive, more Melbourne Chinese had received treatments and had their blood pressure under control than other Australians. We do not have data to support suggestions that Melbourne Chinese are likely to seek and/or follow medical advice more than their Australian counterparts. Despite a low mean blood pressure (systolic pressure below 120 mmHg and diastolic pressure 80 mmHg), the high prevalence of hypertension in the Melbourne Chinese is consistent with reports that Chinese are more susceptible to hypertension and stroke.[25,26,34] Although there may be a genetic predisposition to hypertension in humans,[35] primary or essential hypertension is probably not only genetic but has other causes in Chinese and in other ethnic groups.[36]

The prevalence of hyperlipidaemia

Hypercholesterolaemia has received a lot of attention for its role in human atherosclerosis and is probably the most widely studied cardiovascular risk factor in modern medical research. High blood cholesterol is partly and variably genetically determined.[37] That dietary interventions may alter the population blood cholesterol levels[38–40] suggests that environmental factors are important in atherosclerosis and cardiovascular disease mortality. Where the health of migrant populations is of interest, diet-related risk factors (particularly blood cholesterol levels) are studied in an attempt to demonstrate the influence of changing life-style factors on cardiovascular risk or disease patterns.[24,41,42] Choi and colleagues showed that elderly Chinese immigrants to Boston, USA, had lower blood lipid levels than elderly American whites.[24] It is also known that the mean plasma cholesterol concentrations in native Chinese are generally low.[43] Thus, the seemingly higher levels of plasma total cholesterol and triglyceride concentrations and the prevalence of hyperlipidaemia in

Table 6: Comparisons of the cardiovascular disease risk factor prevalence of the Melbourne Chinese (MCHS) and the 1989 National Heart Foundation Survey (NHF), by gender (%)

	Men		Women	
	MCHS[a]	NHF[b]	MCHS[a]	NHF[b]
Overweight or obese[c]				
n[d]	*260*	*4167*	*260*	*4255*
Underweight	17.7	3.9	31.2	13.8
Acceptable weight	63.9	43.2	52.7	48.3
Overweight	17.7	40.4	13.8	23.2
Obese	0.8	9.6	2.3	11.7
Not stated	–	3.0	–	3.1
Hypertensive, defined by diastolic blood pressure and treatment[f]				
n	*260*	*4166*	*267*	*4335*
On blood pressure tablets and DBP<95 mmHg	3.5	6.3	9.0	8.8
On blood pressure tablets and DBP≥95 mmHg	1.2	3.3	0.4	1.9
Not on blood pressure tablets and DBP≥95 mmHg	1.9	8.5	0.4	3.1
Total	6.6	18.1	9.8	13.8
Hypertensive, defined by diastolic blood pressure, systolic blood pressure and treatment[e]				
n	*260*	*4166*	*267*	*4335*
On blood pressure tablets and DBP<95 mmHg and SBP<160 mmHg	3.5	5.4	6.7	7.6
On blood pressure tablets and DBP≥95 mmHg and/or SBP≥160 mmHg	1.2	4.2	2.6	3.2
Not on blood pressure tablets and DBP≥95 mmHg and/or SBP≥160 mmHg	3.9	10.2	1.9	4.8
Total	8.6	19.8	11.2	15.6
Hyperlipidaemia[e]				
n	*259*	*3715*	*267*	*2761*
Cholesterol≥5.5 mmol/L	52.1	49.2	37.5	40.7
Cholesterol≥6.5 mmol/L	15.8	17.2	13.5	15.1
Triglyceride≥2.0 mmol/L	25.1	21.3	14.6	7.0
Cholesterol≥6.5 mmol/L and triglyceride≥2.0 mmol/L	7.7	6.8	5.2	4.4
Smoking status				
n	*260*	*4161*	*267*	*4335*
Cigarette smoker	26.9	24.1	3.4	20.3
Cigar and/or pipe only	0.8	1.4	0.0	0.1
Ex-smoker	22.7	32.8	4.1	20.5
Never smoked regularly	49.6	41.6	92.5	59.2
Multiple risk factors[b]				
n	*260*	*4166*	*267*	*4335*
No risk factors	60.4	56.3	83.5	64.8
One risk factor	33.5	35.2	15.4	30.1
Two risk factors	6.2	8.0	1.1	4.9
Three risk factors	0.0	0.5	0.0	0.2

Notes: (a) The Melbourne Chinese Health Study population, excluding those aged 70 years and over. (b) The 1989 NHF RFPS population, aged 25 to 69 years.[7] (c) The classifications for underweight, acceptable weight, overweight and obese recommended by the NHMRC are used.[13,14] (d) Excludes pregnant women. (e) Uses the classification of the 1989 NHF RFPS report.[7] (f) Includes women now taking and those not now taking the oral contraceptive pill.

adult Melbourne Chinese are of public health significance, especially in combination with a lower low-density lipoprotein cholesterol and somewhat higher high-density lipoprotein cholesterol levels.

It is unclear whether the higher plasma cholesterol or triglyceride concentrations in the Melbourne Chinese are associated with the event of immigration to Australia. This cannot be answered directly without a retrospective or cohort investigation into the relationship between the population plasma lipid levels and the length of exposure to the Australian environment. Even then, the potential cohort effect associated with the waves of migration may introduce biases to the exposure factor, that is, the length of stay in Australia. Results of this study, however, reveal that Melbourne Chinese had plasma total cholesterol or triglyceride levels similar to the Australia norm, which is in decline. Thus, a longitudinal or continuing investigation in plasma lipid profiles in Melbourne Chinese population is warranted.

Cigarette smoking

Cigarette smoking is regarded as the most preventable coronary risk factor in Australia[18] and developed countries.[23,44] As a behavioural risk factor, cigarette smoking has been shown to modify the effect of alcohol consumption on blood pressure in men.[45] Melbourne Chinese women had a very low prevalence of cigarette smoking and the prevalence of hypertension was comparable to that of their Australian counterparts. Melbourne Chinese women also had a very low prevalence of cigarette smoking compared to their male counterparts. On the other hand, Chinese men had a smoking prevalence comparable to the Australian norm, but a lower prevalence of hypertension. Thus, cigarette smoking per se cannot explain why Chinese had a high or low prevalence of hypertension. That the cigarette smoking is an independent risk factor for cardiovascular disease appears plausible and offers explanation as to why the effect of cigarette smoking on cardiovascular risk is less pronounced in women than in men living in society where these risk factors are common.[46]

Overweight or obesity and abdominal fatness

Body fatness, both total and abdominal, is an important risk factor because it is positively associated with blood pressure,[47-55] blood cholesterol level,[48,56-63] blood glucose level and diabetes.[64-66] Having an acceptable weight for stature is probably the only consistent cardiovascular advantage that Melbourne Chinese have. Being slim does not seem to prevent the Melbourne Chinese from having hypertension (women only) or hyperlipidaemia. Melbourne Chinese had a relatively high WHR (mean WHR was more than 0.90 for men and more than 0.85 for women). This suggests that regional body fatness may be more important than other cardiovascular risk factors in Melbourne Chinese. Whether or not WHR in the Melbourne Chinese had changed after immigration to Australia is not known. However, Melbourne Chinese had significantly greater waist circumferences and WHR, but not hip circumferences, than their counterparts in Southern China.[67] The same study also showed that Melbourne Chinese were heavier and had higher BMI but not stature.

The classification for underweight, acceptable weight, overweight and obesity was based upon data of predominantly Caucasian Australians.[13,14] It differs from the Bray's classification, which has a lower gender-specific cut-off point for underweight (BMI = 19 for men and BMI = 18 for women).[68] The two classifications produce the same prevalence of overweight or obesity for a given population and may be inappropriate for use in populations other than Caucasian. While it is highly speculative that the presumed lower prevalence of overweight in Melbourne Chinese may be attributable to misclassification, our findings suggest the relative importance of abdominal obesity in cardiovascular risk.

Conclusion

The observed increase in cardiovascular mortality in the 1970s among the longer-term Asian migrants living Australia coincided with national declines in cardiovascular mortality and risk-factor prevalence.[2-4,69] As the Australian general public have become more aware of the risk-factor concept, there has been more of such a decline. Migrants in Australia, however, may not be able to participate in the same health improvement. We have shown that Melbourne Chinese (especially men), a presumed low cardiovascular-risk population, are in fact at comparable risk to other Australians (using conventional risk criteria). The high prevalence of the combined high plasma cholesterol and triglyceride concentration suggests possible changes in diet in the Melbourne Chinese. The low prevalence of overweight, often accompanied by abdominal fatness, is interesting and warrants further investigation into the nature of dietary change and its impact on cardiovascular risk in this population. Ultimately, cardiovascular morbidity and mortality for a given conventional risk-factor profile in Chinese compared to Caucasian Australians may be one of the more important future observations to be made.

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