3 Hypertension

Introduction

Hypertension is an important risk factor for coronary heart disease and cerebrovascular disease, which together accounted for nearly 29% of all deaths in 2004. Early detection and adequate treatment of hypertension is an essential component of primary prevention of heart disease and stroke.

Definition

The WHO Classification criteria for hypertension *(WHO, 2003)* was used for the National Health Survey 2004. Table 3.1

Table 3.1: Diagnostic values for hypertension

Classification	Blood pressure (mmHg) Systolic		Diastolic
Normal	< 140	and	< 90
Hypertension	≥ 140	or	≥ 90

Method Used

The standards prescribed in the WHO MONICA Protocol for measurement of blood pressure was used.

Blood pressure was measured using a standard mercury sphygmomanometer. All blood pressure measurements were taken in a quiet room away from the main survey site. The subjects were rested adequately before the measurements were taken. Blood pressure was measured with the subject seated and the right arm supported by the table at heart level.

A cuff of suitable size was applied, 2-3 cm above the cubital fossa, on the subject's exposed upper arm. The cuff was inflated until the sphygmomanometer reading was 30 mmHg above the level at which the radial pulse disappeared, and then slowly deflated. During this time, the Korotkoff sounds (identifiable as pulses) were monitored with the bell of a stethoscope placed over the brachial artery.

The pressure at which the first Korotkoff sounds were heard was the systolic blood pressure. The

diastolic blood pressure was the pressure at which the sounds disappeared.

Two measurements were taken for each subject, with a 30-second interval between them. However, if the systolic pressure between the two measurements differed by more than 25 mmHg or the diastolic pressure by more than 15 mmHg, a third measurement was taken. The mean of the two closest readings was then calculated.

Hypertension Status

The survey found that among Singapore residents aged between 30 and 69 years[1], 24.9% had hypertension[2]. Table 3.2

Table 3.2: Hypertension status (%) of Singapore residents aged 30-69 years, by gender, 2004

Hypertension Status	Males	Females	Total
Normal	70.5	79.6	75.1
Hypertension*	29.5	20.4	24.9

* Includes known hypertensives on treatment

Prevalence of Hypertension

Hypertension was more common among males (29.5%) than females (20.4%). Overall, Chinese had the highest prevalence of hypertension (25.6%), followed by the Malays (22.7%) and Indians (21.6%). The prevalence of hypertension among females was highest in Malays, followed by Chinese and Indians, whilst the prevalence of hypertension among males was highest in the Chinese, followed by Indians and Malays. The age-specific prevalence for hypertension increased markedly from age 40 onwards. Graph 3.1; Table 3.3

[1] The analysis is confined to the 30-69 age group as most cases of hypertension in younger ages are secondary to causes such as kidney diseases, metabolic disorders etc.

[2] 20.1% of Singapore residents aged between 18 and 69 years had hypertension in 2004 as compared to 21.5% in 1998 and 16.1% in 1992.

Graph 3.1: Crude prevalence (%) of hypertension among Singapore residents aged 30-69 years, by gender and ethnic group, 2004

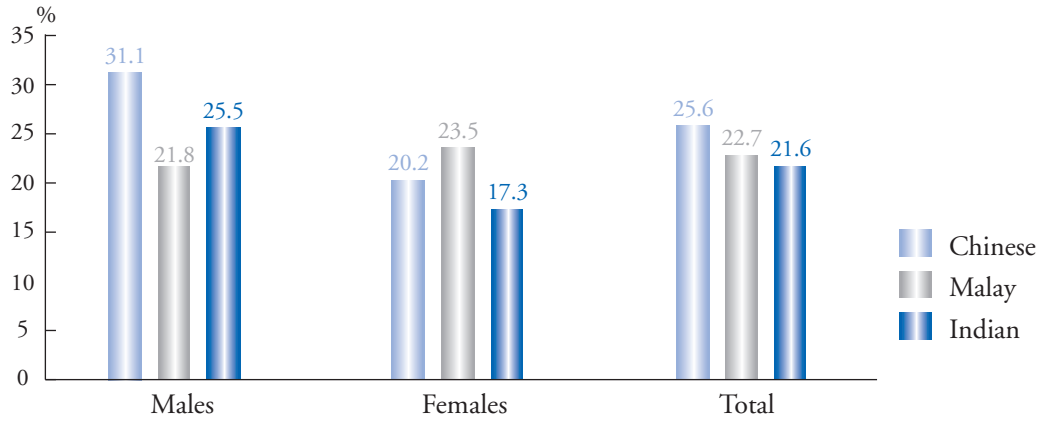

Table 3.3: Age-specific prevalence (%) of hypertension, by gender, 2004

Age (years)	Males	Females	Total
30-39	13.3	4.6	8.8
40-49	27.2	15.9	21.6
50-59	40.5	31.8	36.2
60-69	58.5	53.7	56.1
30-69	**29.5**	**20.4**	**24.9**

Trends in Hypertension

The prevalence of hypertension among Singapore residents aged 30 to 69 years decreased from 27.3% in 1998 to 24.9% in 2004.

Comparisons in age-standardised prevalence showed that hypertension rate had decreased significantly between 1998 and 2004 in the total population, in females as well as among the Chinese and Malay populations. Malays registered the largest decrease in age-standardised rates, from 34.4% in 1998 to 23.0% in 2004. Table 3.4

Table 3.4: Prevalence (%) of hypertension, by gender and ethnic group, 1992, 1998 and 2004

Gender / Ethnic group	Crude prevalence			Age-standardised prevalence (95% Confidence Interval)			Difference in age-standardised prevalence	
	1992	1998	2004	1992	1998	2004	['98-'92]	['04-'98]
Total	22.2	27.3	24.9	24.0 *(22.3, 25.8)*	28.0 *(26.5, 29.6)*	24.0 *(22.5, 25.6)*	4.0***	-4.0***
Gender								
Males	25.7	30.5	29.5	27.9 *(25.2, 30.6)*	31.7 *(29.3, 34.1)*	28.7 *(26.3, 31.1)*	3.8*	-3.0
Females	18.7	24.0	20.4	20.1 *(17.9, 22.4)*	24.4 *(22.5, 26.4)*	19.3 *(17.4, 21.3)*	4.3**	-5.1***
Ethnic group								
Chinese	22.1	26.9	25.6	23.9 *(21.8, 26.0)*	27.4 *(25.6, 29.2)*	24.3 *(22.5, 26.2)*	3.5*	-3.1*
Malay	24.0	31.5	22.7	26.6 *(22.5, 30.8)*	34.4 *(30.7, 38.0)*	23.0 *(19.7, 26.2)*	7.8**	-11.4***
Indian	21.2	24.6	21.6	21.3 *(17.5, 25.2)*	25.2 *(21.5, 28.9)*	22.5 *(18.8, 26.2)*	3.9	-2.7

* $0.01 < p < 0.05$
** $0.001 < p < 0.01$
*** $p < 0.001$

Prevalence of Undiagnosed Hypertension

Among those found to have hypertension at the survey, 38.5% had not been previously diagnosed. More male hypertensives (44.2%) than female hypertensives (30.4%) were newly diagnosed.

Chinese hypertensives had the highest proportion of newly diagnosed cases (39.4%), followed by Indians (37.0%) and Malays (32.1%).

The majority (84.0%) of the newly diagnosed hypertensives had Grade 1 hypertension[3]. However, it was noted that a higher proportion of newly diagnosed Malay hypertensives (20.5%) had Grade 2 and 3 hypertension[4] compared with Indians (19.7%) and Chinese (15.3%).

[3] WHO/ISH has defined Grade 1 hypertension as systolic blood pressure of 140-159 mmHg or diastolic blood pressure of 90-99 mmHg *(WHO/ISH, 2003)*.
[4] WHO has defined Grade 2 hypertension as systolic blood pressure of 160-179 mmHg or diastolic blood pressure of 100-109 mmHg and Grade 3 hypertension as systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg *(WHO/ISH, 2003)*.

Control of Blood Pressure in Known Hypertensives

The survey found that 49.5% of all known hypertensives had good blood pressure control[5], while the proportion among those on treatment was 52.9%.

Among the known hypertensives, Chinese hypertensives (51.7%) had the highest proportion of cases with good blood pressure control, followed by Malay hypertensives (40.6%) and Indian hypertensives (39.4%).

[5] WHO has defined good blood pressure control at the population level as systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg, although individual blood pressure target would depend on one's cardiovascular risk stratification *(WHO/ISH, 2003).*

4 Cholesterol

Introduction

Hypercholesterolaemia is a major risk factor for coronary heart disease. Elevated blood cholesterol, in particular LDL-cholesterol, causes atherosclerosis and increases the risk for coronary heart disease. HDL-cholesterol has been shown to have a protective effect against coronary heart disease. Low HDL-cholesterol has been shown to be an important independent risk factor for development of coronary heart disease *(Ministry of Health, Clinical Practice Guidelines on Lipids, 2001).*

Definition

The classification criteria for blood cholesterol status used in National Health Survey 2004 were adapted from the Ministry of Health's Clinical Practice Guidelines on Lipids *(Ministry of Health, Clinical Practice Guidelines on Lipids, 2001).* Table 4.1

Table 4.1: Classification of blood cholesterol status

Classification	Blood cholesterol concentration	
	mmol/l	mg/dl
Total cholesterol		
Desirable	< 5.2	< 200
Borderline-high	5.2 - 6.1	200 - 239
High	≥ 6.2	≥ 240
HDL-cholesterol		
Desirable	≥ 1.0	≥ 40
Low	< 1.0	< 40
LDL-cholesterol		
Desirable	< 3.3	< 130
Borderline-high	3.3 - 4.0	130 - 159
High	≥ 4.1	≥ 160

Method Used

After an overnight fast of at least 10 hours, subjects had blood taken by venepuncture to determine their fasting total cholesterol, LDL-cholesterol and HDL-cholesterol levels.

All blood specimens were collected in plain tubes and despatched on the same day to the Biochemistry Laboratory in Singapore General Hospital for analysis.

Total blood cholesterol was measured using the Roche modular DP analyser with the enzymatic colorimetric method, while LDL-cholesterol was measured with the homogenous turbidimetric method.

HDL-cholesterol was determined using the same instrument with the homogeneous enzymatic colorimetric method.

Cholesterol Status

The survey found that 18.7% of Singapore residents aged 18 to 69 years had high total cholesterol levels while 34.4% had borderline-high levels and 46.9% desirable levels. Almost all had desirable HDL-cholesterol levels (94.5%). 19.8% of Singapore residents had high LDL-cholesterol levels and 31.8% had borderline-high LDL-cholesterol levels. Table 4.2

Table 4.2: Cholesterol status (%) of Singapore residents aged 18-69 years, by gender, 2004

Cholesterol Status	Males	Females	Total
Total cholesterol			
Desirable	44.6	49.2	46.9
Borderline-high	35.6	33.3	34.4
High	19.8	17.5	18.7
HDL-cholesterol			
Desirable	91.1	97.8	94.5
Low	8.9	2.2	5.5
LDL-cholesterol			
Desirable	42.4	54.4	48.4
Borderline-high	35.2	28.3	31.8
High	22.4	17.3	19.8

Prevalence of High Total Cholesterol

More males (19.8%) than females (17.5%) had high total cholesterol levels. Malays had the highest prevalence of high total cholesterol (22.8%), followed by Chinese (18.2%) and Indians (16.9%). Prevalence of high total cholesterol levels increased progressively with age, in both genders. Males below 50 years of age tended to have a higher prevalence of high total cholesterol than their female counterparts. However, the reverse was observed in those 50 years and above. Graph 4.1; Table 4.3

Graph 4.1: Crude prevalence (%) of high total cholesterol among Singapore residents aged 18-69 years, by gender and ethnic group, 2004

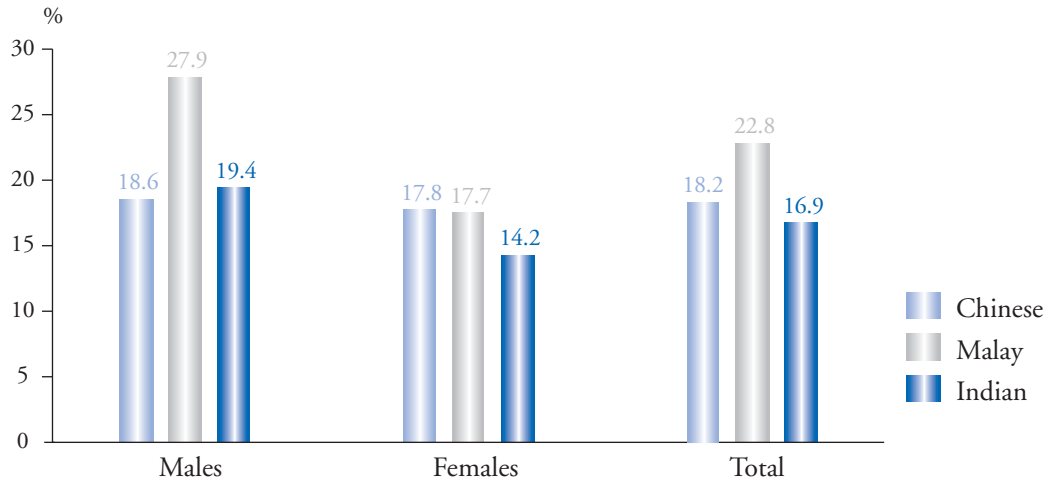

Table 4.3: Age-specific prevalence (%) of high total cholesterol, by gender, 2004

Age (years)	Males	Females	Total
18-29	6.1	4.3	5.2
30-39	21.6	10.3	15.8
40-49	26.3	18.3	22.3
50-59	25.8	35.6	30.7
60-69	19.5	33.6	26.7
18-69	**19.8**	**17.5**	**18.7**

Trends in High Total Cholesterol

The prevalence of high total blood cholesterol among Singapore residents aged 18 to 69 years declined from 25.4% in 1998 to 18.7% in 2004. Overall, there was a significant decrease in the age-standardised prevalence of high blood cholesterol between 1998 and 2004. Significant decreases in the age-standardised prevalence of high blood cholesterol were detected in both genders and all three ethnic groups. Table 4.4

Table 4.4: Prevalence (%) of high total cholesterol, by gender and ethnic group, 1992, 1998 and 2004

Gender / Ethnic group	Crude prevalence			Age-standardised prevalence (95% Confidence Interval)			Difference in age-standardised prevalence	
	1992	1998	2004	1992	1998	2004	['98-'92]	['04-'98]
Total	**19.4**	**25.4**	**18.7**	**21.4** *(20.0, 22.8)*	**26.0** *(24.8, 27.3)*	**18.1** *(16.8, 19.3)*	4.6**	-7.9**
Gender								
Males	20.1	27.3	19.8	21.9 *(19.9, 24.0)*	27.9 *(26.0, 29.9)*	19.5 *(17.7, 21.4)*	6.0**	-8.4**
Females	18.7	23.5	17.5	20.8 *(18.9, 22.7)*	24.1 *(22.4, 25.8)*	16.6 *(15.0, 18.3)*	3.3*	-7.5**
Ethnic group								
Chinese	18.7	23.9	18.2	20.5 *(18.9, 22.1)*	24.4 *(22.9, 25.9)*	17.3 *(15.9, 18.8)*	3.9**	-7.1**
Malay	22.6	35.6	22.8	25.7 *(22.3, 29.0)*	37.3 *(34.0, 40.5)*	23.5 *(20.5, 26.4)*	11.6**	-13.8**
Indian	21.1	24.4	16.9	23.5 *(20.1, 27.0)*	24.9 *(21.6, 28.2)*	17.0 *(14.0, 19.9)*	1.4	-7.9**

* $0.001 < p < 0.01$
** $p < 0.001$

Mean Total Cholesterol

The mean total blood cholesterol level of Singapore residents aged 18 to 69 years was 5.3 mmol/l in 2004. This was a 3.6% decrease from the mean level of 5.5 mmol/l in 1998.

Prevalence of Low HDL-Cholesterol

The prevalence of low HDL-cholesterol among Singapore residents aged 18 to 69 years was 5.5%. This risk factor was four times more prevalent in males (8.9%) than females (2.2%). Indians (19.1%) had a higher prevalence of low HDL-cholesterol than Malays (7.3%) and Chinese (3.9%). This ethnic variation was more obvious in males than females. The prevalence of low HDL-cholesterol was consistently higher in males than females for all age groups. Graph 4.2; Table 4.5

Graph 4.2: Crude prevalence (%) of low HDL-cholesterol among Singapore residents aged 18-69 years, by gender and ethnic group, 2004

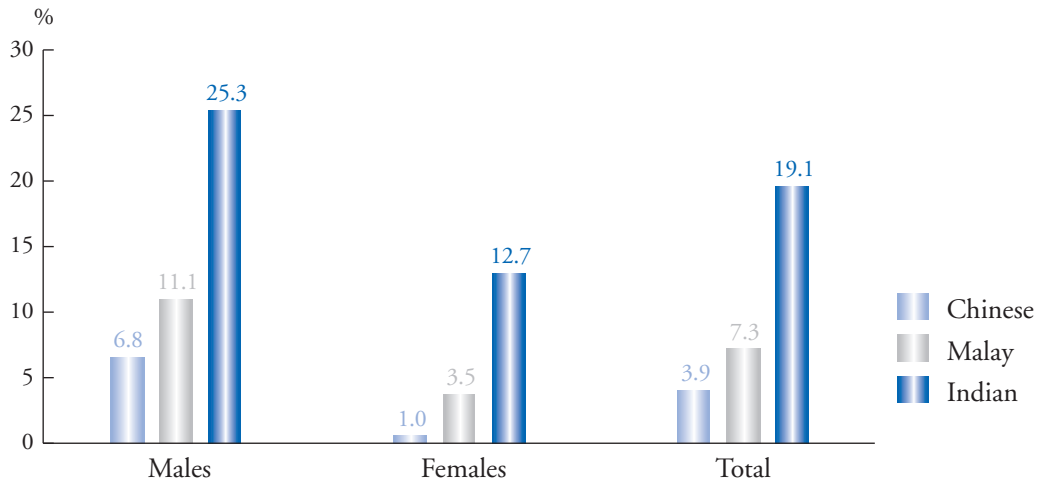

Table 4.5: Age-specific prevalence (%) of low HDL-cholesterol, by gender, 2004

Age (years)	Males	Females	Total
18-29	6.2	1.2	3.7
30-39	10.2	3.8	7.0
40-49	9.8	2.3	6.1
50-59	9.4	1.7	5.5
60-69	8.4	1.6	4.9
18-69	**8.9**	**2.2**	**5.5**

Trends in Low HDL-Cholesterol

The prevalence of low HDL-cholesterol among Singapore residents aged 18 to 69 years declined from 11.7% in 1998 to 5.5% in 2004. There was a significant decrease in the overall age-standardised prevalence between 1998 and 2004. Significant decreases in age-standardised prevalence were seen in both genders and the three ethnic groups. Table 4.6

Table 4.6: Prevalence (%) of low HDL-cholesterol, by gender and ethnic group, 1992, 1998 and 2004

Gender / Ethnic group	Crude prevalence			Age-standardised prevalence (95% Confidence Interval)			Difference in age-standardised prevalence	
	1992	1998	2004	1992	1998	2004	['98-'92]	['04-'98]
Total	12.8	11.7	5.5	*13.4* *(12.2, 14.5)*	*15.1* *(14.1, 16.1)*	5.5 *(4.8, 6.2)*	1.7*	-9.6**
Gender								
Males	20.1	19.0	8.9	21.0 *(19.1, 23.0)*	23.9 *(22.2, 25.6)*	8.8 *(7.6, 10.1)*	2.9*	-15.1**
Females	5.4	4.4	2.2	5.8 *(4.7, 6.8)*	6.4 *(5.4, 7.3)*	2.2 *(1.7, 2.7)*	0.6	-4.2**
Ethnic group								
Chinese	15.4	9.4	3.9	11.4 *(10.2, 12.7)*	12.4 *(11.4, 13.4)*	3.9 *(3.1, 4.6)*	1.0	-8.5**
Malay	11.1	16.7	7.3	17.5 *(14.8, 20.3)*	21.0 *(17.9, 24.1)*	7.6 *(5.7, 9.4)*	3.5	-13.4**
Indian	27.5	28.4	19.1	26.7 *(23.2, 30.2)*	33.3 *(28.5, 38.1)*	18.8 *(15.7, 21.9)*	6.6*	-14.5**

* $0.01 < p < 0.05$
** $p < 0.001$

Mean HDL-Cholesterol

The mean HDL-cholesterol level was 1.5 mmol/l in 2004, compared to 1.4 mmol/l in 1998.

Prevalence of High LDL-Cholesterol

The prevalence of high LDL-cholesterol among Singapore residents aged 18 to 69 years was 19.8%. Males (22.4%) had a higher prevalence of high LDL-cholesterol than females (17.3%). Among the ethnic groups, the prevalence was highest in Malays (24.4%), followed by Indians (22.6%) and Chinese (18.8%). Prevalence of high LDL-cholesterol rose sharply with age in both genders. Females tended to have a lower prevalence of high LDL-cholesterol than males in the age groups between 18 and 49 years, but the trend was reversed in those above 50 years old. Graph 4.3; Table 4.7

Graph 4.3: Crude prevalence (%) of high LDL-cholesterol among Singapore residents aged 18-69 years, by gender and ethnic group, 2004

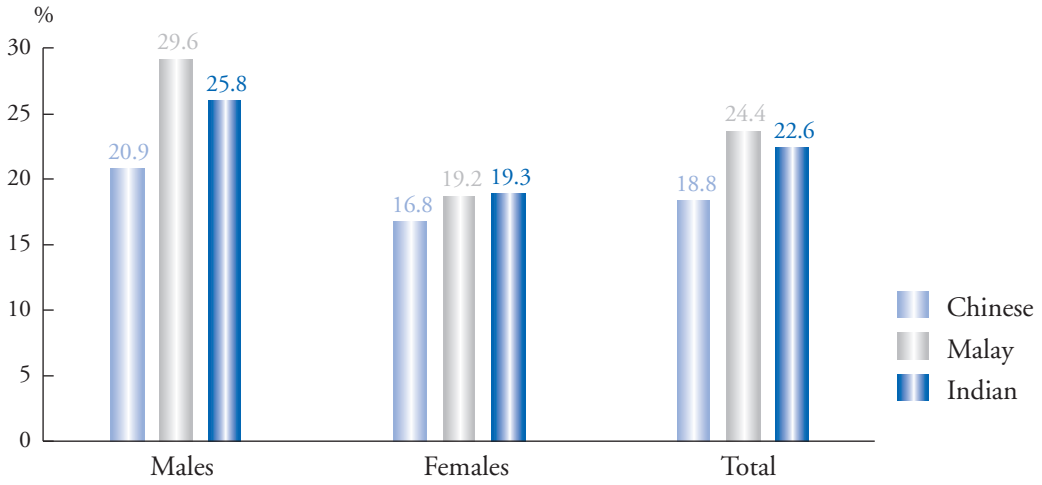

Table 4.7: Age-specific prevalence (%) of high LDL-cholesterol by gender, 2004

Age (years)	Males	Females	Total
18-29	8.1	4.0	6.0
30-39	27.0	10.1	18.4
40-49	29.0	18.5	23.8
50-59	25.8	35.3	30.6
60-69	20.8	32.5	26.8
18-69	**22.4**	**17.3**	**19.8**

Trends in High LDL-Cholesterol

The prevalence of high LDL-cholesterol among Singapore residents aged 18 to 69 years decreased from 26.5% in 1998 to 19.8% in 2004. There was a significant decrease in the overall age-standardised prevalence of high LDL-cholesterol between 1998 and 2004. Decreases in age-standardised prevalence were also noted in both genders and the three ethnic groups. Table 4.8

Table 4.8: Prevalence (%) of high LDL-cholesterol, by gender and ethnic group, 1992, 1998 and 2004

Gender / Ethnic group	Crude prevalence			Age-standardised prevalence (95% Confidence Interval)			Difference in age-standardised prevalence	
	1992	1998	2004	1992	1998	2004	['98-'92]	['04-'98]
Total	**22.9**	**26.5**	**19.8**	**25.0** *(23.5, 26.5)*	**27.1** *(25.9, 28.4)*	**19.2** *(18.0, 20.5)*	**2.1***	**-7.9****
Gender								
Males	25.3	30.8	22.4	27.4 *(25.2, 29.7)*	31.5 *(29.5, 33.5)*	22.2 *(20.3, 24.1)*	4.1**	-9.3***
Females	20.6	22.3	17.3	22.5 *(20.6, 24.5)*	22.8 *(21.2, 24.5)*	16.3 *(14.7, 17.9)*	0.3	-6.5***
Ethnic group								
Chinese	21.6	24.2	18.8	23.5 *(21.8, 25.3)*	24.7 *(23.3, 26.2)*	18.1 *(16.6, 19.5)*	1.2	-6.6***
Malay	27.2	39.2	24.4	30.2 *(26.6, 33.7)*	40.4 *(37.1, 43.6)*	24.7 *(21.8, 27.7)*	10.2***	-15.7***
Indian	29.6	30.0	22.6	31.4 *(27.7, 35.2)*	30.5 *(27.0, 34.0)*	22.7 *(19.4, 26.0)*	-0.9	-7.8**

* $0.01 < p < 0.05$
** $0.001 < p < 0.01$
*** $p < 0.001$

Mean LDL-Cholesterol

The mean LDL-cholesterol level was 3.4 mmol/l in 2004, compared to 3.5 mmol/l in 1998.