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# Health Status of Senior Civil Servants in Kuala Lumpur

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## Summary

733 senior civil servants comprising 520 males and 213 females with a mean age of 44 years (range 25 - 56 years) were screened for their health status. The sample population comprised of 67.9% Malays, 22.5% Chinese, 9.1% Indians and 0.4% other ethnic origins. The subjects' medical histories were recorded and a full medical examination including anthropometric measurements (weight, height, waist and hip circumference), blood biochemistry and urine analysis, chest X-ray and electrocardiograms were done. The results obtained showed that 36.0% of the study population were overweight with 6.5% being obese. Of this 32.0% had central obesity. 15.2% of the subjects had systolic hypertension (systolic BP ≥ 140 mmHg) whilst 27.6% had diastolic hypertension (diastolic BP ≥ 90 mmHg). Hyperlipidaemia was common, with 75.2% subjects having raised cholesterol, 19.9% raised triglycerides, 50.2% raised LDL-C, 74.6% raised TC:HDL-C and 26.6% raised LDL:HDL-C.

An elevated blood glucose was found in 8.4% subjects, whilst urine sugar was detected in only 2.6%, and a raised uric acid was found in 2.8% subjects.

The prevalence of hypertension, raised blood glucose and hyperlipidaemia increased with age with more males affected than females. Although hypercholesterolaemia appeared more frequently amongst the Malays, the Indians, by comparision had the highest prevalence for a raised LDL:HDL-C ratio, a reflection of the increase in LDL-C and a concomitant decrease in HDL-C. The latter findings indicate that the Indians are at greater risk for the development of coronary heart disease than the Chinese and Malays.

In addition, the mean levels of serum cholesterol found in this study seemed to have exceeded the levels found in populations in the industrialised countries such as the USA. There is thus an urgent need for more public health campaigns aimed at the reduction and control of such coronary risk factors.

*Key Words:* Hyperlipidaemia, Hypercholesterolaemia, Hypertension, Diabetes mellitus, Obesity, Body mass index, Hip-waist ratio, Coronary risk factors, Coronary heart disease

## Introduction

The health status of civil servants has always been of great concern to medical workers and the government. Since the 1960's, senior civil servants have been encouraged to go for annual medical check-ups at the Hospital Kuala Lumpur. Heads of Government Departments are informed of such services by the Public Services Department and arrangements are made for the senior executive staff to undergo annual medical examinations at the Physician's Clinic, General Hospital and the Tanglin Clinic, Kuala Lumpur.

In 1991, increased health awareness was propagated

by the launching of healthy lifestyle campaigns by the Ministry of Health, encouraging civil servants to attend medical check-ups and health education seminars in various places under "Program Kecergasan".

However, little is known of the health status of civil servants, though there have been several previous surveys on the health status of various sectors of the Malaysian population such as the rural community[1], military personnel[2], the Orang As1i[3], railway workers[4], Malaysian executives[5], urban population[6] and other population samples[7,8,9] in Malaysia.

This paper aims to evaluate the present health status of a sample of senior government servants in Kuala Lumpur.

It is hoped that these findings would be useful to create awareness of common health problems experienced by the civil service so that appropriate health care programmes can be planned accordingly.

## Materials and Methods

The subjects comprised of 733 senior male and female civil servants with a mean age of 44 years (range 25-56 years) who attended the Tanglin Clinic, Kuala Lumpur and the Physician's Clinic, Hospital Kuala Lumpur from January 1993 to December 1994 for an annual medical check-up.

They were Division One officers (especially those above 40 years) who were encouraged by their Departments to undergo annual medical check-ups under the healthy lifestyle campaign. However, attendance was not compulsory.

Their medical histories were recorded and a full medical examination including measurements on weight, height, waist, hip and blood pressure, (taken three times in the sitting position), were carried out. 20 cc of venous blood were drawn from each subject after a 12 hr overnight fast and sent to the Hospital Kuala Lumpur laboratory for the determination of fasting blood sugar, fasting serum lipids, serum creatinine, blood urea, electrolytes, serum uric acid, liver function and a full blood picture including the erythrocyte sedimentation rate.

In addition to the above, mid-stream urine analysis was also done together with an electrocardiographic recording and chest X-ray examination.

Serum lipids were determined using Hitachi 704 Boehringer Mannhein Machine as described in the manual (Boehringher Mannheim Co.). Fasting blood sugar was measured using Kobas - Bio. Roche instrument. Liver function tests were measured using Hitachi 717 machine while renal function tests employed Hitachi 747 for determination of various renal associated parameters. Some of the important parameters with their methodology and abnormal range(s) are given in Appendices I-III.

Strictly, serum lipid abnormality was based on cut-off values given by the expert panel of the National Cholesterol Education Program[10,11] (NCEP) and are summarised below.

| Parameter | Unit | Abnormality Status I | Abnormality Status II |
|---|---|---|---|
| TC | mmol/l | ≥ 5.2 | ≥ 6.2 |
| TG | mmol/l | ≥ 2.3 | – |
| HDL-C | mmol/l | < 0.9 | – |
| LDL-C | mmol/l | ≥ 3.3 | ≥ 4.1 |
| TC:HDL-C | – | ≥ 6.0 | |
| LDL:HDL-C | – | ≥ 4.0 | |

Hypertension criteria were based on cut-off values of 140 mmHg and/or 90 mmHg for systolic and diastolic pressures respectively in Abnormality Status I and 150 mmHg and/or 100 mmHg for systolic and diastolic pressures respectively in Abnormality Status II[12,13]. Prevalence of hypertension also includes those known hypertensive cases reported in their personal histories. Raised fasting blood sugar was based on values equal or higher than 6.7 mmol/l[14]. Prevalence of diabetes mellitus (DM) included those with raised blood sugar and those known to be diabetic.

## Statistical Analysis

Simple statistics including means, standard deviations and range (minimum and maximum values) by sex, age and ethnic groups were estimated. Prevalence of hyperlipidaemia, hypertension, diabetes and other abnormalities were obtained using appropriate cut-off values. Analysis of variance (ANOVA) was performed

to test whether there was any significant difference among different groups of means. When statistical significance was detected in the ANOVA, comparisions between means were then carried out by Duncan Multiple Range tests (DMRT) or Student-t tests where appropriate. Chi-square tests were also used for testing dependency and associations among various groups in questions.

The above analyses were performed by using selected procedures of SAS Statistical package of SAS Institute Inc, USA[15,16].

## Results

### The Sample

The sample comprised 733 subjects of whom 70.9% (n = 520) were males and 29.1% (n = 213) females. Among these, 67.9% (n = 498) were Malays, 22.5% (n = 165), Chinese, 9.1% (n = 67) Indians and 0.4% (n = 3) were of other ethnic origins. The mean age of the studied sample was 43.7 years with a range of 25 to 56 years. The majority of the subjects (84.7%) belonged to the 31 to 50 age group.

### Personal and Family History

From the personal history records, 10.1% (n=68) of the subjects were reported to be hypertensive, 4.7% (n=31) diabetic and 7.6% (n=52) asthmatic. From the family history records, 25.9% had close relatives (brothers, sisters, parents, their parents' siblings and grandparents) who suffered from hypertension and 20.2% and 8.3% had relatives who suffered from diabetes and asthma respectively.

When we examined the personal and family histories of the corresponding subjects, we found an increased incidence of asthma, diabetes and hypertension in the subjects known to have a positive family history. This familial tendency of illnesses was also clearly evident particularly among asthma and diabetic cases as reflected in the chi-square test (Table I).

### Physical Status and Lifestyle Habits

The physical status of body mass index (BMI) and waist-hip ratio (WHR), which were estimated from weight, height, waist and hip measurements were used to reflect the physical well being of the subjects studied (Table II-III). Based on BMI, 6.5% of all subjects (n = 698) were considered obese (BMI > 30 kg/m$^2$) and 36.0% overweight (BMI = 25 to 30 kg/m$^2$). 6.6% of males were obese compared with 6.2% of females. Similarly, a higher proportion of males (38.5%) were overweight compared to females (29.4%). The prevalence of obesity was higher with increasing age (4.2% in the 31-40 age group to 10.7% in the >51 age group). Among ethnic groups, there was higher prevalence of obesity among the Malays (8.5%)

**Table I**
**Chi-square tests between personal and family histories with regards to asthma, diabetes and hypertension**

| Personal history | Family history | | Chi-square |
|---|---|---|---|
| | A | B | |
| No asthma (A) | 370 | 25 | 27.58*** |
| Asthma (B) | 23 | 11 | |
| No diabetes (A) | 343 | 70 | 4.46* |
| Diabetes (B) | 10 | 6 | |
| No Hypertension (A) | 102 | 83 | 3.52+ |
| Hypertension (B) | 29 | 15 | |

*+, **,*** : P ≤ 0.10, 0.05 and 0.001 respectively*

**Table II**
**Body mass index (BMI in kg/m²) and prevalence of abnormality for civil servants by sex, age and ethnic group**

| Parameter | N | Mean | SD | Abnormality (%) | |
|---|---|---|---|---|---|
| | | | | Overweight | Obese |
| Average | 698 | 24.6 | 3.6 | 36.0 | 6.4 |
| **By sex** | | | | | |
| Male | 504 | 24.9 | 3.61 | 38.5 | 6.6 |
| Female | 194 | 24.0 | 3.47 | 29.4 | 6.2 |
| **By age** | | | | | |
| < 30 | 17 | 23.4 | 3.19 | 41.2 | 0.0 |
| 31 – 40 | 193 | 24.4 | 3.82 | 34.7 | 4.2 |
| 41 – 50 | 428 | 24.7 | 3.53 | 36.9 | 7.2 |
| > 50 | 56 | 24.9 | 3.47 | 30.4 | 10.7 |
| **By ethnic group** | | | | | |
| Malay | 469 | 25.3 | 3.69 | 42.2 | 8.5 |
| Chinese | 161 | 23.1 | 3.03 | 22.4 | 1.2 |
| Indian | 65 | 24.0 | 2.94 | 24.6 | 4.6 |
| Others | 3 | 23.6 | 2.50 | 33.3 | 0.0 |

*Footnote:* *Overweight 25-30 kg/m²*
*Obese > 30 kg/m²*

**Table III**
**Waist: hip ratio (WHR) and prevalence of abnormality for civil servants by sex, age and ethnic group**

| Parameter | N | Mean | SD | Abnormality (%) |
|---|---|---|---|---|
| Average | 562 | 0.85 | 0.07 | 32.0 |
| **By sex** | | | | |
| Male | 402 | 0.88 | 0.05 | 35.6 |
| Female | 160 | 0.77 | 0.04 | 23.1 |
| **By age** | | | | |
| < 30 | 16 | 0.82 | 0.07 | 31.3 |
| 31 – 40 | 167 | 0.84 | 0.06 | 20.4 |
| 41 – 50 | 342 | 0.86 | 0.07 | 36.3 |
| > 50 | 34 | 0.88 | 0.06 | 47.1 |
| **By ethnic group** | | | | |
| Malay | 383 | 0.85 | 0.07 | 31.3 |
| Chinese | 126 | 0.84 | 0.07 | 29.4 |
| Indian | 50 | 0.87 | 0.09 | 44.0 |
| Others | 3 | 0.87 | 0.04 | 33.3 |

*Footnote: Central Obesity:* *> 0.8 (female)*
*> 0.9 (male)*

followed by the Indians (4.6%) and the Chinese (1.2%). The overweight prevalence also showed a similar trend being highest in Malays (42.2%) followed by Indians (24.6%) and Chinese (22.3%). When WHR was used, 32% of individuals were found to be abnormal (male > 0.9; female >0.8) with males (35.6%) showing a higher prevalence of central obesity than females (23.1%). There was a small increase in the means of WHR with increasing age (0.84 in the 31-40 age group to 0.88 in the > 51 age group). The prevalence of central obesity also increased with increasing age (20.4% in the 31-40 age group to 47.1% in the > 51 age group). Among ethnic groups, the Indians (44%) had the highest prevalence of central obesity followed by the Malays (31.3%),then Chinese (29.4%).

Among the 682 subjects studied, about 19.8% were regarded as smokers (ie, >5 cigarettes/day). In terms of ethnic groups, the highest percentage of smokers was found in the Malays (24.9%), followed by Indians (21.2%) and Chinese (18.2%). More males (27.3%) smoked compared to females (2.0%). 11.3% (n=77) of the sample studied consumed alcohol, but very few (0.4%, n = 3) were considered frequent drinkers. Only non-Muslims (Chinese and Indians) were noted to have alcohol drinking habits. 70.8% of the subjects were recorded to engage in some form of exercise of whom only 8.2% exercised daily.

### Lipid Profile

The means of the various lipid components by sex, age and ethnic groups are summarized in Table IV-VI.

**Table IV**
**Simple statistics for lipid parameters (mmol/l) of civil servants by sex group**

| Parameter | Statistic | Male | Female | Combined |
|---|---|---|---|---|
| TC | $\bar{X}$ ± SD | 6.11 ± 1.09b | 5.61 ± 1.01a | 5.97 ± 1.09 |
| (mmol/l) | min–max | 3.30 – 10.40 | 3.10 – 9.40 | 3.10 – 10.40 |
| | N | 508 | 211 | 719 |
| TG | $\bar{X}$ ± SD | 1.86 ± 1.00b | 1.21 ± 0.99a | 1.67 ± 1.04 |
| (mmol/l) | min–max | 0.40 – 8.60 | 0.40 – 9.80 | 0.40 – 9.80 |
| | N | 507 | 211 | 718 |
| LDL-C | $\bar{X}$ ± SD | 4.09 ± 0.99b | 3.59 ± 0.95a | 3.95 ± 1.00 |
| (mmol/l) | min–max | 1.60 – 8.40 | 1.70 ± 7.90 | 1.60 – 8.40 |
| | N | 495 | 206 | 701 |
| HDL-C | $\bar{X}$ ± SD | 1.19 ± 0.27a | 1.50 ± 0.35b | 1.28 ± 0.33 |
| (mmol/l) | min–max | 0.60 – 2.50 | 0.80 – 2.50 | 0.60 – 2.50 |
| | N | 505 | 210 | 715 |
| TC:HDL-C | $\bar{X}$ ± SD | 5.38 ± 1.49b | 3.93 ± 1.16a | 4.96 ± 1.55 |
| (mmol/l) | min–max | 2.42 – 11.14 | 2.10 – 9.40 | 2.10 – 11.14 |
| | N | 505 | 210 | 715 |
| LDL:HDL-C | $\bar{X}$ ± SD | 3.60 ± 1.19b | 2.52 ± 0.97a | 3.28 ± 1.23 |
| (mmol/l) | min–max | 1.05 – 9.00 | 0.71 – 7.90 | 0.71 – 9.00 |
| | N | 494 | 206 | 700 |

*Footnote:*
*o Highly significant ($P \leq 0.001$) between means of male and female for all lipid parameters in ANOVA*
*o Means with different letters are significantly different*

Males had statistically higher mean serum lipid levels than females for most lipid parameters except for HDL-cholesterol which was higher in the females. The combined means of both males and females for TC, TG, LDL-C, HDL-C, TC:HDL-C and LDL:HDL-C were 5.97 mmol/l, 1.67 mmol/l, 3.95 mmol/l, 1.28 mmol/l, 4.96 and 3.28 respectively (Table IV).

There was some indication of a rising trend for the level of certain lipid components such as LDL-C and a decreasing trend for HDL-C with increasing age (Table V). While statistical significance between certain lipid parameters such as TC, TG and LDL-C and age group were not detected, the means of the older age group (51 and above) seemed to be higher than the young age groups of 31-50 years old for all the lipid parameters except HDL cholesterol which was statistically higher in the younger age group. It should be noted that the sample size for the 30 and below age group was small and may not be a good representative sample for this age group.

There was also a suggestion of some ethnic group differences in relation to the lipid levels studied (Table VI). The Malays had the highest values for the mean TC, TG, LDL-C values followed by the Indians and the Chinese. The differences in the lipid profile between both the Indians and Malays were statistically significant

**Table V**
**Simple statistics for lipid parameters (mmol/l) of civil servants by sex groups**

| Parameter | Statistic | Age group 30 & below | 31 – 40 | 41 – 50 | 51 & above |
|---|---|---|---|---|---|
| TC | $\bar{X}$ ± SD | 6.28 ± 1.14a | 5.91 ± 1.13a | 5.94 ± 1.07a | 6.24 ± 1.04a |
| | min–max | 4.40 – 8.00 | 3.10 – 10.40 | 3.30 – 10.40 | 4.20 – 8.70 |
| | N | 16 | 207 | 438 | 57 |
| TG | $\bar{X}$ ± SD | 1.68 ± 1.45a | 1.61 ± 1.04a | 1.65 ± 1.01a | 1.90 ± 1.00a |
| | min–max | 0.50 – 6.60 | 0.40 – 8.60 | 0.50 – 9.80 | 0.70 – 6.00 |
| | N | 16 | 202 | 437 | 57 |
| LDL–C | $\bar{X}$ ± SD | 4.23 ± 1.08a | 3.90 ± 1.01a | 3.92 ± 0.99a | 4.22 ± 1.00a |
| | min–max | 2.50 – 5.90 | 2.00 – 7.90 | 1.60 – 8.40 | 2.10 – 6.80 |
| | N | 16 | 197 | 528 | 55 |
| HDL–C | $\bar{X}$ ± SD | 1.45 ± 0.32b | 1.28 ± 0.31a | 1.29 ± 0.34a | 1.20 ± 0.30a |
| | min–max | 1.00 – 2.10 | 0.60 – 2.20 | 0.60 – 2.50 | 0.80 – 2.00 |
| | N | 16 | 201 | 435 | 57 |
| TC:HDL–C | $\bar{X}$ ± SD | 5.54 ± 1.30b | 4.93 ± 1.66a | 4.91 ± 1.49a | 5.48 ± 1.57b |
| | min–max | 2.71 – 6.50 | 2.28 – 11.14 | 2.10 – 11.00 | 2.81 – 9.22 |
| | N | 16 | 201 | 435 | 57 |
| LDL:HDL–C | $\bar{X}$ ± SD | 3.09 ± 1.13a | 3.25 ± 1.30a | 3.25 ± 1.20a | 3.67 ± 1.27b |
| | min–max | 1.47 – 5.00 | 1.17 – 9.00 | 0.71 – 8.88 | 1.31 – 6.89 |
| | N | 16 | 197 | 427 | 55 |

*Footnote:*
*o Statistical significance ($P \leq 0.05$) detected for means of HDL–C, TC: HDL–C and LDL:HDL–C in relation to age groups in ANOVA*
*o Means with same letter are not significantly different using DMRT*

**Table VI**
**Simple statistics for lipid parameters (mmol/l) of civil servants by ethnic group**

| Parameter | Statistic | Malay | Chinese | Indian | Others |
|---|---|---|---|---|---|
| TC | $\bar{X}$ ± SD | 6.05 ± 1.10a | 5.71 ± 0.97b | 5.95 ± 1.27ab | 6.33 ± 0.31 |
| | min–max | 3.30 – 10.40 | 4.10 – 8.90 | 3.10 – 10.40 | 6.00 – 6.60 |
| | N | 488 | 162 | 66 | 3 |
| TG | $\bar{X}$ ± SD | 1.73 ± 1.10a | 1.47 ± 0.91a | 1.69 ± 0.83a | 1.80 ± 1.23 |
| | min–max | 0.40 – 9.80 | 0.50 – 6.90 | 0.40 – 4.70 | 0.90 – 3.20 |
| | N | 487 | 162 | 66 | 3 |
| LDL–C | $\bar{X}$ ± SD | 4.04 ± 1.00a | 3.64 ± 0.91b | 3.98 ± 1.12a | 4.33 ± 0.25 |
| | min–max | 1.60 – 7.90 | 1.70 – 6.80 | 1.80 – 8.40 | 4.10 – 4.60 |
| | N | 472 | 161 | 65 | 3 |
| HDL–C | $\bar{X}$ ± SD | 1.25 ± 0.31b | 1.40 ± 0.33a | 1.20 ± 0.35b | 1.13 ± 0.29 |
| | min–max | 0.60 – 2.50 | 0.70 – 2.40 | 0.70 – 2.50 | 0.80 – 1.30 |
| | N | 484 | 462 | 66 | 3 |
| TC:HDL–C | $\bar{X}$ ± SD | 5.12 ± 1.56a | 4.30 ± 1.30b | 5.28 ± 1.16a | 5.93 ± 2.02 |
| | min–max | 2.10 – 11.14 | 2.14 – 9.78 | 2.69 – 9.45 | 4.61 – 8.25 |
| | N | 484 | 162 | 66 | 3 |
| LDL:HDL–C | $\bar{X}$ ± SD | 3.41 ± 1.23a | 2.77 ± 1.03b | 3.55 ± 1.34a | 4.02 ± 1.19 |
| | min–max | 0.90 – 9.00 | 0.71 – 7.76 | 1.44 – 7.64 | 3.15 – 5.38 |
| | N | 471 | 161 | 65 | 3 |

*Footnote:*
- *Statistical significance ($P \leq 0.01$) detected for the 3 major ethnic groups with regards to means of all the lipid parameters except TG in ANOVA*
- *Means with same letter are not significantly different using DMRT*
- *Other ethnic group is not included in comparison between ethnic groups due to small sample size*

compared with the Chinese but there was no significant difference in the lipid profile between the Indians and Malays. However, the mean TC:HDL-C and LDL:HDL-C ratios were statistically highest in the Indians followed by the Malays then Chinese, largely as a result of low HDL-C values amongst the Indians.

Tables VII-IX summarize the results based on the Abnormal Status I and II criteria for the various lipid components by sex, age and ethnic group. In general, males showed a statistically significant higher prevalence for lipid abnormality than females for all the lipid components (Table VII). The combined prevalence for lipid abnormality (Status 1) in both sexes for TC, TG, LDL-C, HDL-C, TC:HDL-C and LDL:HDL-C were 75.2%, 19.9%, 74.6%,6.7%,26.6% and 25.6% respectively.

There appeared to be a slight increase in prevalence of abnormal lipid values with age (86% with abnormal cholesterol in the 51 age group and above compared to 71.3% in the 31-40 age group) (Table VIII). However, there were two cases of a higher prevalence of TC and LDL-C abnormality in the younger age group (30 and below) which has a small sample size of 16.

There was a higher prevalence of lipid abnormality in the Malays and Indians compared to the Chinese for all lipid components studied (Table IX). However, the

**Table VII**
**Prevalence of abnormality for civil servants with reference to lipid parameters (mmol/l) measured by sex group**

| Parameter | Statistic | Abnormal range | Male | Female | Combined |
|---|---|---|---|---|---|
| TC | N | – | 508 | 211 | 719 |
| | AI (%) | ≥ 5.2 | 80.7 | 62.1 | 75.2 |
| | AII (%) | ≥ 6.2 | 41.3 | 25.6 | 36.7 |
| TG | N | – | 507 | 211 | 718 |
| | AI (%) | > 2.3 | 25.6 | 6.2 | 19.9 |
| LDL–C | N | – | 495 | 206 | 701 |
| | AI (%) | ≥ 3.3 | 80.6 | 60.2 | 74.6 |
| | AII (%) | ≥ 4.1 | 42.8 | 25.7 | 37.8 |
| HDL–C | N | – | 505 | 210 | 715 |
| | AI (%) | < 0.9 | 8.9 | 1.4 | 6.7 |
| TC:HDL–C | N | – | 505 | 210 | 700 |
| | AI (%) | > 6 | 30.5 | 5.7 | 26.6 |
| LDL:HDL–C | N | – | 494 | 206 | 151 |
| | AI (%) | > 4 | 35.0 | 6.3 | 25.6 |

*Significant chi-square values ($P \leq 0.001$) detected between sex group (male and female) and lipid levels (normal and abnormal status) for all lipid parameters*

**Table VIII**
**Prevalence of abnormality for lipid parameters (mmol/l) measured for civil servants by age group**

| Parameter | Statistic | Abnormal range | Age group 30 & below | 31 – 40 | 41 – 50 | 51 & above | Combined |
|---|---|---|---|---|---|---|---|
| TC | N | – | 16 | 202 | 438 | 57 | 713 |
| | AI (%) | ≥ 5.2 | 75.0 | 71.3 | 75.6 | 86.0 | 75.2 |
| | AII (%) | ≥ 6.2 | 50.0 | 33.7 | 26.3 | 47.4 | 36.8 |
| TG | N | – | 16 | 202 | 437 | 57 | 712 |
| | AI (%) | ≥ 2.3 | 12.5 | 20.3 | 18.8 | 22.8 | 19.4 |
| LDL–C | N | – | 16 | 197 | 428 | 55 | 696 |
| | AI (%) | ≥ 3.3 | 75.0 | 72.1 | 74.8 | 81.8 | 74.6 |
| | AII (%) | ≥ 4.1 | 50.0 | 36.0 | 36.9 | 49.1 | 37.9 |
| HDL–C | N | – | 16 | 201 | 435 | 57 | 709 |
| | AI (%) | < 0.9 | 0.0 | 6.0 | 7.6 | 5.3 | 6.8 |
| TC:HDL–C | N | – | 16 | 201 | 435 | 57 | 709 |
| | AI (%) | > 6 | 18.8 | 21.4 | 22.8 | 33.3 | 23.1 |
| LDL:HDL–C | N | – | 16 | 197 | 427 | 55 | 695 |
| | AI (%) | > 4 | 18.8 | 23.4 | 26.9 | 38.2 | 26.6 |

*Significant contingency chi-square values are not detected between age group and lipid levels (normal and abnormal status) for all the lipid parameters*

highest prevalence of abnormality for TC:HDL-C and LDL:HDL-C ratios were seen amongst Indians followed by the Malays and the Chinese.

### Blood Pressure Profile

The mean values and prevalence of abnormality for systolic and diastolic pressures of the subjects studied by sex, age and ethnic groups are summarized in Table X-XI.

The mean systolic blood pressure and diastolic blood pressure, for the subjects studied were found to be 118.2 mm Hg and 78.6 mm Hg respectively. These values fall within the range of normal values. The males had statistically higher means than females for both the systolic and diastolic blood pressures. The means of these characteristics increased with advancing age. There was no significant difference among the three major ethnic groups in both systolic and diastolic blood pressures.

Raised systolic blood pressure occurred in 15.2% and 8.4% of the subjects studied when ≥ 140 mmHg and ≥ 150 mmHg were used as cut-off points respectively (Table X). Elevated diastolic blood pressure occurred in 27.6% and 7.6% of the subjects studied based on the respective cut-off values of ≥90 mmHg and ≥ 100 mmHg (Table XI). Although significant difference in hypertension prevalence among ethnic groups, was not detected, the Chinese appeared to have a slightly high prevalence than the Indians and the Malays in systolic and diastolic hypertension when SBP≥140 mmHg and DBP≥90 mmHg were used as hypertension criteria. In addition, both the Chinese and Indians were shown to have a higher prevalence when SBP≥150 mmHg and DBP≥100 mmHg were used as cut-off values. Prevalence of hypertension also increased with age.

### Fasting Blood Sugar

The prevalence of abnormality for fasting glucose was 6.2% (Table XII).

**Table IX**
**Prevalence of abnormality for lipid parameters (mmol/l) measured for civil servants by ethnic group**

| Parameter | Statistic | Malay | Chinese | Indian | Others | Combined | Abnormal range |
|---|---|---|---|---|---|---|---|
| TC | N | 488 | 162 | 66 | 3 | 719 | – |
| | AI (%) | 78.1 | 67.3 | 72.8 | 100.0 | 75.2 | ≥ 5.2 |
| | AII (%) | 40.0 | 25.9 | 37.9 | 66.7 | 36.7 | > 6.2 |
| TG | N | 487 | 162 | 66 | 3 | 718 | – |
| | AI (%) | 21.6 | 13.6 | 22.7 | 33.3 | 19.9 | ≥ 2.3 |
| LDL-C | N | 472 | 161 | 65 | 3 | 701 | – |
| | AI (%) | 77.8 | 65.8 | 72.3 | 100.0 | 74.6 | ≥ 3.3 |
| | AII (%) | 42.2 | 25.5 | 35.4 | 66.7 | 37.8 | > 4.1 |
| HDL-C | N | 484 | 162 | 66 | 3 | 715 | – |
| | AII (%) | 8.3 | 1.9 | 6.1 | 33.3 | 6.7 | < 0.9 |
| TC:HDL-C | N | 484 | 162 | 66 | 3 | 715 | – |
| | AI (%) | 26.5 | 9.9 | 31.8 | 33.3 | 23.2 | > 6 |
| LDL:HDL-C | N | 471 | 161 | 65 | 3 | 700 | – |
| | AI (%) | 30.2 | 12.4 | 35.4 | 33.3 | 26.6 | > 4 |

*Significant chi-square values (P ≤ 0.05-0.001) detected between ethnic groups and lipid levels (normal and abnormal status) for all lipid parameters except TG.*

**Table X**
**Mean systolic blood pressure (mmHg) and prevalence of hypertension for civil servants by sex, age and ethnic group**

| Parameter | N | Mean | SD | Abnormality (%) AI | AII |
|---|---|---|---|---|---|
| Average | 725 | 118.2 | 15.21 | 15.2 | 8.4 |
| **By sex** | | | | | |
| Male | 515 | 120.4b | 15.19 | 18.1 | 10.9 |
| Female | 210 | 112.7a | 13.80 | 11.4 | 9.0 |
| **By age** | | | | | |
| < 30 | 17 | 109.1a | 11.76 | 0.0 | 0.0 |
| 31 - 40 | 203 | 113.9ab | 13.35 | 7.4 | 3.4 |
| 41 - 50 | 441 | 119.4b | 15.28 | 17.5 | 9.8 |
| > 51 | 58 | 126.1c | 16.36 | 39.7 | 15.5 |
| **By ethnic groups** | | | | | |
| Malay | 490 | 117.7 | 15.25 | 14.9 | 7.6 |
| Chinese | 165 | 117.0 | 14.81 | 19.4 | 10.9 |
| Indian | 67 | 120.0 | 15.95 | 17.9 | 9.0 |
| Others | 3 | 116.7 | 15.28 | 0.0 | 0.0 |

*Footnotes:*
*AI ≥ 140 mmHg*
*AII ≥ 150 mmHg*

- *Statistical significance detected between means of sex and between age groups (P ≤ 0.001) but not detected between ethnic groups in ANOVA*
- *Means with same letter are not significantly different*

Like other characteristics, males had a higher percentage of abnormality than females; the abnormality incidence also increased as age progressed. The Indians (9.1 %) had the highest percentage abnormality for blood glucose followed by the Malays (6.9%) and the Chinese (3.1%) with the least. However, urine tests for sugar were positive in only 2.6% individuals, suggesting that a large percentage has mild diabetes detectable only on blood examination.

### Chest X-ray and E.C.G

Resting ECG was recorded in subjects above 40 years of age. Among the 634 subjects examined, 3.0% (n= 19) were found to be abnormal (in relation to arrhythmia, LVH, T-wave changes and/or ischaemic changes) reflecting potential heart problems which needed further investigations.

Chest X-rays were recorded in 615 subjects. Of these, 3.7% (n = 23) were found to have abnormalities, notably lung shadow and cardiac shadow abnormalities.

### Liver Function Tests

A fairly high proportion (38.1%) of the subjects (n = 633) had raised levels of alanine transaminase suggesting liver dysfunction. However, the elevation in values in all these subjects were less than twice the normal values. The serum bilirubin was found to be slightly elevated in 11.4% of individuals. 3.4% of the subjects were found to have mildly elevated alkaline phosphatase. There were very few individuals (0.3%) with abnormally low albumin and total protein values indicating the probability of chronic liver disease.

**Table XI**
**Mean diastolic blood pressure (mmHg) and prevalence of hypertension for civil servants by sex, age and ethnic group**

| Parameter | N | Mean | SD | Abnormality (%) AI | AII |
|---|---|---|---|---|---|
| Average | 725 | 78.6 | 10.03 | 27.6 | 7.6 |
| **By sex** | | | | | |
| Male | 515 | 80.1b | 9.99 | 31.3 | 7.6 |
| Female | 210 | 75.0a | 9.20 | 19.0 | 7.6 |
| **By age** | | | | | |
| < 30 | 17 | 73.5a | 9.31 | 5.9 | 0.0 |
| 31 - 40 | 203 | 75.9ab | 10.08 | 16.7 | 3.9 |
| 41 - 50 | 441 | 79.7b | 9.80 | 32.7 | 8.8 |
| > 51 | 58 | 81.0c | 9.71 | 34.5 | 12.1 |
| **By ethnic group** | | | | | |
| Malay | 490 | 78.6 | 10.24 | 27.6 | 6.7 |
| Chinese | 165 | 78.7 | 9.24 | 29.1 | 9.1 |
| Indian | 67 | 78.0 | 10.48 | 25.4 | 10.4 |
| Others | 3 | 80.0 | 10.00 | 33.3 | 0.0 |

*Footnotes:*
*AI ≥ 90 mmHg*
*AII ≥ 100 mmHg*

- *Statistical significance detected between means of sex and age groups (P ≤ 0.001) but not detected between major ethnic groups in ANOVA*
- *Means with same letter are not significantly different*

### Renal Function Tests

Abnormal renal function (creatinine > 124 mmol/l) was observed in 6% of the studied population. However, blood urea values were mostly normal. The decreased serum $Na^+$ and $K^+$ levels found in 6.1% and 7.9% of the population were found in subjects who were on diuretics for treatment of hypertension. The serum uric acid was elevated in 2.8% of the subjects measured.

### Urine Test

Among the subjects tested, 2.2% showed a positive test for the presence of pus cells, 3.9% for albumin and 2.6% for sugar in the urine.

### Blood Count

22.3% of the 497 subjects tested showed a suboptimal haemoglobin content; most of these cases had values slightly below the cut-off values (13 g/dl for males and 11.5 g/dl for females). Of the 474 subjects tested, 0.4% (2 cases) showed a slightly higher than normal total white blood cell count, probably due to concurrent infection at the time of examination.

### Status of CHD Risk Factors

From the above parameters measured or recorded it would be of interest to know the number of additional CHD risk factors associated with hypercholesterolaemic (≥5.2 mmol/l) subjects as this would provide a guide for clinical management. Taking age (male ≥45 years; female ≥55 years), smoking, hypertension (≥140/90 mmHg) and diabetes mellitus as positive risk factors as indicated in NCEP, Adult Treatment Panel II[11], the status of hypercholesterolaemic subjects (≥5.2 mmol/l) with none or additional CHD risk factors was given in Table XIII. Among the 541 hypercholesterolaemic

**Table XII**
**Mean Fasting Blood Glucose (mmol/l) and prevalence of abnormality for civil servants by sex, age and ethnic group**

| Parameter | N | Mean | SD | Abnormality (%) |
|---|---|---|---|---|
| Average | 724 | 5.27 | 1.52 | 8.4 |
| **By sex** | | | | |
| Male | 512 | 5.42b | 1.69 | 10.4 |
| Female | 212 | 4.91a | 0.90 | 8.8 |
| **By age** | | | | |
| < 30 | 16 | 4.67a | 0.68 | 0.0 |
| 31 - 40 | 206 | 4.98ab | 1.04 | 6.3 |
| 41 - 50 | 439 | 5.35bc | 1.58 | 8.2 |
| > 51 | 58 | 5.63c | 2.00 | 17.5 |
| **By ethnic group** | | | | |
| Malay | 493 | 5.29 | 1.59 | 8.9 |
| Chinese | 162 | 5.15 | 1.46 | 6.2 |
| Indian | 66 | 5.41 | 1.11 | 10.6 |
| Others | 3 | 5.07 | 1.10 | 0.0 |

*Footnote:*
- *o Fasting blood glucose of 6.7 mmol/l and above are considered abnormal*
- *o Statistical significance detected between means of sex ($P \leq 0.001$) and age ($P \leq 0.01$) groups but not detected between major ethnic groups*
- *o Means with same letter are not significantly different*

**Table XIII**
**Hypercholesterolaemic patients (TC ≥ 5.2 mmol/l) with zero or more coronary risk factors**

| No. of other risk factor | No. of subjects (N) | Frequency (%) |
|---|---|---|
| 0 | 186 | 34.4 |
| 1 | 207 | 38.2 |
| 2 | 103 | 19.0 |
| 3 | 36 | 6.7 |
| 4 | 9 | 1.7 |

subjects studied, 72.6% had fewer than two positive CHD risk factors while the remainder, 27.4%, had two or more risk factors.

## Discussion

This is the first study on the health status of senior civil servants in this country. As noted, they were in apparent good health comprising Malays, Chinese, Indians and other ethnic origins in the order of 67.9%, 22.5%, 9.1% and 0.4% respectively, with the majority (69.2%) being above 40 years of age. They may be classified as belonging to the upper income group and held sedentary but high stress jobs.

The results presented showed that the common health problems encountered in this study sample were obesity, hypertension, diabetes and hyperlipidaemia. Unhealthy lifestyle habits such as smoking and lack of exercise were also common amongst the subjects while a small percentage of the subjects consumed alcohol.

This spectrum of diseases found together with smoking are well-known risk factors for cardiovascular disease. They are found to occur singly or in combination in

some individuals, the majority (38.3%) having at least 1 other risk factor besides hypercholesterlaemia and 1.7% having 4 other risk factors.

This clustering of risk factors in an individual form a lethal cocktail in the potential development of coronary artery disease. The presence of multiple risk factors has been shown in the Multiple Risk Factor Intervention Trial, MRFIT studies to lead to multiplicative, not additive, adverse effects on coronary risk[17]. According to NCEP, Adult Treatment Panel II[11], the aggressiveness of treatment for raised lipids and target goal of LDL-C depends on the presence of CHD and other risk factors. Those with CHD requires aggressive treatment and a target goal of LDL-C of 2.6 mmol/l is expected to prevent recurrence of cardiovascular events. For those without CHD, like the cases in the present study, the target level of LDL-C depends on the number of risk factors present. A target goal of 4.1 mmol/l in LDL-C level is expected for those hypercholesterolaemic subjects, with fewer than two additional risk factors, whereas a target goal of 3.4 mmol/l in LDL-C level would suffice for those hypercholesterolaemic subjects with two or more risk factors. There were 27.4% of the hypercholesterolaemic subjects requiring more aggressive treatments in the present study population.

The findings here serve to explain the rising trend in mortality and morbidity from cardiovascular disease in Malaysia in recent years as reported by Khoo *et al*[18].

This rising trend is largely due to rapid socioeconomic changes, increasing affluence and alteration in food habits as a result of "westernization" of dietary patterns which lead to over nutrition and unhealthy lifestyle practices in this region.

### Obesity

Based on BMI, 36% of the study population were overweight with 6.5% being obese. The prevalence rate is higher here compared to other studies in Malaysia. In an urban population, Ismail *et al*[20] showed that 29% males were overweight with 5% being obese, whilst in females 26% were overweight and 8% were obese. In a rural population Mohd Aminuddin *et al*[21] found an overweight prevalence of 21.4% and obesity 6.5%. In Kelantan, Wan Mohamad *et al*[22] showed an overweight prevalence of 21.3% and obesity 4.5%. In Singapore 21% of adult Singaporeans were found to be overweight and 5% obese[23]. The higher overweight prevalence seen in this study population could be due to the population sample - the majority (84.7%) being in the older age group (≥30-50 years). The prevalence of obesity has also been noted to be higher in this age group in a study in Bombay[24].

This study also failed to show a greater preponderance of females with obesity compared to males. Ismail *et al*[22] reported 8% females were obese compared to 5% males as mentioned earlier. 5% females and 4% males were reported obese in Singapore[23]. A study in Kuwait showed that obesity was more common in non-working women[25] and that obesity was also negatively correlated to social class and level of education in a study in the Netherlands[26]. The present selected population of females are actively working outside the home as well and belong to the higher socio-economic group. This may explain the lower prevalence of obesity amongst females in this study population.

Amongst ethnic groups, the Malays (8.5%) showed a higher prevalence for obesity, followed by Indians (4.6%), then Chinese (1.2%). In neighbouring Singapore in the National Health Survey 1992[23], Indian men (10%) had the highest prevalence of obesity followed by Malays (6%) then Chinese (3%) whereas for women, the Malays (17%) took the lead, followed by Indians (13%) then Chinese (4%).

The waist-hip ratio (WHR) is a measure of central, abdominal or android obesity. In the 1950's Vague[27] suggested that a preponderence of abdominal fat increases the risk for diabetes and cardiovascular disease. Cross-sectional studies have now shown an increased prevalence of glucose intolerance, insulin resistance, elevated blood pressure and elevated blood lipids in men and women with increased abdominal fat[28].

In this study, more males (35.6%) were found to have central obesity compared to females (23.1%) and this severity and prevalence increased with age. Among ethnic groups, the Indians had the highest prevalence of abdominal WHR, unlike BMI measurements, where Malays took the lead. This helps to explain the greater prevalence of diabetes among Indians (10.6%)

compared to Malays (8.9%) and Chinese (6.2%) as central obesity has been shown to be associated with an increase in diabetes. It has been suggested that increased abdominal fat represents an increase in the size and number of metabolically active intra-abdominal fat cells. These fat cells release free fatty acids which might interfere with insulin clearance in the liver and cause hyperinsulinaemia and insulin resistance, leading to diabetes[29].

### Hypertension

The prevalence rate of hypertension using SBP≥140 mmHg and DBP≥90 mmHg as cut off points were 15.2% and 27.6% respectively affecting males more than females, and increase with age. This prevalence is consistent with the findings in a recent review of the blood pressure profiles in Malaysia[30] where a hypertension prevalence rate of 16% was reported. However, the prevalence of diastolic hypertension appears higher in this study population.

This high prevalence of hypertension has been postulated to occur as a result of dietary and socioeconomic changes and increased stress in an urbanized community. This is illustrated by studies of the "Orang Asli" living in the deep jungle who were reported by Chong *et al*[3]. to have lower blood pressures with no significant increase with age. Moreover, there is also a rise in the mean systolic and diastolic pressures of "Orang Asli" in the order: periurban > fringe > deep jungle. Prevalence of hypertension for the deep jungle subjects was 0%, the fringe jungle 7% and the periurban 21% using a cut off point of 140/90 mm Hg.

The effect of stress on hypertension is further illustrated by the fact that the prevalence of hypertension in developed countries like Singapore[31] and the United States[32,33] are even higher in the order of 25% and 21.2% respectively. There was no ethnic difference among the major ethnic groups, Malays, Chinese and Indians, detected in the mean blood pressure levels although the Indians and Chinese appeared to have a slightly higher prevalence of severe hypertension (SBP ≥ 150 mmHg and or DBP ≥ 100 mmHg) than the Malays in this study. Liew *et al*[30] pointed out that there was no obvious and consistent ethnic differences in the prevalence of hypertension reported in Malaysia.

Percentage unawareness of hypertension in subjects has been reported to be high from 33% to 69% by Liew *et al*[30]. This may explain the high pick up rate in this study of individuals who are apparently healthy.

### Diabetes mellitus

There was a paucity of diabetic subjects who gave a family history of diabetes, though this is a well documented familial disease. This probably reflects a number of factors such as earlier mortality whereby individuals do not know what their relatives died from, and ignorance concerning the disease.

In this study, the prevalence of diabetes was 8.4%, with males affected more often than females and most prevalent in the Indians, followed by the Malays, then the Chinese (10.6%, 8.9%, 6.2% respectively). The prevalence for diabetes also seemed to increase with age.

The prevalence rate in this study population appeared high in comparison with studies by Mustaffa[34], Rampal *et al*[35] and West & Kalbfleisch[36] who reported the prevalence of diabetes in Malaysia as about 2%, 3.9% and 3.5% respectively.

An almost similar ethnic distribution has been reported by Mustaffa[34], Khoo & Ngan[35] in studies on other sections of the local population in Malaysia. The latter reported that the highest prevalence rate of 1.62%was seen among the Indians compared to 0.88% in the Chinese. The Malays had a prevalence rate of 0.66%. The considerably higher prevalence rate found in our study may be attributed to the relatively older subjects in this study (41-56 years) and that they were drawn from an affluent group with sedentary occupations.

For countries with similar ethnic population groups such as in Singapore, Cheah *et al*[38] also found a similar trend in the prevalence rate of diabetes being 6.07% in the Indians, 2.48% in the Malays and 1.55% in the Chinese. Furthermore, it has been found that migrant populations of the Indians and the Chinese showed a higher prevalence of diabetes compared to their counterparts living in their respective countries of origin. Thus, the overall prevalence of diabetes amongst Indians living in India is 1.8%, whilst the prevalence of diabetes

in the Indians living outside India is uniformly higher ranging from 2.3% to 37%[38]. It has been postulated that the Indians are genetically more susceptible to diabetes (the diabetic genotype) and greater food consumption coupled with less manual work and an easier lifestyle unmasks the diabetic genotype. Similarly, the overseas Chinese do less manual work than their ancestors in China. This together with a richer diet leads to obesity and diabetes.

Higher levels of social development and urbanisation have not spared the Malays. Osman Ali[39] reported that the prevalence of diabetes was 0.3% among the Orang Asli, compared to 4.7% amongst Malays. Furthermore, among rural Malays, prevalence of diabetes was only 2.8% and for settlers of land scheme 6.7%, whereas urban Malays had a prevalence of 8.2%.

Thus, though hereditary factors play a part, environmental factors such as socioeconomic development, demographic differences and migration, increasing affluence and lack of physical activity all contribute to the development of diabetes.

### Hyperlipidaemia

The mean total cholesterol found in this study was 5.97 mmol/l. This is much higher than the figures reported by Chong[40] and Lau *et al*[7]., who found the values to be 4.87 mmol/l and 4.44 mmol/l respectively in the 1960s and Khoo[8] and Chong *et al*[41], who found mean values of 5.18 mmol/l in the 1970s through the 1980s.

More recently Khoo *et al*[6], reported a mean value of 5.4 mmol/l in a population of urban Malaysians. It can be seen that serum cholesterol values have increased progressively throughout the years in tandem with an increase in coronary artery disease as reported by Khoo *et al*[4]. In neighbouring Singapore the mean cholesterol level was reported to be 5.49 mmol/l in 1992 by Teo *et al*[42].

The unusually high mean cholesterol levels found here in this study may be due to a biased population sample drawn from the civil service comprising mainly of Malays (67.9%) who were also found to have the highest cholesterol values. Nevertheless, such high values of the mean total cholesterol is disturbing as even in the United States, the mean total cholesterol is only 4.9 mmol/l as reported by Rifkind *et al*[43].

As for most other local studies with the exception of the study of Zaraihan *et al*[44] the total cholesterol in this study was found to be higher in males than females and the prevalence rate was higher in older age groups.

Among ethnic groups the mean values of total cholesterol were significantly higher in the Malays and the Indians compared to the Chinese. The prevalence rate of elevated total cholesterol is in the order of 78. 1%, 72.8% and 67.3% in the Malays, Indians and Chinese respectively. This is consistent with the findings by Chong and Khoo[45]. However, mortality from coronary artery disease has always been highest among Indians.

Danaraj *et. al*[46] in 1959 found from necropsy evidence that coronary artery disease in Singapore accounted for about 50% of all heart disease in the Indian males above the age of 20 years, whereas in the Chinese males it was only between 10 - 20%.

Data from the Department of Statistics in Malaysia showed that mortality from coronary artery disease was highest amongst the Indians, being 1.5 - 1.8 times greater than that of the Malays or Chinese[6].

This apparent discrepancy can be explained by the high prevalence amongst the Indians of other unfavourable lipid fractions which are also atherogenic factors. Abnormal TG and HDL cholesterol levels occurred most frequently in Indians followed by the Malays then the Chinese in this study. A combination of high TG and low HDL cholesterols has been found to increase the risks of coronary artery disease in the Framingham study[47]. A high TG and low HDL-C is often found in association with diabetes which is also found to be most prevalent amongst Indians[48]. Furthermore, diabetes also gives rise to an increase in small dense LDL cholesterol, an increase in Lp(a) and an increase in fibrinogen levels, all of which have been found to increase coronary artery disease risk[49,50].

Similar findings have been reported by McKeigue *et al*[48] who found the tendency for Indians in South Asia

to have a decreased HDL-C, increased TG and an increase in NIDDM, together with insulin resistance. High levels of insulin by itself has also been found to be highly atherogenic[50].

In addition, abnormal TC:HDL-C and LDL:HDL-C ratios were most prevalent amongst the Indians, followed by the Malays then the Chinese. This is largely the result of low HDL-C levels being most prevalent amongst Indians. Results of the Framingham Study have also shown that these two lipid ratios are highly sensitive atherogenic indices[51].

The importance of these ratios is further shown by the Orang Asli in the deep jungle who are known to have no coronary artery disease. They were reported by Chong *et al*[3] to have the lowest TC:HDL-C ratios compared to Orang Asli in the fringe jungle and the periurban areas.

The present lipid findings amongst the Indians therefore help to explain the higher prevalence of coronary artery disease amongst them compared to the Malays and the Chinese.

## Conclusion

This study showed that the common health problems encountered in the study sample of senior civil servants in Kuala Lumpur were obesity, hypertension, diabetes and hyperlipidaemia. These occurred singly or in combination.

The high prevalence of these disorders which by themselves are also well known coronary risk factors, together coupled with unhealthy lifestyle practices can undoubtedly pave the way for the early development of coronary artery disease which has escalated rapidly in Malaysia in recent years to reach alarming proportions. Coronary artery disease is presently the major cause of mortality and morbidity in Malaysia.

Increased efforts by the public health authorities, health planners, nutritionists and even teachers alike to educate the public on good eating habits and healthy lifestyles starting young are needed in order to stem the advances of premature death from cardiovascular diseases.

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## References

1. Chong YH, Soh CC, Ho GS, *et al.* Serum low density lipoproteins, triglycerides and cholesterol levels in Malaysians. Clin Chim Acta 1971;34 : 85-92.

2. Federation of Malaya. Nutrition Survey Sept-Oct 1962. A report by the interdepartmental committee in nutrition for National Defence. Federation of Malaya 1964: 255pp.

3. Chong YH, Pang CW. Serum lipids, blood pressure and body mass index of Orang Asli. Proceedings of International Workshop on Effects of Alteration of Food Habits on Health, Japan-US Malnutrition Panel, December 1978. Osaka, pp 84-95.

4. Khalid BAK, Usha Rani, Ng Mee Lian, *et al.* Prevalence of diabetes, hypertension and renal disease amongst railway workers in Malaysia. Med J Malaysia 1990;45(1) : 8-13.

5. Teo PH, Chong YH, Zaini M. Coronary risk factors among Malaysian male executives in two urban areas. Med J Malaysia 1988;43(2) : 125-33.

6. Khoo KL, Tan H, Liew YM. Serum lipids and their relationship with other coronary risk factors in healthy subjects in a city clinic. Med J Malaysia 1997;52(1) : 38-52.

7. Lau KS, Lopez CG, Gan OM. Serum cholesterol level in Malays, Indians and Chinese in Malaya. Med J Malaya 1962; 16(3) : 184-92.

8. Khoo KL. A Study Of Certain Lipid Abnormalities in Peninsular Malaysia. MD Thesis; University of Singapore 1980.

9. Khoo KL, Tan H, Sambhi JS, *et al.* Screening for blood pressure, cholesterol and glucose during National Heart Weeks 1992-1994. Med J Malaysia 1996;51(3) : 307-16.

10. The Expert Panel. Report of the National Cholesterol Education Program (NCEP). Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults. Arch Intern Med. 1988;148 : 36-69.

11. The Expert Panel. Summary of the Second Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholestrol in Adults (Adult Treatment Panel ll). JAMA 1993; 269(23): 3015-3023.

12. WHO Expert Committee. Hypertension and coronary heart disease: Classification and criteria for epidemiological studies. WHO Techinical Rep Ser 168, 1959, Geneva.

13. WHO Expert Committee. Arterial hypertension. WHO Technical Rep Ser 628, 1978; Geneva.

14. World Health Organization. Diabetes mellitus. Report of a WHO study group. WHO Technical report series, 727, 1985, Geneva.

15. SAS Institute Inc. SAS User's Guide: Basics, Version 5 Edition. Cary, NC : SAS Institute Inc. 1985 : 1290 pp.

16. SAS Institute Inc. SAS/STAT Guide For Personal Computers Version 6 Edition. Cary, NC: SAS Institute Inc. 1987: 1028 pp.

17. Stamler J, Wentworth D, Neaton JD. Is relationship between serum cholesterol and risk of premature death from coronary heart disease continuous and graded ? Findings in 35622 primary screenees of the Multiple Risk Factor Intervention Trial (MRFIT). J Am Med Assoc. 1986;256 : 2823-8.

18. Khoo KL, Tan H, Khoo TH. Cardiovascular mortality in Peninsular Malaysia 1959-1989. Med J Malaysia 1991;46(1) : 7-20.

19. Hughes K, Yeo PPB, Lun KC, *et al.* Ischaemic heart disease and its risk factors in Singapore in comparison with other countries. Ann Acad Med Singapore 1989;18(3) : 245-9.

20. Ismail MN, Zawiah H, Chee SS, *et al.* Prevalence of obesity and chronic energy deficiency (CED) in adult Malaysians. Mal J Nutr 1995;1 : 1-9.

21. Mohd Aminuddin MS, Yusoff K, Osman BA, *et al.* Is coronary heart disease potentially a serious public health problem in rural Malaysia? Quarterly Scientific Meeting Academy of Medicine, Malaysia, Penang 1993.

22. Wan Mohamed WB, Moktar N, Mafauzy M, *et al.* Obesity: The Extent of the problem in Malaysia. Proc MASSO 1996;1: 51-8.

23. Uma Rajan. Obesity: is it a problem in the Asia - Pacific regions? Singapore Perspective. Proc MASSO 1996;1 : 59-70.

24. Dhurandhar NV, Kulkarni PR. Prevalence of obesity in Bombay. Int J Obesity 1992;16 : 367-75.

25. Al-Awadi F, Amine EK. Overweight and obesity in Kuwait. J Roy Soc Health 1989;109 : 175-7.

26. Deurenberg P, Hautvast JGAJ. Prevalence of overweight and obesity in the Netherlands in relation to socio-demographic variables, life style and eating behaviour: starting points for the prevention and treatment of obesity. Bibl Nutr Dieta 1989; 44 : 8-21.

27. Vague J. The degree of masculine differentiation of obesities: a factor determining predisposition to diabetes, arteriosclerosis, gout and uric acid calculous disease. Am J Clin Nutr 1956;4 : 20-34.

28. Reaven GM. Abnormal lipoprotein metabolism in non-insulin dependent diabetes mellitus. Am J Med 1987; 83 (Suppl SA): 31-40.

29. Fujioka S, Matsuzawa Y, Tokunaga K, *et al.* Contribution of intra-abdominal fat accumulation to the impairment of glucose and lipid metabolism. Metabolism 1987; 36: 54-59.

30. YM Liew, H Tan, KL Khoo. A review of blood pressure profile and hypertension Studies in Malaysia. The Family Physician. 1994;6(2) : 36-45.

31. Lee HP, Seah CS, Yik TY, *et al.* An epidemiological survey of blood pressure in Singapore 1974. J Chronic Diseases 1977; 30 : 793-882.

32. Roberts J, Maurer K. Blood pressure levels of person 6-74 years. Vital Health Statistics. Departments of Health Education and Welfare Pub. No. (HRA) 1977; 78-1648, series 11, No. 203.

33. Rowland M, Robert J. NCHS advance data. Vital and Health Statistics of the National Centre for Health Statistics, No. 84, Oct 8, 1982. Washington DC, United States Department of Health and Human Services 1982.

34. Mustaffa BE. Diabetes mellitus in Peninsula Malaysia: ethnic differences in prevalence and complications. Ann Acad Med 1985; 14 (2): 272-276.

35. Rampal KG, Osman A, Lubis SH, *et. al.* A prevalence study of diabetes mellitus among rural Malays in Kuala Selangor, Malaysia. In: 3rd World Congress on diabetes in the Tropics and Developing Countries, Bangkok, Thailand Dec 2-8, 1984;16.

36. West KM, Kalbflcisch JM. Glucose tolerance, nutrition and diabetes in Uruguay, Veneuela, Malaya and East Pakistan. Diabetes 1966;15 : 9-18.

37. Khoo BH, Ngan A. Juvenile diabetes in Peninsular Malaysia. In: Mimura G, Kitagawa T, Hibi I, eds. Childhood diabetes in Asia: The proceedings of the Asian symposium on childbood diabetes, 1978. Medical Journal Sha, 1978;92-9.

38. Cheah JS, Liu KF, Yeo PPB, *et al.* Diabetes mellitus in Singapore: Results of a countrywide population survey. In. Ahuja MMS ed. Epidemiology of diabetes in developing countries. Interprint, New Dehli 1979;93-102.

39. Osman Ali, Tan TT, Sakinah O, *et al.* Prevalence of NIDDM and impaired glucose tolerance in Malaysia and their relationship to sociodemographic, health and nutritional factors. Diabetes Care 1993;16(1) : 68-75.

40. Chong YH. Serum lipids and lipoproteins in healthy Malaysians. Med J Malaya 1961;16 : 136-8.

41. Chong YH, Ng TKW, Ooi HE. High density lipoprotein cholesterol levels in assessing coronary heart disease in Malaysia. Asean J Clin Sci 1982;3(1) : 96-98.

42. Teo WS, Ng ASH, Chee TS, *et al.* Lipid screening in a Volunteer Population in Singapore. Ann Acad Med Singapore. 1992;21(1) : 5-9.

43. Rifkind BM and Segal P. Lipid Research Clinics Program reference values of hyperlipidaemia and hypolipidaemia. J Am Med Assoc. 1983;250 : 1869-72.

44. Zaraihan S, Azman AB, Tariq AR. Racial differences in the fasting lipid profile of healthy Malaysians. Med J Malaysia 1994;49(4) : 355-63.

45. Chong YH, Khoo KL. Serum lipid levels and prevalence of hyperlipidaemia in Malaysia. Clin Chim Acta 1975;65 : 143-8.

46. Danaraj TJ. Acker MS, Danaraj W, *et al.* Ethnic group differences in coronary heart disease in Singapore; an analysis of necropsy records. Am Heart J 1959; 58: 516-526.

47. Castelli WP. Epidemiology of triglycerides: A view from Framingham. Am J Cardiol 1992;70(Suppl) : 3H-9H.

48. McKeigue PM, Miller GJ, Marmon MG. Coronary heart disease in South Asians: a review. J Clin Epidemiol 1989;42(7) : 597-609.

49. Kannel WB. Lipids, diabetes and coronary heart disease: Insights from the Framingham Study. Am Heart J 1985;110 : 1100-7.

50. Stout RW. Insulin and atheroma-an update. Lancet 1987;1(8541) : 1077-9.

51. Castelli WP, Abott RD, McNamara PM. Summary estimates of cholesterol used to predict coronary heart disease. Circulation 1983;67(4) : 230-4.

## APPENDIX I
## Methodology and abnormal range for lipid profile determination

| Test | Methodology | Abnormal Range I | Abnormal Range II |
|---|---|---|---|
| Total cholesterol, TC (mmol/l) | CHOD PAP Method Cholesterol Oxidase | ≥ 5.2 | ≥ 6.2 |
| Triglycerides, TG (mmol/l) | Lipase/Glycerol Kinase Colorimetric | ≥ 2.3 | – |
| HDL-C (mmol/l) | CHOD PAP Method Cholesterol Oxidase | 0.9 | – |
| LDC-C (mmol/l) | Friedewald Formula (TC – HDL) – 75/2.19 mmol/l | ≥ 3.3 | ≥ 4.1 |
| TC:HDL-C | Calculated | > 6.0 | – |
| LDL:HDL-C | Calculated | > 4.0 | – |

**APPENDIX II**
**Methodology and abnormal range for liver function tests**

| Test | Methodology | Abnormal Range |
|---|---|---|
| Alanine transaminase μ/l | UV optimised method according to German recommendation (Phosphate buffer) | > 44 |
| Alkaline phosphatase μ/l | P–Nitrophenyl phosphate (Amino methylpropanol buffer) | > 104 |
| Total protein (g/l) | Biuret reaction (End point method) | < 67 |
| Albumin (g/l) | bromocresol green (Dye binding method) | < 44 |
| Total bilirubin (mmol/l) | Jendrassik & Graf (Caffeine benzoate Accelerator) | > 23 |
| Calcium (mmol/l) | Cresolphathalein complexone | > 2.54; <2.14 |
| Phosphate (mmol/l) | Phosphomolybdate reduction | > 1.36; <0.79 |

**APPENDIX III**
**Methodology and abnormal range for renal function and blood sugar tests**

| Test | Methodology | Abnormal Range |
|---|---|---|
| Urea (μmol/l) | Urease, kinetic method | > 8.3 |
| Uric Acid (μmol/l) | Uricase/Peroxidase colorimetric | > 416 |
| Creatinine (μmol/l) | Alkaline picrate, rate | > 97 |
| Sodium (mmol/l) | Ion selective electrode (Indirect measurement) | > 145; < 135 |
| Potassium (mmol/l) | Ion selective electrode (Indirect measurement) | > 5.0; < 3.5 |
| Fasting blood sugar (mmol/l) | GOD – PAP Method Glucose oxidase B – M reagent | > 6.7 |