ORIGINAL ARTICLE

Racial Differences in the Fasting Lipid Profile of Healthy Malaysians

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Summary

The fasting lipid profile of a sample of Malays, Chinese and Indians in Peninsular Malaysia was studied to see whether these might explain differences in the rate of coronary heart disease mortality amongst the three ethnic groups. Fifty healthy subjects were studied from each of the three groups. They were matched for age. body mass index, gender and smoking habits, if any. The total cholesterol/HDL-cholesterol ratio and LDL-cholesterol/HDL-cholesterol ratio were found to be statistical]y higher in thc Indians than in the Malays and the Chinese. The differences between the Indians and the Chinese were statistically more significant than the differences between the Indians and the Malays. Our findings may partially explain the higher predisposition of the Indian community in Malaysia to CHD mortality and are consistent with those of other studies performed on Indian communities living outside the Indian subcontinent.

Key Words: Lipid, Coronary heart disease

Introduction

As in many developed societies, coronary heart disease (CHD) is the major cause of mortality in Peninsular Malaysia[1,2]. Numerous epidemiological, laboratory and angiographic studies have established that lipid abnormalities play a role in the aetiology of coronary heart disease. Other major risk factors include hypertension, diabetes mellitus and smoking[3,4].

The CHD mortality rates in the USA and Finland were found to decline during the period 1967 – 1985. This was attributed to the reduction in coronary risk factors, the results of effective intervention efforts and treatment[5,6]. In contrast, CHD mortality in Peninsular Malaysia has shown an increasing trend since the 1970s till the present time[2]. Furthermore, the Indians were found to have a higher CHD mortality rate than the Malays and the Chinese[2]. Whether this difference among the major ethnic groups in Peninsular Malaysia is due to one or more of the established coronary risk factors such as lipid abnormalities is still unclear. A number of other studies have also reported a higher rate of CHD morbidity amongst those who originate from the Indian subcontinent as compared to other ethnic groups[7,8,9]. The reasons for this trend have yet to be clearly established although it was suggested by McKeigue *et al*[9] that the high risk of CHD found amongst the Indians worldwide from an early age suggests the existence of a common underlying mechanism. The same authors also reported a tendency towards a lower level of HDL-cholesterol, a higher level of triglycerides and a higher incidence rate of non-insulin-dependent diabetes mellitus (NIDDM) amongst the Indians as compared to other ethnic groups[9].

The aim of this study is to compare the fasting lipid profiles of a sample of healthy Malays, Chinese and

Indians in Peninsular Malaysia and to determine whether any differences found could partially explain the higher predisposition of the local Indian community towards CHD mortality.

Materials and Methods

Study design

Apparently healthy subjects from the three ethnic groups were screened to enable selection of subjects which fulfilled our criteria. Fasting blood samples were then collected for lipid analysis. The performance of the laboratory techniques used for the lipid analysis had previously been studied[10].

Sampling of healthy subjects

The subjects were aged 18-60. These were volunteers from amongst the local inhabitants in and around Kuala Lumpur and Tanjung Karang. The medical history of each potential subject was recorded in a specially prepared questionnaire. The physical examination included the measurement of resting supine blood pressure, body weight and height. Fasting plasma glucose, serum creatinine and serum SGPT of each potential subject were performed to screen for diabetes mellitus, renal impairment and liver impairment respectively. Only subjects who fulfilled the following criteria were considered healthy and included in the study:

i) No symptoms of serious illness known to affect the lipid profile, such as heart disease, hypertension, diabetes mellitus, renal impairment and thyroid dysfunction.

ii) Not having undergone any chronic medical treatment for at least one month before the blood sampling for the lipid study.

iii) Following a normal diet.

iv) Having a resting supine blood pressure below 160/95 mm Hg. (160/95 mm Hg being the criterion for hypertension recommended by WHO[11]).

v) A fasting plasma glucose of below 8.0 mmol/l (to exclude volunteers who may be suffering from diabetes mellitus in accordancc with WHO criterion)[12], serum creatinine of below 135 μmol/l and SGPT level of below 40 IU/l.

Alcoholics and drug addicts were excluded from the study, as were pregnant subjects and those on oral contraceptives. All subjects were required to fast for 12 hours before their venous blood samples were taken.

Sampling and storage of blood samples

The blood was centrifuged within hours of collection and the serum and plasma were aliquoted. The aliquots were stored at -20° Centigrade when not immediately analysed. All blood tests were performed within one week of collection of the samples.

Method of laboratory analysis

Total cholesterol and triglycerides in the serum were analysed by the enzymatic colorimetric method on the Centrifichem 500 (obtained from Union Carbide Corp., USA) using the Boehringer Mannheim reagent kits (obtained from Boehringer Mannheim Diagnostics, Germany). The HDL-cholesterol was separated by precipitating the non-HDL fractions with the Boehringer Mannheim magnesium chloride/phosphotungstic acid precipitating reagent. The supernatant was analysed for its cholesterol content by the same technique as for total cholesterol. A calibrating standard with a lower value of total cholesterol was, however used to account for the lower physiological range of cholesterol in the HDL fraction. LDL-cholesterol was calculated using the Friedewald formula.

Results

Table I shows the characteristics of the three ethnic groups in the population studied, matched for age, body mass index (BMI), gender and smoking habits. Due to difficulties in matching for these four parameters, only five Tanjung Karang volunteers (all Malays) were eventually included in this study. Of these, only one was a local Tanjung Karang inhabitant, while the remaining four were doctors and medical students of Universiti Kebangsaan Malaysia who were doing their posting in Tanjung Karang. Thus, only one volunteer was a rural inhabitant.

Table I
Comparison of characteristics of healthy Malays, Chinese & Indians (matched for age, BMI, gender & smoking habits) : Kruskal – Wallis Test

Characteristics of Subjects		Malays (n = 50)	Chinese (n = 50)	Indians (n = 50)	Kruskal – Wallis Test
Age	(years)	36 ± 7	36 ± 7	36 ± 7	(NS)
BMI	(kg/m^2)	22.3 ± 2.9	21.4 ± 2.8	22.2 ± 2.9	(NS)
Systolic Pressure	(mm Hg)	119 ± 11	118 ± 9	118 ± 9	(NS)
Diastolic Pressure	(mm Hg)	77 ± 8	77 ± 8	75 ± 7	(NS)
Pulse Rate	(per minute)	74 ± 8	75 ± 7	74 ± 6	(NS)
Plasma Glucose	(mmol/l)	4.3 ± 0.5	4.5 ± 0.5	4.3 ± 0.6	(NS)
Serum Creatinine	(μmol/l)	86 ± 21	81 ± 19	84 ± 19	(NS)
SGPT	(IU/l)	20 ± 15	21 ± 14	18 ± 14	(NS)

(NS) = not significant ($p > 0.05$)

Table II
Comparison of serum lipid levels amongst healthy Malays, Chinese & Indians (matched for age, BMI, gender & smoking habits) : Kruskal – Wallis Test

Lipid Components (mmol/l)	Malays (n = 50)	Chinese (n = 50)	Indians (n = 50)	Kruskal – Wallis Test
Cholesterol	5.5 ±1.1	5.4 ± 1.2	5.7 ± 0.8	(NS)
Triglycerides	1.2 ±0.6	1.2 ± 0.9	1.4 ± 0.9	(NS)
LDL–cholesterol	3.7 ±1.0	3.6 ± 1.1	3.9 ± 0.8	(NS)
HDL–cholesterol	1.3 ±0.3	1.3 ± 0.3	1.2 ± 0.4	(NS)
Cholesterol/ HDL–cholesterol	4.57 ±1.44	4.32 ±1.33	5.33 ±1.92	*
LDL–cholesterol/ HDL–cholesterol	3.08 ±1.21	2.83 ±1.12	3.63 ±1.54	*

(NS) = not significant ($p > 0.05$)
* = ($p < 0.05$)

The mean age for each ethnic group studied was 36 ± 7 years. The mean BMI was 22.3 ± 2.9 kg/m^2 for the Malays, 21.4 ± 2.8 kg/m^2 for the Chinese and 22.2 ± 2.9 kg/m^2 for the Indians. The number of males and females was 22 and 28 respectively. The subjects were also matched for the number of cigarettes smoked per day (if any). There were no significant differences in the age, BMI, systolic and diastolic blood

Table III
Comparison of serum lipid levels amongst healthy Malays, Chinese & Indians (matched for age, BMI, gender & smoking habits) : Mann – Whitney Test

Lipid Components (mmol/l)	Malays (n = 50)	Chinese (n = 50)	Indians (n = 50)	Comparison between Race	Mann – Whitney Test
Cholesterol/ HDL-cholesterol	4.57 ± 1.44	4.32 ± 1.33	5.33 ± 1.92	M vs C	(NS)
				M vs I	*
				C vs I	**
LDL-cholesterol/ HDL-cholesterol	3.08 ± 1.21	2.83 ± 1.12	3.63 ± 1.54	M vs C	(NS)
				M vs I	*
				C vs I	**

M = Malays
C = Chinese
I = Indians

(NS) = not significant (p > 0.05)
** = p < 0.05*
*** = p < 0.01*

Table IV
Comparison of serum lipid levels amongst healthy Malay, Chinese & Indian men (matched for age, BMI & smoking habits) : Kruskal – Wallis Test

Lipid Components (mmol/l)	Malays (n = 22)	Chinese (n = 22)	Indians (n = 22)	Kruskal – Wallis Test
Cholesterol	5.5 ± 1.1	5.2 ± 0.9	5.7 ± 0.9	(NS)
Triglycerides	1.4 ± 0.6	1.6 ± 1.2	2.0 ± 1.1	(NS)
LDL-cholesterol	3.7 ± 1.0	3.3 ± 1.0	3.8 ± 1.0	(NS)
HDL-cholesterol	1.2 ± 0.2	1.1 ± 0.2	1.0 ± 0.3	*
Total cholesterol/ HDL-cholesterol	5.09 ± 1.66	4.8 ± 1.35	6.37 ± 1.89	**
LDL-cholesterol/ HDL–cholesterol	3.47 ± 1.4	3.04 ± 1.13	4.25 ± 1.58	*

(NS) = not significant (p > 0.05)
** = p < 0.05*
*** = p < 0.01*

Table V
Comparison of serum lipid levels amongst healthy Malay, Chinese & Indian Men (matched for age, BMI & smoking habits) : Mann – Whitney Test

Lipid Components (mmol/l)	Malays (n = 22)	Chinese (n = 22)	Indians (n = 22)	Comparison between Race	Mann – Whitney Test
HDL-cholesterol	1.2 ± 0.2	1.1 ± 0.2	1.0 ± 0.3	M vs C	(NS)
				M vs I	*
				C vs I	*
Total cholesterol/ HDL-cholesterol	5.09 ± 1.66	4.8 ± 1.35	6.37 ± 1.89	M vs C	(NS)
				M vs I	*
				C vs I	**
LDL-cholesterol/ HDL-cholesterol	3.47 ± 1.4	3.04 ± 1.13	4.25 ± 1.58	M vs C	(NS)
				M vs I	*
				C vs I	**

M = Malays
C = Chinese
I = Indians

(NS) = not significant ($p > 0.05$)
** = $p < 0.05$*
*** = $p < 0.01$*

pressures, pulse rate, plasma glucose level, serum creatinine level and serum SGPT level amongst the three ethnic groups.

The results of a comparative study of the fasting lipid profile of the three ethnic groups are shown in Table II. Due to the non-parametric distribution of the parameters measured, the Kruskal-Wallis statistical test was used. Analysis of the data by the Kruskal-Wallis statistical method showed a significant difference in the ratios of total cholesterol/HDL-cholesterol and LDL-cholesterol/HDL-cholesterol amongst the three ethnic groups. However, the test could not determine between which ethnic groups this difference lies. Thus, the Mann-Whitney statistical test was subsequently performed. As shown by Table III, the differences in the two ratios were found to be between the Malays and the Indians, and between the Chinese and the Indians. The differences between the Indians and the Chinese were statistically more significant than the differences between the Indians and the Malays.

A comparison of the fasting lipid profile amongst the male gender from the three ethnic groups was also performed (Table IV and Table V). Results of the Kruskal-Wallis test showed a significant difference in the level of HDL-cholesterol and in the ratios of total cholesterol/HDL-cholesterol and LDL-cholesterol/HDL-cholesterol (Table IV). The Mann Whitney test subsequently showed that the differences were between the Indian males and the Malay males, and between the Indian males and the Chinese males (Table V).

Table VI showed that with the exception of triglycerides, no statistical differences could be found in the fasting lipid profile amongst the female gender of the three ethnic groups. The Malay females had significantly higher levels of triglycerides than the Chinese females (Table VII).

Discussion

The results of previous studies by other workers could

Table VI
Comparison of serum lipid levels amongst healthy Malay, Chinese & Indian women (matched for age, BMI & smoking habits) : Kruskal – Wallis Test

Lipid Components (mmol/l)	Malays (n = 28)	Chinese (n = 28)	Indians (n = 28)	Kruskal – Wallis Test
Cholesterol	5.5 ± 1.1	5.6 ± 1.3	5.7 ± 0.7	(NS)
Triglycerides	1.1 ± 0.5	0.8 ± 0.5	0.9 ± 0.4	*
LDL-cholesterol	3.6 ± 1.0	3.8 ± 1.2	3.9 ± 0.7	(NS)
HDL-cholesterol	1.4 ± 0.3	1.5 ± 0.2	1.4 ± 0.3	(NS)
Total cholesterol/ HDL-cholesterol	4.16 ± 1.10	3.98 ± 1.23	4.51 ± 1.52	(NS)
LDL-cholesterol/ HDL-cholesterol	2.77 ± 0.95	2.71 ± 1.11	3.15 ± 1.36	(NS)

(NS) = not significant ($p > 0.05$)
** = $p < 0.05$*

Table VII
Comparison of serum lipid levels amongst healthy Malay, Chinese & Indian women (matched for age, BMI & smoking habits) : Mann – Whitney Test

Lipid Components (mmol/l)	Malays (n = 28)	Chinese (n = 28)	Indians (n = 28)	Comparison between Race	Mann – Whitney Test
Triglycerides	1.1 ± 0.5	0.8 ± 0.5	0.9 ± 0.4	M vs C	**
				M vs I	(NS)
				C vs I	(NS)

M = Malays
C = Chinese
I = Indians

(NS) = not significant ($p > 0.05$)
*** = $p < 0.01$*

not detect significant differences in the lipid profile of the Malays, Chinese and Indians of Peninsular Malaysia[13,14,15]. However, a recent study by Teo *et al* [16] on a group of male professionals and executives did find that there was a higher prevalence of hypercholesterolemia and hypertriglyceridemia and low levels of HDL-cholesterol amongst the Malay subjects when compared to the Chinese. No comparison could be made with the Indian subjects due to their small sample size. If the previous studies were comparable with the present study, the failure of the former to detect differences in the lipid profile of the three ethnic groups could be explained by one or more of several possibilities. In most of the previous studies, there was no mention of differences in body mass index being accounted for although the three groups of subjects were matched for age and gender. The subjects were not always fasting and thus the triglyceride levels may not be accurate. Furthermore, previous studies with the exception of the recent study by Teo *et al* [16], did not have the benefit of fully automated enzymatic techniques which are more precise and accurate in determining the levels of the lipid components in blood. The change in environmental factors such as diet and lifestyle may also be partly responsible.

Data from the Department of Statistics, Malaysia[2] showed that the rate of mortality due to cardiovascular diseases was highest amongst the Indian population. Coronary heart disease (CHD) and cerebrovascular disease were the main causes of death. CHD mortality amongst the Indians was 1.5 – 1.8 times greater than that of the Malays or the Chinese. The significantly higher ratios of total cholesterol/HDL-cholesterol and LDL-cholesterol/HDL-cholesterol amongst the Indians as compared to the Malays and the Chinese, as found by this study, could partially explain the higher CHD mortality rate of the Indian population. Results of the Framingham study have shown the two lipid ratios to be sensitive atherogenic indices[17].

It was reported by Jeyamalar[1] that data from the Department of Statistics, Malaysia showed that the ratio of men to women who died from ischemic heart disease in Peninsular Malaysia was 2.2 : 1 (2.5 : 1 amongst the Malays, 1.7 : 1 amongst the Chinese and 3.0:1 amongst the Indians). That this data indicated that male Indians are at higher risk of dying from CHD is in line with the findings of this study which found that the higher lipid ratios amongst the Indian subjects were confined to the males. Khoo *et al*[2] also noted a higher CHD mortality trend amongst the males as compared to the females in the overall population of Peninsular Malaysia.

The present study found that the differences in the lipid profile between the Indians and the Chinese were statistically more significant than between the Indians and the Malays. However, no significant statistical differences in the lipid profile between the Malays and the Chinese could be detected (except for triglyceride levels between the Malay and Chinese women). This finding would seem to be in line with that of Khoo *et al*[2] who reported that in the period 1970 - 1984, the CHD mortality rate of the Malays and the Chinese was approximately the same. However, the authors could not rule out the possibility that incompleteness of the mortality data in the study by Khoo *et al*[2] and insufficiency of sample size in the present study (thus giving rise to Type II error[21]) could have suppressed significant statistical differences which may in fact exist between the two ethnic groups as regards the CHD mortality rate and lipid profile, respectively. That this suppression of significant statistical differences may be taking place are borne out by two observations. Firstly, the present study observed the emergence of a trend whereby the lipid levels of the Malays were almost always intermediate between those of the Indians and the Chinese. Secondly, the Malays, Chinese and Indians of Peninsular Malaysia are genetically the same as their counterparts in Singapore where the differences in CHD mortality rate and lipid profile between the Malays and the Chinese were shown to reach statistical significance[18,19,20].

A number of studies have reported that in other parts of the world, the CHD mortality rate was also highest amongst those originating from the Indian subcontinent when compared to other ethnic groups[7,8,9]. These studies seem to indicate that the higher predisposition of the Indians to CHD mortality could not be attributed to the known risk factors such as high blood pressure, smoking, diet or environmental factors.

A review by McKeigue *et al*[9] reported that a feature often found in Indian communities living outside the Indian subcontinent was a relatively low level of HDL-cholesterol, high level of triglycerides and high prevalence of NIDDM as compared to the other communities residing in the same area. This present study also found a trend of lower HDL-cholesterol levels and higher triglyceride levels among the Indian subjects as well as a statistically lower HDL-cholesterol level among the Indian male subjects. McKeigue *et al*[8,9] suggested that the pattern of relatively low level of HDL-cholesterol, high triglyceride levels and high prevalence of NIDDM in the Indian communities reflect an insulin resistance phenomena. High levels of plasma insulin could produce atherogenic effects either directly or through disturbances to the HDL and triglyceride levels[22]. It was therefore proposed that insulin resistance, which eventually results in diabetes, hyperinsulinemia and secondary disturbances to lipoproteins, is a mechanism which elevates the CHD rate amongst the Indians in Britain and other countries outside the Indian subcontinent. However the authors could not be certain whether their hypothesis, even if true, would on its own be sufficient to explain the high CHD rate amongst the Indians. The extent of genetic and environmental factors could not be ascertained since, amongst others it should be noted that the CHD rate in the rural communities of India itself is low.

This study is also unable to determine the extent of the involvement of genetic factors, diet and lifestyle in causing the differences in the lipid profile of the Malays, Chinese and Indians. Further studies are required to investigate these aspects as well as any differences in other lipid components such as apoproteins and Lp(a) and to determine whether factors other than lipids, such as blood viscosity, could also be responsible for the high CHD mortality rate of the Indians. However, our preliminary findings that the ratios of total cholesterol/HDL-cholesterol and LDL-cholesterol/HDL–cholesterol were statistically higher amongst the Indians, as compared to the Malays and Chinese, could, at least partially, explain the higher CHD mortality rate of the Indian population in Peninsular Malaysia.

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