Serum Lipid Profile in an Elderly Chinese Population

Jean Woo and Christopher W. K. Lam

The serum lipid profile of a cohort of Hong Kong Chinese subjects living in the community (160 men, 154 women, mean age 70.2±11.4 years) was examined to determine the influence of age, sex, indices of obesity, drugs, smoking, alcohol intake, and presence of diabetes mellitus on serum lipid, lipoprotein, and apolipoprotein concentrations. A high waist/hip ratio (an index of central obesity) was associated with higher serum triglyceride and lower apolipoprotein (apo) A-I concentrations, while a higher body mass index was associated with lower high density lipoprotein (HDL) cholesterol and higher apo B concentrations. Smokers and those taking beta-blockers had lower apo A-I concentrations. Subjects on methyldopa had higher triglyceride and very low density lipoprotein cholesterol, with lower HDL and HDL₂ cholesterol. All the HDL fractions were lower in diabetic subjects, and cholesterol and triglyceride concentrations correlated with indices of glycemic control.

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The role of serum lipids, lipoproteins, and apolipoproteins in the development of atherosclerosis (and consequently in the development of coronary and cerebrovascular diseases) has been reviewed.1 It has also been shown that there is a strong positive association between the serum cholesterol levels of different national groups and their ischemic heart disease mortality rates.2 According to previous studies among Oriental populations, serum cholesterol concentrations tend to be low in all age groups. Nevertheless, among the Chinese population in Hong Kong, cardiovascular disease is the second commonest cause of mortality after stroke. Therefore, serum lipid profiles and the factors that may influence the concentration of the different lipid fractions were examined in an apparently healthy cohort of Chinese.

Methods

Subjects

Blood was taken from 314 apparently healthy subjects (160 men, 154 women) living in the community and was used for lipid analysis as part of a case-control study on risk factors for stroke among Chinese. Subjects who were 60 years old or older were recruited from a social center for the elderly, and those younger than 60 years were recruited from subjects who attended a general practice clinic for health check-ups or minor psychosomatic complaints. Those persons with infections or liver, renal, biliary, and cerebrovascular disease were excluded. All subjects gave their informed consent. Information regarding occupation, medical history, smoking, drinking habits, and use of medication was obtained from all subjects. A smoker was defined as anyone currently smoking. Subjects who consumed alcohol in any amount were classified as drinkers, while those who did not take any alcohol were classified as nondrinkers. Subjects were classified as having diabetes mellitus or hypertension if a diagnosis had been made in the past or if they were taking the relevant medications. Height and weight were measured with the subjects in light indoor clothing. Body mass index (BMI) was calculated as weight (kg) divided by height (m)². The waist/hip ratio (WHR), an index of distribution of body fat thought to be related to lipid levels, was also measured. Waist girth was taken as that level yielding the minimum circumference between the umbilicus and xiphoid process. Hip girth was recorded as the maximum circumference around the buttocks posteriorly and anteriorly by the symphysis pubis. Blood pressure was recorded in the sitting position with a mercury sphygmomanometer. After a 12-hour fast, 20 ml of venous blood was taken from the antecubital vein for estimation of complete blood picture, renal and liver functions, glucose, glycosylated hemoglobin, fructosamine, cholesterol, triglycerides (TG), high density lipoprotein (HDL), HDL₃ and HDL₂ cholesterol, low density lipoprotein (LDL), very low density lipoprotein (VLDL), lipoprotein(a) (Lp[a]).

Procedures

Serum total cholesterol (TC) and TG were assayed enzymatically with commercial reagents (Baker Instruments Corporation, Allentown, PA). The cholesterol content of HDL and subfractions (HDL-C, HDL₃-C, and HDL₂-C) was determined after fractional precipitation with dextran sulfate-MgCl₂. LDL cholesterol (LDL-C) and VLDL cholesterol (VLDL-C) were calculated with the formula of Friedewald et al. Apo A-I and apo B were assayed by rate immunonephelometry (Array Analyzer, Beckman Instruments, Bera, CA). Lp(a) concentration was measured by immunoradiometric assay (reagents from Pharmacia Diagnostic AB, Uppsala, Sweden). Interassay coefficients of variation were: TC, 1.9% at 6.4 mmol/l; TG, 2.6% at 1.9 mmol/l;
Table 1. Characteristics of Study Population

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total</th>
<th>Men</th>
<th>Women</th>
<th>Men</th>
<th>Women</th>
<th>Men</th>
<th>Women</th>
<th>Men</th>
<th>Women</th>
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<td>Alcohol drinkers</td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Nondrinkers</td>
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<td>90</td>
<td>169</td>
<td>59</td>
<td>53</td>
<td>20</td>
<td>55</td>
<td>160</td>
<td>154</td>
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<td>Smokers</td>
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<td>24</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>51</td>
<td>7*</td>
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<tr>
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<td>26</td>
<td>23</td>
<td>3</td>
<td>35</td>
<td>49</td>
<td>15</td>
<td>53</td>
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<td>147</td>
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<tr>
<td>Alcohol drinkers</td>
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<td>13</td>
<td>12</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>41</td>
<td>9*</td>
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<tr>
<td>Nondrinkers</td>
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<td>23</td>
<td>21</td>
<td>34</td>
<td>22</td>
<td>47</td>
<td>52</td>
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<td>145</td>
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</tbody>
</table>

*Significant difference between men and women by Mantel-Haenszel test after controlling for age group, p<0.0001.

Prevalence of Common Diseases and Drug Use

<table>
<thead>
<tr>
<th>Disease/Drug</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
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<td>History of diabetes</td>
<td>25</td>
<td>289</td>
</tr>
<tr>
<td>History of hypertension</td>
<td>77</td>
<td>237</td>
</tr>
<tr>
<td>Using diuretics</td>
<td>30</td>
<td>284</td>
</tr>
<tr>
<td>Using beta-blockers</td>
<td>8</td>
<td>306</td>
</tr>
<tr>
<td>Using methyldopa</td>
<td>17</td>
<td>297</td>
</tr>
</tbody>
</table>

HDL, 5.4% at 0.86 mmol/l; apo A-l, 2.2% at 136 mg/dl; apo B, 2.8% at 85 mg/dl; Lp(a), 5.3% at 52 mg/dl; glucose, 2.0% at 6.6 mmol/l; fructosamine, 2.0% at 1.51 mmol/l; and glycosylated hemoglobin (HbA1c), 7.1% at 6.5%. Our laboratory has participated in two external quality control programs that use standards from Australia and the UK. During the period of study, the imprecision, expressed as coefficients of variation (%) and calculated from duplicates, varied from 2.2% to 4.6% for cholesterol, and from 0.5% to 5.5% for TG.

Plasma glucose was assayed with the Trinder reagent (Diagnostic Chemicals Ltd., Charlottetown, Prince Edward Island, Canada) on a Cobas Mira analyzer (Hoffmann-La Roche, Basel, Switzerland). Fructosamine concentration was determined by the reduction of nitro-blue tetrazolium in the alkaline solution (Sigma Chemical, St. Louis, MO) on a Cobas Bio centrifugal analyzer (F. Hoffmann-La Roche). Plasma total protein and albumin were measured by standard methods. HbA1c in whole blood was measured on agar gel by use of a Corning "Glytai" electrophoresis apparatus (Corning, Palo Alto, CA).

Statistics

Results were entered into a Dbase program and analyzed by using the Statistical Package for the Social Sciences for IBM personal computers.

Results

The age and sex distribution and other characteristics of the subjects are shown in Table 1. The subjects are all from lower socioeconomic groups (i.e., service or agricultural workers, production workers, or laborers). None of the women were using oral contraceptive drugs. The mean±SD serum lipid profile by age group and sex are shown in Table 2. No significant variation attributable to age or sex was observed. The relationships between BMI and WHR and various lipid fractions are shown in Table 3. Serum TG and VLDL-C concentrations increased with higher BMI and higher WHR (i.e., increasing central obesity) in both men and women. HDL-C had a negative correlation with BMI in both men and women and WHR, in men. However, multiple regression analysis with BMI and WHR as independent variables showed that the only factor significantly associated with TG and VLDL concentrations was WHR. In contrast, multiple regression analysis showed that the only factor significantly associated with HDL was BMI. In men, apo A-I was negatively correlated with WHR and BMI, while apo B had a positive correlation with BMI in both men and women and with WHR in men.

When the effect of smoking and alcohol on serum lipid profiles was examined, female smokers had higher TC compared to nonsmokers (6.6±1.1 vs. 5.7±1.1 mmol/l), while male smokers had lower mean apo A-I concentrations (105.4±34.3 mg/dl) compared to nonsmokers (130.6±29.5 mg/dl). Those taking methyldopa (n=17) had higher VLDL-C (1.0±0.9 vs. 0.7±0.5 mmol/l), higher TG (2.28±2.07 vs. 1.59±1.16 mmol/l), lower HDL-C (1.1±0.3 vs. 1.5±0.4 mmol/l), and lower HDL2-C (0.3±0.3 vs. 0.5±0.4 mmol/l). Again, the number of subjects was too small to allow proper evaluation of the effect of these drugs on lipid concentrations, when account was taken of other variables such as age, sex, and BMI. Compared to the group mean, subjects with a past history of diabetes mellitus had lower HDL-C (1.1±0.4 vs. 1.3±0.4 mmol/l), lower LDL-C (0.4±0.3 vs. 0.5±0.4 mmol/l), and lower HDL2-C (0.7±0.2 vs. 0.8±0.3 mmol/l). Again, the number of subjects was too small (n=25) for detailed analysis of the effects of diabetes mellitus on lipid concentrations. Significant correlations were also seen between certain lipid fractions and glycemic indices: fasting glucose correlated positively with TG (r=0.23, p<0.001, n=275) and VLDL-C (r=0.23,
p<0.001) and negatively with HDL-C concentrations (r=-0.22, p<0.001). HbA1c and fructosamine also had similar correlations, although these were slightly weaker. In addition, there was a positive correlation between cholesterol and fructosamine concentrations (r=0.21, p<0.001).

After excluding subjects taking methyldopa or beta-blockers and those with diabetes, the mean ± SD serum lipid profile for all age groups and both sexes (together with the 95% confidence intervals) are presented in Table 4. Published values from other countries are given for comparison. No statistical comparisons can be made, since there may be methodological differences. However, it is possible that Chinese and Koreans have higher apo A-I/apo B ratios and higher HDL-C concentrations compared to some Caucasian populations, and the mean Lp(a) concentration in Chinese is higher than the median value of 5 mg/dl from the Austrian study.

**Discussion**

Since our subjects were recruited as age- and sex-matched controls for stroke cases, no lipid profiles for younger age groups (<40 years) were available. Therefore, the values obtained would be representative of the elderly Chinese population in the lower socioeconomic groups. These constitute at least 50% of the population. Unlike other studies, no age and sex differences were observed. This could be explained by the predominantly younger age of the subjects in other studies. For example, Keitel et al.13 found increasing serum cholesterol concentrations with age, but the mean age for men was 37 years and for women, 36 years. Cai et al.9 also reported a rise in HDL-C with age in men only and higher concentrations in women before age 50. Rises in TC and LDL-C were also reported in both men and women. However, the age range of these subjects was 20 years to ≥60 years, with only 6% of the men and 3% of the women...
in the over 60-year-old group. It is possible that there are no age or sex differences in serum lipid concentrations after about age 60.

Weight gain and obesity are related to TC and LDL-C in serum,14 but the association is weaker at older ages.15 In our study of a predominantly elderly population, an association with BMI (a measure of obesity) was still observed, being correlated with lower HDL-C and apo A-I and higher TG, VLDL-C, and apo B levels. Fat distribution has been shown to be closely related to concentrations of TG, VLDL-C, and HDL-C.16 Among our older subjects, increasing central fatness (as shown by a higher WHR) was also related to increasing TG, VLDL-C, and apo B, as well as to lower HDL-C and apo A-I concentrations.

We did not observe the increase in LDL-C and TG and decrease in HDL-C among smokers as noted in other studies.17 However, female smokers did have higher TC concentrations. There was no difference in the serum lipid profile between nondrinkers and those who drank alcohol. The lack of effect may be explained by the small amount of alcohol consumed, as very few subjects were regular heavy drinkers.

Many antihypertensive drugs are known to adversely affect the lipid profile,18 and the effect of some of the commoner ones were examined in our study. Diuretics were the commonest drug used; approximately 10% of the study population were taking this kind of medication. Surprisingly, there was no difference in lipid profiles between those who were taking diuretics compared to those not taking them. Most studies that showed adverse effects were short-term studies, and there is a suggestion that with long-term therapy (1 to 2 years) changes in lipid profile might not persist.16 Moreover, a short-term study of the effects of diuretics on lipid profiles in Japanese subjects failed to show any changes in two-thirds of the subjects; those showing an adverse effect tended to be overweight, with impaired glucose tolerance.19 Further studies are needed to determine whether the serum lipid profile returns to baseline after 1 to 2 years of therapy, and whether there are racial differences in the adverse effect of diuretics on serum lipid profile. Although there were only eight subjects taking beta-blockers, significantly lower apo A-I concentrations were still observed. This is in agreement with the observation that beta-blockers without intrinsic sympathomimetic activity decrease the HDL fractions, as well as increase serum triglycerides.20 The effect of methyldopa was similar to the effect seen by Nakamura.19

Subjects with diabetes mellitus may have higher serum TG and LDL-C and lower HDL-C concentrations.21 However, this only occurs in subjects with evidence of cardiovascular disease, while those without cardiovascular disease or nephropathy have lipid profiles similar to those of nondiabetic subjects.21 However, in our study, diabetic subjects had lower mean HDL-C, HDL-C, and HDL-C, and this difference persisted when the two diabetic subjects with ischemic heart disease were excluded. The difference in findings may be explained by the extent of control of diabetes, since HDL-C correlated negatively with fasting glucose and other glycemic indices (HbA1c and fructosamine).

### Table 4. Comparison of Lipid Values in Hong Kong with Those in Other Countries

<table>
<thead>
<tr>
<th>Countries</th>
<th>TC</th>
<th>TG</th>
<th>HDL-C</th>
<th>LDL-C</th>
<th>Lp(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>5.46±1.14</td>
<td>1.58±1.17</td>
<td>1.34±0.42</td>
<td>3.32±1.25</td>
<td>27.1±27.0</td>
</tr>
<tr>
<td>People's Republic of China</td>
<td>7.89±1.68</td>
<td>1.09±0.20</td>
<td>1.76±0.31</td>
<td>3.51±0.83</td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>4.40±0.97</td>
<td></td>
<td>1.17±0.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United Kingdom (London)</td>
<td>6.15±1.11</td>
<td></td>
<td>1.19±0.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>5.40±0.93</td>
<td>1.32±0.52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North America</td>
<td>5.19±1.20</td>
<td>1.70±0.51</td>
<td>1.09±0.31</td>
<td>3.31±0.50</td>
<td>5.0±1.23</td>
</tr>
</tbody>
</table>

Values are given in mmol/l except for Lp(a), which are mg/dl.

See the legend to Table 2 for an explanation of the abbreviations.

*Median values.
In the light of the dietary habits of our study population (where fat contributed only 20% of total calories compared to 40% among Caucasians), it would be interesting to compare the lipid profile of our subjects with those from other populations. Comparisons between different surveys are difficult, since the population structures, as well as laboratory methods for lipid assays, may be different. Ideally, samples from different ethnic groups should be collected and analyzed by one laboratory. Our values for TC, TG, HDL-C, LDL-C, and LDL-HS were similar to the values for subjects of comparable age groups in the United States. Comparison with other surveys of elderly populations also showed similar values. In a study of nonagenarians in Germany, the mean±SD TC was 5.66±1.20 for women and 5.26±1.09 for men, the mean TG was 1.64±1.15 for women and 1.41±0.40 for women and 1.34±0.37 for men.

Similarly, the HDL-C and LDL-C values among octogenarians in the Framingham Heart Study were 1.47±0.39 and 3.93±0.80, respectively, for women, and 1.19±0.05 and 3.80±1.03, respectively, for men. The mean HDL-C and LDL-C values quoted in Glueck’s Study were 1.38±0.03 and 3.15±0.11, respectively, were also similar. In contrast to the few studies reporting Lp(a) concentrations, our subjects appear to have much higher levels than environmental factors, it would be interesting to assess the role of apolipoprotein profiles in contributing to the different patterns of vascular diseases.

References


Index Terms: cholesterol • triglycerides • lipoproteins • apolipoproteins • age • Chinese
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