Concentrations of Lipids, Lipoprotein, and Apolipoproteins in Serum of Zimbabwean Africans

Z. A. R. Gomo

The subjects in this study were volunteers from a Zimbabwean population: 794 men and 705 women, ages between 20 and 65 years. They were receiving no medication and had no disease that could influence lipid metabolism. For determination of high-density lipoprotein cholesterol and apolipoproteins, they were screened for the known risk factors for coronary heart disease, to exclude factors known to influence those analytes. The results showed a significant sex- and age-dependence. The means and ranges for cholesterol, apolipoprotein B, and triglycerides were lower than those found in European populations. The high-density lipoprotein cholesterol and apolipoprotein A concentrations, on the other hand, were higher than in the European populations. This study established the reference ranges of the analytes studied and suggests that the prevalence of coronary heart disease may be low in Zimbabwean Africans.

Additional Keyphrases: reference interval · sex- and age-related differences

Serum lipids and lipoproteins, especially serum cholesterol, triglycerides, low-density lipoprotein (LDL), and very-low-density lipoprotein (VLDL), are major independent risk factors for coronary heart disease (1–3). High-density lipoprotein (HDL), on the other hand, is an ameliorating factor in coronary heart disease (3–6).

Apolipoproteins (Apo) play a pivotal role in lipoprotein metabolism (7). Avogaro et al. (8) have suggested that apolipoproteins, particularly Apo A-I and Apo B (the principal protein moieties of HDL and LDL, respectively), are better discriminators for coronary heart disease than are the lipid moieties of lipoproteins. Determinations of serum lipids, lipoproteins, and apolipoproteins are valuable in the diagnosis and management of hyperlipoproteinemia (9, 10) and in assessing the risk of developing coronary heart disease (6, 11, 12).

There is a wealth of data on lipids, lipoproteins, and apolipoproteins in the developed countries, but such data are not available for natives of Zimbabwe. Furthermore, the notion that coronary heart disease is not at epidemic proportions in the developing countries has hampered progress in this area of research. It is therefore important to gather basic data for establishing the prevalence of hyperlipoproteinemia and identifying risk factors for coronary heart disease in countries such as Zimbabwe.

Here I report results of a study of lipids, lipoproteins, and apolipoproteins, performed to establish reference intervals for these analytes in a Zimbabwean population.

Materials and Methods

Subjects

Two thousand volunteers, ages 20 to 65 years, were recruited from the urban Harare and rural areas for the study. All were on their usual diet and were at their usual activities.

The urban population consisted of subjects in high, middle, and low social economic groups (13). The urban population appeared to come from different parts of Zimbabwe and were in constant visit to the rural areas, as is typical of the working African population in Zimbabwe.

The concept of the study was explained to each subject. Each volunteer was screened with biochemical tests to eliminate subjects with various diseases, such as diabetes mellitus, hyperlipoproteinemias, liver disease, and uremia. Furthermore, subjects were screened for hypertension to exclude hypertensives from the study. Individuals suffering from gout and hypothyroidism were also excluded. Each volunteer was questioned intensively by an experienced nurse to determine drinking and smoking habits and medication, to exclude subjects taking any medication, including oral contraceptives. This screening left us 1499 subjects.

Procedures

Blood was collected into plain glass tubes after the subjects had fasted overnight (12–14 h). The serum was separated within 2 h. Serum triglycerides were assayed, after enzymic hydrolysis, by a simultaneous enzymic determination of glycerol (14). Total cholesterol and HDL-C were measured by the cholesterol oxidase method (15), HDL-C being determined after precipitation of LDL and VLDL by phosphotungstate–MgCl₂ (16). Abbott reagents and an ABA-100 discrete analyzer (Abbott Laboratories Diagnostic Division, South Pasadena, CA) were used for all these measurements. Apo A-I and Apo B in serum were quantified by radial immunodiffusion (17, 18) with use of Behring M-Partigen immunodiffusion plates (Behringwerke, AG, Marburg, F.R.G.). The overall CVs for these methods were: triglycerides 9.1%, total cholesterol 6.2%, HDL-C 6.8%, Apo A-I 6.5%, and Apo B 8.0%.

Statistical analysis of the results was based on the calculation of mean and standard deviation for the population by the method of Becktel (19). Results for lipids were first expressed as their logarithms before statistical analysis. I used Student's t-test for statistical comparisons of concentrations of lipids, lipoproteins, and apolipoproteins.

Quality Control

Internal and external quality-control schemes were used to ensure high accuracy and precision in these determinations. For internal quality control, normal and abnormal assayed control sera (Ortho Diagnostic Systems, Raritan, NJ) were analyzed with each batch of tests. Results of tests were only accepted when the results for control sera were
Table 1. Summary of Study Results

<table>
<thead>
<tr>
<th>Concentration, mmol/L</th>
<th>Total cholesterol</th>
<th>HDL-cholesterol</th>
<th>Triglycerides</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>n</td>
<td>791</td>
<td>705</td>
<td>240</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>4.50</td>
<td>4.27</td>
<td>1.54</td>
</tr>
<tr>
<td>SD</td>
<td>1.26</td>
<td>1.27</td>
<td>0.38</td>
</tr>
<tr>
<td>Range</td>
<td>1.95-6.99</td>
<td>1.73-6.81</td>
<td>0.78-2.30</td>
</tr>
<tr>
<td>p</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Concentrations, g/L.

Table 2. Age Dependence of Total Cholesterol Concentrations (mmol/L) in Sera from Both Sexes

<table>
<thead>
<tr>
<th>Age, years</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>219</td>
<td>209</td>
</tr>
<tr>
<td>30-39</td>
<td>4.03 $^a$</td>
<td>4.54 $^{a,b}$</td>
</tr>
<tr>
<td>40-49</td>
<td>1.26</td>
<td>1.32</td>
</tr>
<tr>
<td>50-65</td>
<td>1.51-$^a$</td>
<td>1.9-$^a$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age, years</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>210</td>
<td>182</td>
</tr>
<tr>
<td>30-39</td>
<td>3.89 $^a$</td>
<td>4.39 $^{a,d}$</td>
</tr>
<tr>
<td>40-49</td>
<td>1.23</td>
<td>1.29</td>
</tr>
<tr>
<td>50-65</td>
<td>1.43-$^a$</td>
<td>1.81-$^a$</td>
</tr>
</tbody>
</table>

Paired letters indicate significant difference between decades at $^a p < 0.001$, $^b p < 0.01$, $^c p < 0.05$, $^d p < 0.02$, $^e p > 0.02$.

Results

Tables 1 and 2 summarize the results for concentrations of lipids, lipoproteins, and apolipoproteins in the males and females. The mean values and the range for total cholesterol and triglyceride were higher for men than for women. Concentrations of HDL-C and Apo A-I were higher for women than for men. These differences were significant for lipids ($p < 0.001$), Apo A-I ($p < 0.001$), and Apo B ($p < 0.05$). Total concentrations of cholesterol were also age dependent in each sex (Table 2).

Discussion

The data reported here agree with other workers' findings that values for serum cholesterol are related to both age and sex and that concentrations of HDL-C, Apo A-I, and triglyceride in serum are sex-dependent (20, 21). As compared with data on European populations of the same age group (21, 22), the mean and range of values for the lipids are lower in the present population. This difference may be partly an ethnic difference and partly ascribable to the fact that these subjects are probably on a low-fat diet (22), as is generally believed to be the case for "developing" countries.

Serum cholesterol is a composite of HDL-C and LDL-cholesterol, much of the total serum cholesterol being found in LDL. This population shows a higher concentration of HDL-C and a lower concentration of total cholesterol than is the case for Western populations. Thus the high HDL-C and low total cholesterol (i.e., low LDL-cholesterol) concentrations probably account for the low prevalence of coronary heart disease in blacks, although the disease may be on the increase (22, 24). This finding is in agreement with the view that high HDL concentration helps protect against coronary heart disease (6).

The results for the Apo concentrations, particularly Apo A-I, showed trends that have been observed (8) with HDL-C. This seems to confirm that assay of either Apo A-I or HDL-C would reflect HDL concentrations and also that either or both may be used as markers for the risk of developing coronary heart disease.

Hitherto, there has been no study on serum lipids, lipoproteins, and apolipoproteins in a fasting Zimbabwean black population. Nor has any other specific study of lipoproteins and apolipoproteins, in particular of HDL-C and Apo, been carried out on Zimbabwean blacks. The present data, apart from their relevance in establishing reference ranges, appear to indicate that the Zimbabwean black population is at lower risk of developing coronary heart disease. However, this finding needs to be substantiated by a more detailed study of these variables in different Zimbabwean black populations at risk of developing coronary heart disease. Such work is currently in progress.

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References