Reference Intervals for Serum Lipids, Lipoproteins, and Apoproteins in the Elderly

Concepcion Alvarez, Aurora Orejas, Sofia Gonzalez, Rosa Diaz, and Luis F. Colomo

We measured total cholesterol, high-density-lipoprotein cholesterol, low-density-lipoprotein cholesterol, triglycerides, apoprotein A, and apoprotein B in serum. The subjects were a volunteer group of 145 white people (50 men and 95 women) ranging in age between 65 and 95 years, who were not receiving medical treatment and had no disease that could influence lipid metabolism. Before further categorization, we saw no significant sex-related difference in any of these lipid constituents. The mean age of the group was about 80 years, and we compared results for those older and younger. For the women, the only significant difference was a decrease in low-density-lipoprotein cholesterol for those older than 80 years. In men over 80 there was a significant decrease in triglycerides and in apoprotein B and an increase in high-density-lipoprotein cholesterol. The only sex-related difference for persons under and over 80 was in values for high-density-lipoprotein cholesterol, which were higher for men over 80, whereas triglycerides were higher for women over 80.

Additional Keyphrases: sex- and age-related changes • cholesterol • apolipoproteins

Although the need for reference values for any given population has increased, such information is not abundant, especially for persons under 18 and over 65 years of age. Several authors have concerned themselves with the relation of age to various biochemical parameters (1–10), but studies on lipids in the elderly are few and incomplete (11–18), even though the over-65 population will account for 15% of the total population within a few years, cardiovascular disease is the leading cause of death in the world—especially of old people—and certain changes in plasma lipids are an important risk factor at any age.

The aim of this study was to establish reference values for lipids, lipoproteins, and apoproteins in a group of men and women 65 to 95 years old.

Materials and Methods

We studied a group of 145 white people from an oldpeople's home, composed of 50 men from 65 to 89 and 95 women from 66 to 95 years old. Their participation in this study was voluntary. Any potential subject with underlying disease that might influence plasma lipids—such as hypertension, gout, diabetes, hypothyroidism, liver disease, and uremia—was excluded from the study. All participants were going about their usual activities. None was following any special diet or undergoing any specific medical treatment. Blood was sampled after overnight fasting (12–14 h) and centrifuged within 2 h after extraction. The serum was stored at −20 °C until analyzed.

Each study subject received a routine hematological study and a routine biochemical screening (SMA 12/60).

Table 1 summarizes our results for these 145 people. The mean values for TC, LDL-C, and TG were slightly higher for the women than for the men. For HDL-C and Apo-A the reverse was true. However, we found no significant sex-related differences in any of the constituents analyzed. Table 2 shows the distribution of the 2.5, 10, 50, 90, and 97.5 percentiles of the lipids and lipoproteins for the group, as well as for the men and women separately. The different values for n are the result of excluding outliers in each group.

The average age of the total group was about 80 years, so we proceeded to compare data for men under and over 80, and for women under and over 80 (Table 3). Values for TC, LDL-C, Apo-A, and Apo-B decreased with increasing age, regardless of sex. The only significant differences between men under and over 80 were for TG and Apo-B—lower—and HDL-C—higher—in the over-80 group. With regard to the under- and over-80 women, the only significant difference was in the LDL-C, which was lower in the over-80 group.

When we compared the lipid-constituent values between the under- and over-80 groups in both sexes (Table 3) the two significant differences seen were those between men and women in the over-80 group, with respect to HDL-C—higher— and TG—lower—in men.

Discussion

The cholesterol concentration in serum increases progressively with age in the adult, reaching its maximum at about 60 years (16, 17), then gradually decreasing. We found a mean value for total cholesterol of 1.94 g/L in men older than 65, which is lower than that for our population of 40- to

1 Nonstandard abbreviations: TC, total cholesterol; HDL-C, high-density-lipoprotein cholesterol; LDL-C, low-density-lipoprotein cholesterol; TG, triglycerides; Apo-A, apoprotein A; and Apo-B, apoprotein B.
### Table 1. Summary of Data on Lipids (g/L) in the Elderly

<table>
<thead>
<tr>
<th></th>
<th>Total Cholesterol</th>
<th>HDL Cholesterol</th>
<th>LDL Cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>n</td>
<td>134</td>
<td>48</td>
<td>86</td>
</tr>
<tr>
<td>x</td>
<td>2.00</td>
<td>1.94</td>
<td>2.04</td>
</tr>
<tr>
<td>SD</td>
<td>0.34</td>
<td>0.32</td>
<td>0.35</td>
</tr>
<tr>
<td>Range</td>
<td>1.32-2.68</td>
<td>1.30-2.57</td>
<td>1.34-2.73</td>
</tr>
</tbody>
</table>

### Table 2. Percentiles for Lipid Data (g/L) on 145 Old People, 50 Men and 95 Women

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Total Cholesterol</th>
<th>HDL Cholesterol</th>
<th>LDL Cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>2.5th</td>
<td>1.40</td>
<td>1.30</td>
<td>1.40</td>
</tr>
<tr>
<td>10th</td>
<td>1.58</td>
<td>1.47</td>
<td>1.59</td>
</tr>
<tr>
<td>50th</td>
<td>2.00</td>
<td>1.98</td>
<td>2.03</td>
</tr>
<tr>
<td>90th</td>
<td>2.49</td>
<td>2.33</td>
<td>2.51</td>
</tr>
<tr>
<td>97.5th</td>
<td>2.85</td>
<td>2.65</td>
<td>2.66</td>
</tr>
</tbody>
</table>

### Table 3. Mean Values for Plasma Lipids (g/L) of 145 Persons, Ages 65–95 Years

<table>
<thead>
<tr>
<th>Sex</th>
<th>Total Chol.</th>
<th>HDL-C</th>
<th>LDL-C</th>
<th>TG</th>
<th>Apo-A</th>
<th>Apo-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;80</td>
<td>2.01 (0.34)*</td>
<td>0.51</td>
<td>0.39</td>
<td>1.27</td>
<td>2.20</td>
<td>0.85</td>
</tr>
<tr>
<td>&gt;80</td>
<td>1.83 (0.26)</td>
<td>0.59</td>
<td>0.39</td>
<td>1.08</td>
<td>2.03</td>
<td>0.50</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;80</td>
<td>2.09 (0.31)</td>
<td>0.50</td>
<td>0.38</td>
<td>1.35</td>
<td>2.16</td>
<td>0.79</td>
</tr>
<tr>
<td>&gt;80</td>
<td>1.96 (0.39)</td>
<td>0.50</td>
<td>0.39</td>
<td>1.14</td>
<td>2.04</td>
<td>0.70</td>
</tr>
</tbody>
</table>

*Numbers in parentheses are SD. *p < 0.05 for sex-related difference. *p < 0.05 for age-related difference.

60-year-olds (2.07 g/L). For women, on the other hand, the mean value for total cholesterol for the group under study was 2.04 g/L, slightly higher than that of our 40- to 60-year-old female population (1.96 g/L).

In general, our values are lower than those reported for English (4), American (8, 12, 17, 18), and Israeli (15) subjects of similar age, and the difference is greater for women. However, our results compare well with those reported for a Russian group (11).

We show no significant sex-related differences in any of the plasma lipids in this group of old people before further categorization.

There are very few reported studies on HDL-C in the elderly in spite of recent theories about its protective role in coronary heart disease (26) and the association of high values with longevity (14, 17). Nor has any specific analysis of the relationship between HDL-C values and advancing age been undertaken, either in the huge cooperative study on epidemiology of HDL-C, carried out by the Lipid Research Clinics Program (28) or in another important work sponsored by the American Health Foundation on optimal concentrations of plasma lipids (29). The mean HDL-C concentration of 540 mg/L that we found for men is similar to that obtained for an American population, while the 500 mg/L we obtained for the women over 65 is lower, as were the values for TC (17, 18). However, we did not find the significant sex-related differences reported by these authors.

A decrease in LDL-C from 65 years onwards has been reported (17, 18), which seems to be responsible for the parallel decrease in TC. Our study confirms this decrease with age, and it is more noticeable in women, which is probably related to the lower incidence of coronary heart disease in women than in men. The mean value of 1.24 g/L for LDL-C in our study population compares well with reported values for the American population (17, 18), whereas the values we obtained for TG are lower (8, 18).

The apoproteins are now considered to be better discrimi-nants of coronary heart disease than are the other plasma lipids (30, 36), particularly in the 60- to 80-year-old group (33, 37). Mean total Apo-A in our population over 65 was
2.12 g/L, a figure similar to that previously reported (38), although this comparison is not absolutely valid because of the smallness of the group studied in that work and also because of the lack of data in it with regard to age. Apo-A is about 67% Apo-A I (39, 40), so our mean values for Apo-A I can be calculated as 1.42 g/L, a figure that agrees with that originally reported for Apo-A I in relation to sex and age (40), although again the comparison is limited both by the number of people studied (four) and the age range (all were 60 to 65 years old). With regard to Apo-B, we found a mean value of 750 mg/L for both sexes, a value clearly lower than 1.05 g/L reported (31) for a 60- to 69-year-old group.

Storage of serum below -20 °C does not affect the immunoreactivity of Apo-A I (40). With regard to Apo-B, we excluded the possible effect of freezing on its immunoreactivity by using a frozen pooled serum to check the precision and found no significant changes in its concentration during six months.

We think that the study of populations of old people is of great interest because it deals with a selected group of people, those who have thus far escaped the major cause of death in the last decades of life. For example, this study shows that within the elderly there is a significantly different group, men over 80 years of age. In this group, the mean values for TC (as previously reported: 15), LDL-C, TG, and Apo-B are lower than those for the rest of our study population. On the other hand, the HDL-C concentration is markedly higher. Taken together, these data suggest a greater “protection” against cardiovascular disease in this group of octogenarians, a supposition that is in harmony with results obtained in the longevity syndromes (14, 27) in which high values for HDL-C are a frequent finding.

References


