Distribution of Apolipoproteins in Normal Individuals of Various Age Groups

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SUMMARY
The study comprised normal controls with 10 males and 10 females in each decade of age starting from birth till >70 years of age and also 20 cord blood samples (10 males and 10 females). In normal controls there was a progressive increase in the levels of total cholesterol and triglycerides in both men and women with age. Women had significantly lower levels of Tc and TG as compared to men until 40 years of age. Beyond this age levels of Tc were similar to those in men. HDL-c was lower in girls below 10 years of age compared to boys. Above 10 years of age women had significantly higher levels of HDL-c. Apo A-I and A-II levels were also significantly higher in women compared to men.

Additional Indexing Words:
Total cholesterol (Tc) Triglycerides (TG) HDL cholesterol (HDL-c) Apoprotein A-I (Apo A-I) Apoprotein A-II (Apo A-II)

VARIOUS studies have implicated altered levels of plasma lipoproteins in the pathogenesis of atherosclerosis.1,2) In particular, diminished levels of high density lipoprotein cholesterol and increased levels of low-density lipoprotein cholesterol are strong risk factors for the development of atherosclerosis.3,4)

Recent interest has focused on the protein moiety of lipoproteins as a discriminating factor between patients with coronary heart disease (CHD) and healthy individuals. Specifically, low concentrations of serum apo A-I and apo A-II and elevated concentrations of apo B have been reported in survivors of myocardial infarction.5–8)

The present study was undertaken to quantitate the levels of total cholesterol, HDL cholesterol triglycerides, apo A-I, and apo A-II in normal...
controls of different age groups. Since no such study is available in this part of the continent, this will help establish baseline parameters for further studies in coronary heart disease (CHD).

**Materials and Methods**

Twenty samples (10 males and 10 females) each were collected from individuals in different age groups. The groups were: cord blood samples, 0 to 10 years, 11 to 20 years, 21 to 30 years, 31 to 40 years, 41 to 50 years, 51 to 60 years, 61 to 70 years and >70 years.

The criteria for normal included physical examination of the cardiovascular system, measurement of blood pressure (BP) and 12-lead electrocardiogram (ECG) for all individuals. For those above 60 years besides BP and ECG, ocular fundus was also examined. Cord blood was taken from mothers who had no history of hypertension, diabetes mellitus or any other metabolic disorders.

Total cholesterol, HDL-cholesterol and triglycerides were estimated by standard methods. Apo A-I and A-II were prepared from HDL isolated from normal donors by precipitation. Delipidation of the resultant supernate was carried out using ethanol: diethyl ether. Precipitates obtained were then subjected to Sephadex G-200 gel chromatography and DEAE-cellulose column chromatography. The purity of each apoprotein isolated was checked by SDS-polyacrylamide gel electrophoresis. Antibodies against apo A-I and apo A-II were raised in rabbits. The specificity of each antiserum was tested by immunodiffusion and immunoelectrophoresis. Apo A-I and A-II in whole serum were determined by radial immunodiffusion. Standard apo A-I and A-II were obtained from Boehringer Mannheim (West Germany) to check the purity of apo A-I and A-II purified in our laboratory. Statistical analysis of the results was carried out using the Student’s t-test.

**Results**

Table I shows levels of lipids and lipoproteins in normal controls. In the 0 to 10 years age group the levels of total cholesterol, triglycerides, apo A-I and A-II were significantly higher (p<0.05) in girls compared to boys, whereas the levels of HDL-cholesterol were lower (p<0.05) in girls. The levels of total HDL-cholesterol, triglycerides, apo A-I and A-II were significantly higher in females compared to males in the 11 to 40 years age group. A significant increase was observed in the levels of total cholesterol and tri-
### Table I. Normal Individuals

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Total chol mg%</th>
<th>HDL chol mg%</th>
<th>Triglycerides mg%</th>
<th>Apo A-I mg%</th>
<th>Apo A-II mg%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 yrs</td>
<td>178 ± 5.2</td>
<td>53 ± 2.6</td>
<td>94 ± 6.8</td>
<td>134 ± 2.9</td>
<td>28.4 ± 2.5</td>
</tr>
<tr>
<td>F</td>
<td>163 ± 4.3</td>
<td>47 ± 3.2</td>
<td>82 ± 4.3</td>
<td>142 ± 3.4</td>
<td>34.8 ± 2.1</td>
</tr>
<tr>
<td>11-20 yrs</td>
<td>189 ± 6.4 a</td>
<td>48 ± 4.2a</td>
<td>110 ± 7.3a</td>
<td>146.8 ± 4.1a</td>
<td>30.8 ± 2.4</td>
</tr>
<tr>
<td>F</td>
<td>175 ± 5.9a</td>
<td>52.6 ± 3.8a</td>
<td>96 ± 3.8a</td>
<td>154.8 ± 3.7a</td>
<td>34.6 ± 2.9</td>
</tr>
<tr>
<td>21-30 yrs</td>
<td>212.6 ± 6.8ab</td>
<td>49 ± 5.3a</td>
<td>114 ± 5.9a</td>
<td>147.6 ± 3.2a</td>
<td>30.4 ± 3.1</td>
</tr>
<tr>
<td>F</td>
<td>198 ± 6.2a</td>
<td>53.8 ± 6.3a</td>
<td>98 ± 3.8a</td>
<td>154.8 ± 1.9</td>
<td>34.8 ± 1.9</td>
</tr>
<tr>
<td>31-40 yrs</td>
<td>244 ± 8.1abc</td>
<td>52 ± 3.9b</td>
<td>135 ± 7.5abc</td>
<td>149 ± 5.5a</td>
<td>30.6 ± 5.2</td>
</tr>
<tr>
<td>F</td>
<td>219 ± 8.4a</td>
<td>60.6 ± 4.1abc</td>
<td>109 ± 9.1abc</td>
<td>159.8 ± 4.1a</td>
<td>37.7 ± 5.5</td>
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<td>41-50 yrs</td>
<td>232 ± 12.9a</td>
<td>50 ± 4.6</td>
<td>130 ± 6.5abc</td>
<td>150 ± 4.9a</td>
<td>31.2 ± 2.3</td>
</tr>
<tr>
<td>F</td>
<td>224 ± 6.8abcd</td>
<td>60.4 ± 4.6</td>
<td>110 ± 6.3a</td>
<td>160.4 ± 5.2a</td>
<td>38.8 ± 5.9</td>
</tr>
<tr>
<td>51-60 yrs</td>
<td>220 ± 8.2abcde</td>
<td>51.6 ± 3.1b</td>
<td>121 ± 8.3abcde</td>
<td>148.2 ± 3.2a</td>
<td>28 ± 3.1</td>
</tr>
<tr>
<td>F</td>
<td>211 ± 4.6a</td>
<td>58 ± 3.8abc</td>
<td>104 ± 7.6ab</td>
<td>157.9 ± 5.4a</td>
<td>34.2 ± 2.9</td>
</tr>
<tr>
<td>61-70 yrs</td>
<td>205 ± 8.4abcde</td>
<td>46 ± 4.2a</td>
<td>118 ± 6.4abcde</td>
<td>144 ± 4.8a</td>
<td>26 ± 2.9</td>
</tr>
<tr>
<td>F</td>
<td>196 ± 8.6a</td>
<td>55.6 ± 3.1ad</td>
<td>104 ± 4.6ab</td>
<td>152.6 ± 3.1a</td>
<td>31.4 ± 1.4</td>
</tr>
<tr>
<td>&gt;70 yrs</td>
<td>190 ± 6.4abcde</td>
<td>48 ± 4.1a</td>
<td>102 ± 4.6abcde</td>
<td>128 ± 5.9abc</td>
<td>26.4 ± 1.9</td>
</tr>
<tr>
<td>F</td>
<td>182 ± 4.2a</td>
<td>52 ± 2.8ade</td>
<td>91 ± 7.2ab</td>
<td>138 ± 5.1abc</td>
<td>30.2 ± 2.1</td>
</tr>
</tbody>
</table>

Each value is mean ± SD.

Symbols a, b, c, d, e, f, and g denote level of significance, i.e., p<0.05 as compared to age groups 0-10, 11-20, 21-30, 31-40, 41-50, 51-60, 61-70 years, respectively.

Glycerides in both males and females from 0 to 40 years of age. No such trend was seen in the levels of HDL-cholesterol, apo A-I and apo A-II. Beyond 40 years of age the levels of total cholesterol were more or less similar in males and females whereas the levels of triglycerides were significantly lower in females as compared to males. The levels of HDL-cholesterol, apo A-I and apo A-II were significantly higher (p<0.05) in females from 41 to >70 years of age.

In subjects more than 70 years of age the levels of total cholesterol, HDL-cholesterol, triglycerides, apo A-I and A-II were significantly lower (p<0.05) in both males and females as compared to the age groups between
Table II. Cord Blood Samples

<table>
<thead>
<tr>
<th></th>
<th>Total chol mg%</th>
<th>HDL chol mg%</th>
<th>Triglycerides mg%</th>
<th>Apo A-I mg%</th>
<th>Apo A-II mg%</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=10 M Cord blood</td>
<td>90±21</td>
<td>38±14</td>
<td>40±16.8</td>
<td>96.4±1.9</td>
<td>27.4±1.0</td>
</tr>
<tr>
<td>n=10 F Cord blood</td>
<td>88±24.3</td>
<td>39±14.2</td>
<td>38±17.8</td>
<td>97.8±2.2</td>
<td>27.8±1.4</td>
</tr>
</tbody>
</table>

Each value is mean±SD.

21 to 60 years.

In cord blood samples (Table II) HDL-cholesterol represented the main lipoprotein fraction in both males and females. There were no significant differences in the levels of total cholesterol, HDL-cholesterol, triglycerides, apo A-I and A-II between males and females.

**DISCUSSION**

The serum concentrations of total cholesterol and triglycerides increased progressively in both men and women with age. Mean values for both total cholesterol and triglycerides reached a peak between the decade of 41 to 50 years of age in men. Women had significantly lower levels of cholesterol and triglycerides as compared to men until 40 years of age. There was a slight increase in the levels of total cholesterol and triglycerides after the age of 40 years in women, with total cholesterol reaching almost similar levels as those seen in men in older age groups. Although levels of HDL-cholesterol were lower in females between 0 and 10 years, beyond 10 years of age, females always had significantly higher levels of HDL-cholesterol as compared to men. Bodurtha et al\(^{17}\) in their study on HDL-cholesterol levels in 11 year old twin pairs reported lower levels of HDL-cholesterol in girls as compared to boys.

The reports from the Lipid Research Clinics program prevalence study\(^{18}\) also emphasized the occurrence of increased levels of total cholesterol and triglycerides with age in both sexes. They reported higher values in cholesterol levels for women than for men above the age of 50 years. Also, they reported higher levels of HDL-cholesterol in women than in men.

The values for apo A-I and apo A-II were higher for women than for men in all age groups. Studies by Gomo\(^{19}\) also revealed significantly higher levels of apo A-I and HDL-cholesterol in women as compared to men.

Leitersdorf et al\(^{20}\) also reported lower apo A-I and apo A-II levels in males as compared to females in a normal population. In cord blood samples the concentrations of lipids and lipoproteins are low as compared to
adult levels. HDL represents the main lipoprotein class in this group. The lipid and lipoprotein profiles of cord blood samples in our study group are comparable to those reported by McConathy and Lane (1980) and Rovamo et al. (22)

References

19. Gomo ZAR: Concentrations of lipids, lipoproteins and apolipoproteins in serum of Zim-

