Importance of Cholesterol Screening in Saudi Arabia

S. Inam, M. Cumberbatch, R. Judzewitsch


To establish the prevalence of hypercholesterolaemia in the Saudi population, 8291 patients (4179 males, 4112 females), attending the Riyadh Armed Forces Hospital, were screened for serum total cholesterol concentration (STCC). The age range was 0-90 years. The STCC was > 5.2 mmol/l in 37.9%, > 6.5 mmol/l in 11% and > 7.5 mmol/l in 3.6% of the population studied. The mean STCC in mmol/l for females: 5.08 (SD 1.34) was significantly higher (p = 0.04) than for males: 4.84 (SD 1.26). The values for females were higher in all age groups except in the 4th decade. Three hundred patients were identified as having STCC > 7.5 mmol/l. Thus screening for STCC is clearly indicated in Saudi Arabia. The health care system needs to plan for dealing with this major health problem, as the number of patients requiring therapy will overwhelm the currently available resources.

The incidence of coronary artery disease (CAD) is rapidly increasing in Saudi Arabia, judged by admissions for CAD in the past ten years to all major hospitals. Raised serum cholesterol concentration as a major risk factor for coronary artery disease is well established.1-3 Major health care measures are being undertaken to counteract this risk, including public education, routine screening, dietary advice and pharmacological intervention.4-7

Total serum cholesterol concentration varies considerably between populations.3,8,9 The contribution of hypercholesterolaemia as a risk factor for CAD in the Saudi population is not known. The aim of this study was to determine the prevalence of elevated serum total cholesterol concentration (STCC) in a Saudi population, to see if routine screening is warranted and assess its impact on hospital practice.

Materials and Methods

Since STCC is not significantly affected by timing in relation to meals11 we screened prospectively routine blood samples of patients attending the Riyadh Armed Forces Hospital for various reasons. Serum from blood samples sent to the laboratory during the 3 months from October to December 1988 for routine analysis on the multi-channel biochemical analyser (Parallel Analytical System) were assayed for STCC. Since severe illness alters cholesterol levels an attempt was made to make the sample more representative of the general population, by excluding patients in the intensive care, coronary care and the renal units.
The population consisted of both in-patients and out-patients with the majority falling in the latter group. The majority of out-patients were attending the large Family and Community Medicine clinics attached to the hospital. Where more than one sample was sent from a patient only the first STCC value was included in the subsequent statistical analysis. Serum cholesterol concentration was measured on the Parallel® Analytical System (American Monitor Corporation) photometrically using an enzymatic method which utilizes cholesterol oxidase (Enzymatic Cholesterol ST, American Monitor Corporation, Indianapolis, Indiana, USA). All samples were centrifuged immediately on arrival at the laboratory, the sera stored at 4°C and analysed in duplicate within 24 h. The intra- and inter-assay coefficients of variation respectively at 3.6 mmol/l were 2% and 3% and at 5.8 mmol/l were 1.5% and 2%.

An objective assessment of assay accuracy and precision was available through the laboratory’s participation in the Wellcome Diagnostics Clinical Chemistry Quality Assessment Programme, UK. The results of controls during the study period were not significantly different compared with 1326 laboratories, across a range of 3.4–7.5 mmol/l.

**Statistical analysis**

The mean STCC values for males and females at different decades, were compared using two-tailed t-tests and a two-way analysis of variance using a statistical package, viz. STATGRAPHICS version 3.0 (Statistical Graphics Corporation, Rockville, USA).

**Results**

The population sample comprised 8291 patients, 4179 males and 4112 females. The age range was 0–90 years. The population was divided into age groups by decades. The numbers in each age group are shown in Table 1. The distribution among sexes for each decade was similar except after age 60 years, when there were fewer females (453 vs 731).

The mean STCC for the whole population was 4.96; that for females was higher than that for males (Table 1).

The mean STCC for the population studied increased progressively until the age of 50 when it reached a mean of 5.43 mmol/l. There was a plateau between ages 50 and 80 followed by a drop (Table 1).

The frequency histograms for the two sexes are shown in Fig. 1. In males the 5th centile for STCC was 3.01 mmol/l, 50th centile 4.74 mmol/l and the 95th centile 6.97 mmol/l. In females the 5th centile was 3.26 mmol/l, 50th centile 4.92 mmol/l and the 95th centile 7.44 mmol/l.

The STCC values for males and females in the various age groups is shown in Table 1 and Fig. 2. By the analysis of variance females showed a higher cholesterol than males (p < 0.001). The difference in mean cholesterol concentration at different decades was also significant (p < 0.001).

At birth the mean STCC in males (n = 22) was 3.01 vs 3.12 in females (n = 23). After birth there was a rise in STCC up to the age of 12 years in both sexes, following which there was a fall until the age of 16 years. In females there was a progressive increase until the age of 35 years followed by a plateau and a second sharp increase at age 45 years (Figs 2 and 4). This increase was maintained until the age of 80 years, followed by a drop. In males there was a tendency for the STCC to fall until the age of 20 years. Following this there was a progressive rise which was sharper than for females of similar ages, so that males equalled females by the age of 40 years. There was then little change until the age of 70 years, after which there was a fall (Figs 2 and 3).

**Discussion**

Although this is a hospital-based population study it is unique in Saudi Arabia because of its large number of observations. In a previous study13 of healthy normal male volunteers in the oasis area of Al-Kharj, 80 km south of Riyadh the mean STCC was 4.23 (SD 0.97) mmol/l. There were 953 males and over 56% were below the age of 30 years. Our population was much larger with a wider age distribution and only 33% of the males were below

### Table 1

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>0–10</td>
<td>240</td>
<td>3.97 ± 1.40</td>
</tr>
<tr>
<td>11–20</td>
<td>266</td>
<td>3.91 ± 0.99</td>
</tr>
<tr>
<td>21–30</td>
<td>887</td>
<td>4.37 ± 0.97</td>
</tr>
<tr>
<td>31–40</td>
<td>791</td>
<td>5.08 ± 1.11</td>
</tr>
<tr>
<td>41–50</td>
<td>637</td>
<td>5.19 ± 1.23</td>
</tr>
<tr>
<td>51–60</td>
<td>627</td>
<td>5.30 ± 1.25</td>
</tr>
<tr>
<td>61–70</td>
<td>440</td>
<td>5.20 ± 1.29</td>
</tr>
<tr>
<td>71–80</td>
<td>193</td>
<td>5.02 ± 1.39</td>
</tr>
<tr>
<td>&gt;80</td>
<td>98</td>
<td>4.63 ± 1.21</td>
</tr>
</tbody>
</table>

Total        | 4179 | 4.84 ± 1.26 | 4112 | 5.08 ± 1.34 | 0.04 |

*Two-tailed t tests.
NS: not significant.
the age of 30 years. A comparable age group extracted from our current study gave a mean STCC of 4.27 (SD 0.99) which is similar to the value in the Al-Kharj study. In another study of 578 healthy male university students aged 20–29 years, the mean STCC was 4.48 (SD 0.75). This too suggests that our population is likely to be representative of the male population at large.

In a study of 226 healthy Saudi female university students aged 20–29 years the mean STCC was 4.41 (SD 0.5) mmol/l. In 1105 observations in the same age group our mean STCC was 4.8 (SD 1.2) mmol/l. Although the large numbers should have

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Figure 1. Frequency distributions of serum total cholesterol concentration in both sexes.

Figure 2. Comparison of mean serum total cholesterol concentration (mmol/l) as a function of age in both sexes.
eliminated any bias, this difference may have resulted from a higher prevalence of obesity and diabetes in our population. Furthermore some of the women in our study may have been pregnant.

Comparing the mean STCC of our total population to that reported from other countries\textsuperscript{12} the mean values fall in between those of Greece (4.53) and Italy (5.17). These are much lower than those of the USA (5.83) and East Finland (6.48). Since STCC varies with age, a meaningful comparison between populations is only possible if similar age groups are compared. Table 2 compares our population aged 40–64 years with that of some other countries.

In contrast to the data from USA and Britain,\textsuperscript{15–18} the STCC values in Saudi females were higher than for Saudi males in all age groups except in the 4th decade. In the other countries values for females were lower compared with males at age 12 and between ages 25 and 50 years.
Table 2
Comparison of mean cholesterol for age 40–64 years in various countries and age-standardized CAD death rate

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean cholesterol (mmol/l)</th>
<th>Age-standardized CAD death rate/100 000 standard population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>Japan</td>
<td>4.8</td>
<td>5.2</td>
</tr>
<tr>
<td>Greece–Corfu</td>
<td>5.12</td>
<td></td>
</tr>
<tr>
<td>Greece–Crete</td>
<td>5.27</td>
<td></td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>5.25</td>
<td>5.49</td>
</tr>
<tr>
<td>Italy</td>
<td>5.85</td>
<td>5.89</td>
</tr>
<tr>
<td>USA</td>
<td>5.88</td>
<td>5.83</td>
</tr>
<tr>
<td>France</td>
<td>5.89</td>
<td>6.31</td>
</tr>
<tr>
<td>England</td>
<td>6.38</td>
<td>7.29</td>
</tr>
<tr>
<td>Finland</td>
<td>7.03</td>
<td></td>
</tr>
</tbody>
</table>

CAD: Coronary artery disease
aStandardized to Europe
bApplies to Greece
Derived from Simmons,9 Keys et al.,1 WHO Statistics Annual.22

Figures 3 and 4 compare our population aged 12–50 years with that in the USA. The values are lower in the Saudis compared with their US counterparts. The overall trend in STCC with age, however, is similar in both populations. The Saudi males continued to drop their STCC until age 20 years, in contrast to males in the USA who showed an increase after the age of 15 years. In Saudi females there was a progressive increase after the age of 15 years which was steeper than that seen in the US population. The earlier and steeper ascent of STCC in Saudi females compared with male compatriots resulted in higher levels for this sex. This difference may be accounted for by a higher prevalence of factors known to elevate STCC such as obesity19 and diet12 among Saudi females.

There are no wide population-based statistics available on the prevalence of obesity in this country. In a study20 looking at obesity in 467 females aged 15–49 years in the eastern province of Saudi Arabia 54% of the women were above a BMI (body mass index) of 25 kg/m² and 27% had a BMI of >30 kg/m². In a diabetic population21 at our hospital over a 6-month period 86% of females were >10% above ideal body weight (IBW) and 48% were >30% above IBW. In contrast 52% of males were >10% IBW and 13% were >30% IBW. Although the latter study21 was in diabetics it does indicate the relative proportion of obesity in females compared with males in the Saudi population. It must be pointed out that until recently obesity has been a status symbol and especially liked in females.

Based on dietary interviews with patients and their visitors at our hospital (Andrea Gibbon, pers. comm.), on average the present Saudi diet derives 40% of its calories from fat of which >60% is saturated. Carbohydrates account for 40–45% and protein 15–20% of the caloric intake. The contribution of diet and especially saturated fats in elevating STCC is well established.7,12

It is interesting to note that after the age of 60 years there were fewer females (453 vs 731) than males. In the age group >70 years there were 151 females and 291 males. The meaning of this observation remains unclear; it could suggest a lower survival in females. Although this may be a result of the sample bias it is intriguing considering that there appears to be a higher prevalence of factors known to increase CAD-related mortality (including diabetes and obesity22) in this sex.

The mortality figures for CAD in the kingdom are not known. However, based on WHO statistics23 in the sister country of Kuwait (which is culturally and socially similar) CAD age-standardized death rate/100 000 of a standard population (standardized to Europe) was 149 in 1982. This is much higher than that of Japan (49.2), France (75.8), Greece (81.6), Italy (129.2) and lower than that of USA (249.7) and Finland (277.3), Table 2. As a cause of death, definitive CAD age-specific death rate/100 000 population was 30.1 whereas its closest contenders were malignancies (34.2) and motor vehicle accidents (34.3), highlighting CAD as amongst the three leading causes of death in the adult population. It remains to be established whether the figures in this kingdom are similar.

If one believes that an STCC exceeding 5.2 mmol/l requires intervention, the implications of this study for hospital practice in Saudi Arabia are dramatic. In our sample over a 3-month period, 37.9% of the population had an STCC >5.2 mmol/l, a value considered as the upper permissible limit by some epidemiological studies;4–6 11% of the population had values above 6.5 mmol/l (a value for definitive intervention irrespective of other risk factors), and
3.6% had a value >7.5 mmol/l. Over a 3-month period 300 patients were identified with an STCC of >7.5 mmol/l in whom intervention is of very high priority. This indicates a major potential impact on the hospital practice and enormous pressure on resources.

The major increase in the prevalence of CAD is substantiated by an ever-increasing number of patients being admitted to coronary care units with CAD and a major increase in the number of CAD-related surgical procedures. Major efforts are required to stem this explosion. Although other modifiable risk factors in the population such as hypertension, smoking, obesity and lack of exercise need full attention, the importance of lowering cholesterol and major modifications in diet cannot be overemphasized. Simultaneous attention to various risk factors may be more beneficial in lowering CAD-related events than attention to a single factor. We have presently embarked on a study looking at various risk factors in the Saudi population.

In conclusion we have shown that the mean STCC for this selected population is in the intermediate risk group compared to other nations. The mean STCC values are higher in females and this difference persists through most age groups. Routine screening for STCC is justified provided intervention techniques prove viable in this environment. Major modifications are required in the local lifestyle to stem the rising prevalence of coronary artery disease and atherosclerosis in general. Major adjustments in Saudi health care are necessary to permit proper assessment of, and attention to, this problem.

Acknowledgements

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References


