High prevalence of cardiovascular risk factors in Gerona, Spain, a province with low myocardial infarction incidence

Rafel Masiá, Araceli Pena, Jaume Marrugat, Joan Sala, Joan Vila, Marco Pavesi, Maribel Covas, Clara Aubó, Roberto Elosoa and the REGICOR Investigators

Abstract

**Study objective**—To establish the prevalence of main cardiovascular risk factors in the province of Gerona, where the incidence of myocardial infarction is known to be low.

**Design**—This was a cross-sectional study of prevalence of cardiovascular risk factors conducted on a large random population sample.

**Setting**—The province of Gerona, Spain.

**Participants**—Two thousand four hundred and four eligible inhabitants of Gerona aged between 25 and 74 years were randomly selected for a multi-stage sample stratified by age and sex. The following were standardly measured: lipids (total cholesterol, high density, low density, lipoprotein (a) and triglycerides), fibrinogen, basal glycaemia, arterial pressure, anthropometric variables, smoking, history of angina (Rose questionnaire), and a medical history questionnaire. Population measurements were standardised for the world population of 24 to 74 years of age.

**Results**—The participation rate was 72.7% (1748). Total mean cholesterol was 5.69 mmol/l in men and 5.61 mmol/l in women and mean high density cholesterol was 1.22 mmol/l and 1.47 mmol/l, respectively. Median lipoprotein (a) was 0.22 g/l. These three lipids increased significantly with age. Mean fibrinogen was 2.92 g/l in men and 3.09 g/l in women, and was higher in smokers. The prevalence of hypertension (systolic arterial tension ≥140 mm Hg or diastolic ≥90 mm Hg or drug treatment) was 31.3% in men and 27.7% in women. The proportion of male smokers was 33.8% and female smokers 22.7%. The proportion of female smokers in the 25–34 year age group exceeded that of the remaining age groups for both men and women.

**Conclusions**—The prevalence of cardiovascular risk factors in Gerona is relatively high for the low myocardial infarction incidence typical of the area, although similar to that of other Spanish areas. The factors that confer sufficient protection to compensate for the effect of the prevalence of these risk factors remain to be elucidated.

(J Epidemiol Community Health 1998;52:707–715)
group included 152,150 men and 151,753 women. Approximately half the population lived in towns of more than 10,000 inhabitants.

In a pilot study it was estimated that the proportion of censal errors, deaths, those temporarily absent or institutionalised was approximately 20%; the 2400 people sample was therefore increased up to 3000 subjects to replace non-eligible candidates. The study was conducted between September 1994 and January 1996.

Thirty three towns were randomly selected in the first phase of the study. Eight of these, considered urban, had more than 10,000 inhabitants and comprised half of the total sample. The remainder were towns of between 500 and 10,000 inhabitants, considered rural. Selected people were notified in their own towns by a letter informing them of the aims of the study. The tests to be performed were also described and participants were requested to attend the health examination in a fasting state of at least 14 hours; a telephone number for inquiries was supplied. If the participants had a phone, they were contacted one week before the examination to confirm their attendance.

Examinations were performed by a physician, two nurses, and two auxiliaries who went to all the participating towns in teams composed of the physician (always the same), a nurse, and an auxiliary.

REGISTERED VARIABLES

Anthropometric measurements
A precision scale of easy calibration was used for weight measurement. Participants wore underwear. Height was also measured. Body mass index (BMI) was determined as weight divided by squared height (kg/m²). Standardised measures of waist and hip perimeter were performed. The quotient between both measurements constitutes the waist/hip index.

Measurement of the tricipital skin fold of both arms was taken with three consecutive measurements in each arm. The arithmetic mean of the three determinations was used for the analysis.

Electrocardiogram
A standard 12-lead electrocardiogram recording was obtained for each participant. Minnesotta code was applied to assess the result. The proportion of participants with definite (codes 1.1.1 to 1.1.7) or possible (codes 1.2.1 to 1.2.8) AMI is presented.

Blood pressure
Blood pressure (BP) determination was made using a periodically calibrated mercury sphygmomanometer. The operator followed a certification process in the standardised measurement technique at central laboratory and all determinations were always made by the same person. A cuff adapted to upper arm perimeter (young, adult, obese) was selected for each participant. Measurements were performed after a five minute rest. Two measurements were taken: the interval between the first and second was at least 20 minutes. The value used was the arithmetic mean of both determinations.

Laboratory analyses
Total cholesterol, high density lipoprotein cholesterol (c-HDL), triglycerides, low density lipoprotein cholesterol (c-LDL), lipoprotein (a) (Lp(a)), basal glycaemia and fibrinogen were analysed.

Extractions were made after a 14 hour fast without venous compression (or less 60 seconds duration when strictly necessary) using a syringe with a holder and vacuum tubes with separating gel. Extraction with citrate was also made for fibrinogen analysis. Samples were centrifuged between 30 and 60 minutes after extraction and the serum samples immediately frozen at −120°C in liquid nitrogen, and transported within seven days to a refrigerator set at −80°C for definitive conservation. Analyses were performed at an interval of three to four months after extraction in groups of 600 samples.

Total cholesterol and triglycerides concentrations were determined enzymatically (Roche Diagnostica, Basel, Switzerland). c-HDL was measured as cholesterol after precipitation of apoprotein B containing lipoproteins with phosphotungstic-Mg⁺⁺⁺⁺ (Boehringer Mannheim, Mannheim, Germany). Serum Lp(a) was determined by an immunoturbidimetric method (Immuno Lp(a), Immuno Diagnostica, Vienna, Austria). Analyses were performed in an Cobas Mira Plus (Roche Diagnostica, Basel Switzerland). Plasma fibrinogen concentration was determined by a coagulometric method in a coagulometric autoanalyser (Toe Medical Electronics Co, LTD, Kobe, Japan). External quality assessment was performed with External Quality Assessment-WHO Lipid Program (World Health Organisation, Prague, Czech Republic) and Monitrol-Quality Control Program (Baxter Diagnostics, Dudingen, Switzerland). Interassay coefficients of variation were 2.5%, 4.5%, and 3.2% for total cholesterol, HDL cholesterol, and triglycerides, respectively. In Lp(a) concentrations of 0.26 g/l, 0.70 g/l, and 1.22 g/l, respectively were used. c-LDL was calculated by the Friedewald equation.

QUESTIONNAIRES

Demographic characteristics, personal history of diabetes mellitus (DM) and ICD were recorded by inquiry.

Hypertension questionnaire
The hypertension questionnaire of the MONICA-WHO study was used, in which participants were asked whether any healthcare personnel had informed them that their BP was high and whether they had taken any control medication in the previous two weeks. From these data and the BP found during the examination, the participants were classified as: I, controlled hypertension: SBT <160 and DBT <95 mm Hg in those with drug treatment; II, non-controlled hypertension: SBT ≥160 and/or DBT ≥95 mm Hg in those with drug treatment;
III, observed hypertension: SBT $\geq 160$ and/or DBT $\geq 95$ mm Hg in those not treated; IV, normotensive: SBT $<160$ and DBT $<95$ mm Hg in those not treated; V, real hypertension: I + II + III.

On the other hand, with the aim of facilitating comparability of hypertension rates with more modern criteria, those recently published by the Joint National Committee on detection, evaluation and treatment of high blood pressure were used. The categories are the same as those not treated; V, real hypertension: I + II + III.

Smoking questionnaire
The questionnaire applied in the study consisted of eight questions regarding current and past cigarette consumption including daily amount.

Angina questionnaire
The World Health Organisation (WHO) recommends the use of Rose’s WHO Questionnaire to determine the prevalence of angina in epidemiological studies. This questionnaire was administered by trained interviewers. Participants were classified as having definite angina, possible angina, non-exertional chest pain, and no chest pain.

Leisure time physical activity assessment
The Minnesota leisure time physical activity questionnaire was used to assess the amount of leisure time physical activity performed during the previous year. This questionnaire has been validated for use among Spanish men. The questionnaire was administered by a trained interviewer.

ETHICAL ASPECTS
All participants were duly informed and consented to be entered in a computer database and cede their biological samples for the necessary analyses. The study design was approved by an ethics committee and the results sent to participants.

STATISTICAL ANALYSIS
To facilitate comparisons between local and international communities studies, prevalence results of each risk factor are presented by sexes in each 10 year age group for the 25 to 74 year interval, weighed according to the age distribution of the origin population and standardised by the world population in the 25–74 and 35–64 year intervals. Continuous variables are presented as mean and standard deviation and categories as proportions.

In the case of Lp(a), which follows a distribution that clearly departs from normal, data are described using the median and minimum and maximum values.

The Mantel-Haenszel $\chi^2$ test was used to assess the linear trend of the prevalence of different risk factors in the defined age and sex groups.

Pearson’s correlation coefficient was used to assess the strength of the association between each couple of continuous variables (for example, age and total cholesterol).

The Student $t$ test or one way analysis of variance were used to compare means of continuous variables between two or more categories (sex or age groups), respectively.

Results
Of the 3000 subjects selected, 596 (19.9%) were not eligible because of errors in census data in 379 (63.6%), 97 (16.3%) were institutionalised, 83 (13.9%) were temporally absent, and 40 (6.7%) had died before the study was conducted. The final sample was therefore composed of 2404 eligible subjects, of whom 1748 (72.7%) agreed to participate in the study: 839 (48%) were men and 909 (52%) women.

The mean temperature during the examinations was 21.5°C (standard deviation (SD) 1.18) and 99.5% of examinations were performed between 0800 and 1200. There were no statistically significant differences in the number of examinations among the days of the week; 20.8% were performed in spring, 18.1% in summer, 35.4% in autumn, and 25.7% in winter.

LIPIDS
Total cholesterol had been measured in 63.3% of subjects in the previous year. Table 1 shows the distribution of lipids by ages and standardised by the world population.

Total cholesterol, LDL-c, and triglycerides increased significantly with age in women ($r=0.40$, $r=0.37$, $r=0.34$ respectively), and also in men ($r=0.13$, $r=0.14$, $r=0.09$ respectively). However, in men, a significant decrease in total cholesterol and LDL-c was observed in the 65–74 year decade compared with the previous age group.

No differences between sexes in total cholesterol were observed. The mean LDL-c was significantly higher in men between 25 to 44 years, similar between 45 to 64, and higher in women between 65 to 74 years. Mean triglycerides were higher in men than in women in all age groups (table 1).

Levels of c-HDL scarcely changed with age either in men and women. In the latter, HDL-c levels were higher than those of men, regardless of age (table 1).

A slight increase in Lp(a) with age was observed in both sexes. This correlation was more marked in women ($r=0.20$, $p<0.001$) than in men ($r=0.11$, $p=0.002$) (table 1).

FIBRINOGEN
Fibrinogen concentrations increase with age in men ($r=0.35$, $p<0.001$). They decreased in women from the 25 to 34 to the 35 to 44 age group but later increase again ($r=0.29$, $p<0.001$). Values were somewhat higher in women than in men, although differences were not statistically significant between sexes in any age group (table 1).

BLOOD PRESSURE
The adult sleeve was used on 89.5%, the youth sleeve on 6.9%, and the obese on 3.6% of occasions.
Table 1  Mean (SD) by 10 year age groups of total cholesterol (mmol/l), HDL cholesterol (mmol/l), LDL cholesterol (mmol/l), triglycerides (mmol/l), lipoprotein (a) (Lp(a)) (g/l), and fibrinogen (g/l). Study of cardiovascular risk factor prevalence in Gerona, Spain 1995

<table>
<thead>
<tr>
<th></th>
<th>25–34 (n=130)</th>
<th>35–44 (n=160)</th>
<th>45–54 (n=183)</th>
<th>55–64 (n=170)</th>
<th>65–74 (n=170)</th>
<th>Population mean 25–74 (n=802)</th>
<th>Standardised mean 25–74 (n=802)</th>
<th>Standardised mean 35–64 (n=502)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol</td>
<td>5.09 (0.93)</td>
<td>5.95 (1.11)</td>
<td>5.95 (1.16)</td>
<td>6.10 (1.03)</td>
<td>5.66 (1.00)</td>
<td>5.72 (0.41)</td>
<td>5.69</td>
<td>5.97</td>
</tr>
<tr>
<td>HDL cholesterol</td>
<td>1.19 (0.34)</td>
<td>1.22 (0.36)</td>
<td>1.22 (0.36)</td>
<td>1.27 (0.36)</td>
<td>1.19 (0.34)</td>
<td>1.22 (0.31)</td>
<td>1.22</td>
<td>1.24</td>
</tr>
<tr>
<td>LDL cholesterol</td>
<td>3.36 (0.85)</td>
<td>4.03 (1.09)</td>
<td>4.03 (1.01)</td>
<td>4.24 (0.98)</td>
<td>3.90 (0.93)</td>
<td>3.88 (0.34)</td>
<td>3.88</td>
<td>4.09</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>1.47 (2.05)</td>
<td>1.46 (1.03)</td>
<td>1.54 (1.14)</td>
<td>1.39 (0.80)</td>
<td>1.31 (0.59)</td>
<td>1.45 (0.09)</td>
<td>1.46</td>
<td>1.47</td>
</tr>
<tr>
<td>Lp(a)†</td>
<td>0.18 (0.03–1.90)</td>
<td>0.20 (0.03–2.00)</td>
<td>0.20 (0.03–1.60)</td>
<td>0.24 (0.03–2.10)</td>
<td>0.27 (0.03–2.10)</td>
<td>0.22 (0.03–2.10)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>2.67 (0.55)</td>
<td>2.78 (0.60)</td>
<td>3.01 (0.99)</td>
<td>3.14 (0.65)</td>
<td>3.38 (0.77)</td>
<td>2.96 (0.28)</td>
<td>2.93</td>
<td>2.96</td>
</tr>
</tbody>
</table>

*Standardised by the world population. †Median (minimum, maximum) of distributions.

The standardised real hypertension prevalence for the world population was 27.7% in women from 25 to 74 years and 31.3% in men of the same age when participants with SBP ≥140 mm Hg or DBP ≥90 mm Hg or those who had received antihypertensive therapy in the previous two weeks were considered to be hypertensive (table 2). Only in 4.5% of women and 3.5% of men was this hypertension controlled. Drug treatment had been received in the previous two weeks by 15.3% of women and 37.6% of men; of these, BP was controlled in only 11.2% and 35.8%, respectively (table 2).

The standardised prevalence in the 35 to 64 age group, considering the WHO-Monica criteria for hypertension (SBP values ≥160 mm Hg or DBP ≥95 mm or receiving antihypertensive therapy), was 15.6% in women and

Table 2  Prevalence of arterial hypertension by 10 year age groups according to criteria of the Joint National Committee of the United States 1993. Study of cardiovascular risk factor prevalence in Gerona, Spain 1995. Data shown as percentages

<table>
<thead>
<tr>
<th></th>
<th>25–34 (n=133)</th>
<th>35–44 (n=162)</th>
<th>45–54 (n=170)</th>
<th>55–64 (n=193)</th>
<th>65–74 (n=171)</th>
<th>Population prevalence 25–74 (n=839)</th>
<th>Standardised prevalence 25–74 (n=839)</th>
<th>Standardised prevalence 35–64 (n=523)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed hypertension (1)</td>
<td>9.2</td>
<td>18.5</td>
<td>38.0</td>
<td>49.3</td>
<td>63.9</td>
<td>38.3</td>
<td>29.7</td>
<td>33.4</td>
</tr>
<tr>
<td>Real hypertension (2)</td>
<td>9.5</td>
<td>18.5</td>
<td>38.8</td>
<td>53.6</td>
<td>70.4</td>
<td>41.1</td>
<td>31.3</td>
<td>34.8</td>
</tr>
<tr>
<td>Treated hypertension (3)</td>
<td>2.9</td>
<td>2.9</td>
<td>21.3</td>
<td>31.6</td>
<td>40.5</td>
<td>29.9</td>
<td>15.3</td>
<td>16.8</td>
</tr>
<tr>
<td>Controlled hypertension (4)</td>
<td>2.9</td>
<td>0.0</td>
<td>2.0</td>
<td>8.2</td>
<td>9.5</td>
<td>6.9</td>
<td>3.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Treated and controlled hypertension (5)</td>
<td>100</td>
<td>0.0</td>
<td>7.7</td>
<td>24.1</td>
<td>22.4</td>
<td>23.5</td>
<td>39.8</td>
<td>9.0</td>
</tr>
</tbody>
</table>

*Standardised by the world population. SBP = systolic blood pressure; DBP = diastolic blood pressure. (1) SBP ≥140 or DBP ≥90; (2) SBP ≥140 or DBP ≥90 and/or drug treatment; (3) Percentage of hypertensives receiving treatment; (4) SBP <140 and/or DBP <90 in those drug treated among real hypertensives; (5) SBP <140 and/or <90 compared with treated hypertensives.

Table 3  Mean (SD) by 10 year age groups of blood pressure (mm Hg), systolic, diastolic, and glycaemia (mmol/l). Study of cardiovascular risk factors prevalence in Gerona, Spain 1995

<table>
<thead>
<tr>
<th></th>
<th>25–34 (n=133)</th>
<th>35–44 (n=162)</th>
<th>45–54 (n=170)</th>
<th>55–64 (n=193)</th>
<th>65–74 (n=171)</th>
<th>Population mean 25–74 (n=839)</th>
<th>Standardised mean 25–74 (n=839)</th>
<th>Standardised mean 35–64 (n=523)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean SBP</td>
<td>121 (12.3)</td>
<td>122 (12.3)</td>
<td>133 (18.9)</td>
<td>141 (39.4)</td>
<td>146 (18.5)</td>
<td>131 (11.3)</td>
<td>129</td>
<td>131</td>
</tr>
<tr>
<td>Mean DBP</td>
<td>72 (8.9)</td>
<td>77 (10.2)</td>
<td>81 (11.8)</td>
<td>81 (10.1)</td>
<td>80 (9.8)</td>
<td>78 (11.2)</td>
<td>78</td>
<td>80</td>
</tr>
<tr>
<td>Glycaemia</td>
<td>5.41 (1.16)</td>
<td>5.64 (0.87)</td>
<td>5.80 (1.09)</td>
<td>6.30 (1.91)</td>
<td>6.19 (1.72)</td>
<td>5.80 (0.40)</td>
<td>5.75</td>
<td>5.86</td>
</tr>
</tbody>
</table>

*Standardised by the world population. Abbreviations as for table 2.
15.7% in men. The hypertension was controlled in 15.9% of men and 59.5% of women.

BP levels increased with age in both men and women (p<0.001) (table 3). Both SBP and DBP values were significantly higher in men than in women, except in the last two age decades studied (55–64 and 65–74 years) (table 3). It is important to note that 79.7% of subjects interviewed stated that their BP had been controlled at least once in the previous year.

DIABETES

Of the interviewees, 9.4% of men and 6.8% of women stated that they had been diagnosed of diabetes and were receiving corresponding dietetic, drug treatment or both at that time; in all, 3.9% were taking oral antidiabetic medication and 1.3% were on injected insulin. Table 3 shows glycaemia distribution by age and sex.

SMOKING

Smoking prevalence of one or more cigarettes per day, standardised for the world population, was 33.8% in men and 22.7% in women in all the age groups studied. The female smoker rate was 33.8% in men and 22.7% in women in all age groups studied. The female smoker rate was 33.8% in men and 22.7% in women in all age groups studied. The female smoker rate was 33.8% in men and 22.7% in women in all age groups studied. The female smoker rate was 33.8% in men and 22.7% in women in all age groups studied.

Table 5 shows angina prevalence rates by sex and age groups. A total of 74 participants had definite or possible AMI were found in 33 participants (1.8%): 21 men (2.6%) and 12 women (1.4%).

ANGINA PREVALENCE

Table 6 shows angina prevalence rates by sex and age groups. A total of 74 participants had definite or possible AMI were found in 33 participants (1.8%): 21 men (2.6%) and 12 women (1.4%).

*Standardised by the world population.
†Cigarettes/day: mean (SD).
‡Ex-smokers of more than one year.

Table 4

Prevalence of smoking by 10 year age groups. Study of cardiovascular risk factor prevalence in Gerona, Spain 1995

<table>
<thead>
<tr>
<th></th>
<th>25–34 (n=133)</th>
<th>35–44 (n=162)</th>
<th>45–54 (n=170)</th>
<th>55–64 (n=193)</th>
<th>65–74 (n=181)</th>
<th>Population prevalence 25–74 (n=839)</th>
<th>Standardised prevalence 25–74 (n=839)</th>
<th>Standardised prevalence 25–74 (n=525)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smokers (%)</td>
<td>39.1</td>
<td>45.1</td>
<td>30.5</td>
<td>23.7</td>
<td>15.3</td>
<td>29.57</td>
<td>33.8</td>
<td>34.4</td>
</tr>
<tr>
<td>Maximum consumption in current smokers†</td>
<td>27 (15)</td>
<td>24 (15)</td>
<td>22 (13)</td>
<td>30 (16)</td>
<td>23 (16)</td>
<td>25 (2)</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>Ex-smokers (%)‡</td>
<td>37.3</td>
<td>39.9</td>
<td>48.8</td>
<td>59.2</td>
<td>57.1</td>
<td>50.6</td>
<td>45.9</td>
<td>48.0</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smokers (%)</td>
<td>48.6</td>
<td>30.0</td>
<td>8.6</td>
<td>4.7</td>
<td>1.3</td>
<td>17.0</td>
<td>22.7</td>
<td>15.9</td>
</tr>
<tr>
<td>Maximum consumption in current smokers†</td>
<td>16.9</td>
<td>20 (13)</td>
<td>14 (8)</td>
<td>15 (6)</td>
<td>16 (10)</td>
<td>17 (2)</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Ex-smokers (%)‡</td>
<td>22.7</td>
<td>17.4</td>
<td>4.1</td>
<td>1.7</td>
<td>2.6</td>
<td>7.4</td>
<td>11.9</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Table 5

Mean (SD) of anthropometric measurements and daily energy expenditure in leisure time physical activity by 10 year age groups. Study of cardiovascular risk factor prevalence in Gerona, Spain 1995

<table>
<thead>
<tr>
<th></th>
<th>25–34 (n=133)</th>
<th>35–44 (n=162)</th>
<th>45–54 (n=170)</th>
<th>55–64 (n=193)</th>
<th>65–74 (n=181)</th>
<th>Population mean 25–74 (n=839)</th>
<th>Standardised mean 25–74 (n=839)</th>
<th>Standardised mean 25–74 (n=525)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>25 (3)</td>
<td>26 (3)</td>
<td>27 (3)</td>
<td>27 (5)</td>
<td>27 (4)</td>
<td>26 (1)</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Right tricipital skinfold (mm)</td>
<td>10 (5)</td>
<td>10 (5)</td>
<td>11 (6)</td>
<td>11 (6)</td>
<td>9 (4)</td>
<td>10 (1)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Left tricipital skinfold (mm)</td>
<td>10 (5)</td>
<td>10 (5)</td>
<td>11 (6)</td>
<td>11 (6)</td>
<td>9 (4)</td>
<td>10 (1)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Arm perimeter (cm)</td>
<td>30 (2)</td>
<td>30 (2)</td>
<td>31 (3)</td>
<td>30 (3)</td>
<td>29 (3)</td>
<td>30 (1)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Waist/hip ratio</td>
<td>0.87 (0.07)</td>
<td>0.90 (0.07)</td>
<td>0.93 (0.07)</td>
<td>0.94 (0.07)</td>
<td>0.96 (0.07)</td>
<td>0.91 (0.03)</td>
<td>0.91</td>
<td>0.92</td>
</tr>
<tr>
<td>Physical activity (kcal/d)</td>
<td>325.3 (264.3)</td>
<td>328.4 (337.9)</td>
<td>271.4 (303.3)</td>
<td>398.7 (402.2)</td>
<td>400.3 (336.0)</td>
<td>345.0 (333.5)</td>
<td>333.7</td>
<td>326.7</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>23 (3)</td>
<td>25 (8)</td>
<td>27 (4)</td>
<td>28 (5)</td>
<td>28 (5)</td>
<td>26 (2)</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Right tricipital skinfold (mm)</td>
<td>16 (6)</td>
<td>19 (7)</td>
<td>19 (7)</td>
<td>20 (8)</td>
<td>19 (7)</td>
<td>18 (1)</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Left tricipital skinfold (mm)</td>
<td>16 (7)</td>
<td>29 (3)</td>
<td>20 (7)</td>
<td>20 (8)</td>
<td>19 (7)</td>
<td>19 (1)</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Arm perimeter (cm)</td>
<td>28 (4)</td>
<td>28 (4)</td>
<td>30 (3)</td>
<td>30 (3)</td>
<td>29 (3)</td>
<td>29 (1)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Waist/hip ratio</td>
<td>0.78 (0.09)</td>
<td>0.80 (0.07)</td>
<td>0.82 (0.08)</td>
<td>0.85 (0.08)</td>
<td>0.87 (0.07)</td>
<td>0.81 (0.03)</td>
<td>0.81</td>
<td>0.82</td>
</tr>
<tr>
<td>Physical activity (kcal/d)</td>
<td>212.8 (183.6)</td>
<td>261.1 (398.5)</td>
<td>181.3 (191.7)</td>
<td>194.9 (197.6)</td>
<td>207.2 (221.8)</td>
<td>211.5 (238.6)</td>
<td>214.0</td>
<td>215.7</td>
</tr>
</tbody>
</table>

*Standardised by the world population.
definite and 29 possible angina. Angina prevalence also increased steeply with age. Standardised prevalence rates of definite angina were 2.6% in men and 3.4% in women aged 25–74 years. When definite or possible angina was considered, these rates ranged from 4.2% in men to 4.0% in women.

### LEISURE TIME PHYSICAL ACTIVITY

Leisure time physical activity was greater in men than in women (table 5). In men, physical activity tended to decrease with age between 25 and 55 years, an increase in physical activity was observed thereafter. In women, a slight decrease in physical activity was observed with age.

### FAMILY HISTORY OF ISCHAEMIC CORONARY DISEASE

A family history of ICD was observed in 16.5% of participants, with no statistically significant differences between sexes (15.1% in men and 17.7% in women).

### Discussion

Over 40 years ago, researchers of the Framingham study\textsuperscript{16} coined the term CRF and related its presence to the incidence and mortality of ICD.\textsuperscript{17} Later clinical trials on the role of these factors showed that they could be modified\textsuperscript{18,19} and that such modifications resulted in a decrease in morbidity and mortality of ICD.\textsuperscript{20} This evidence and the low efficiency on the public health level of the preventive approach of “high risk” necessitate the study of the prevalence of CRFs in wide geographical areas to organise the preventive methods provided on a populational scale.

A study conducted in a Spanish working population assessed the relation between coronary risk factors and the incidence at 20 years of ICD and observed that both hypercholesterolaemia ($\geq$6.47 mmol/l) and systolic hypertension ($\geq$160 mm Hg), smoking and hyperglycaemia ($>66.96$ mmol/l) were associated with a greater risk of myocardial infarction.\textsuperscript{21} In our environment, the results of this study confirm the high prevalence of some classic CRF already observed in other studies conducted in Spain a few years ago.\textsuperscript{3–5}

#### Table 6  Prevalence of angina pectoris by 10 year age groups. Study of cardiovascular risk factor prevalence in Gerona, 1995. Data shown as percentages

<table>
<thead>
<tr>
<th></th>
<th>25–34 (n=113)</th>
<th>35–44 (n=162)</th>
<th>45–54 (n=170)</th>
<th>55–64 (n=193)</th>
<th>65–74 (n=181)</th>
<th>Population prevalence 25–74 (n=839)</th>
<th>Standardised prevalence* 25–74 (n=839)</th>
<th>Standardised prevalence* 35–64 (n=525)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite angina</td>
<td>1.3</td>
<td>1.8</td>
<td>1.6</td>
<td>4.5</td>
<td>6.9</td>
<td>3.0</td>
<td>2.6</td>
<td>2.5</td>
</tr>
<tr>
<td>Possible angina</td>
<td>0</td>
<td>0</td>
<td>0.9</td>
<td>4.3</td>
<td>7.2</td>
<td>2.1</td>
<td>1.6</td>
<td>1.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>25–34 (n=149)</th>
<th>35–44 (n=179)</th>
<th>45–54 (n=190)</th>
<th>55–64 (n=217)</th>
<th>65–74 (n=166)</th>
<th>Population prevalence 25–74 (n=869)</th>
<th>Standardised prevalence* 25–74 (n=869)</th>
<th>Standardised prevalence* 35–64 (n=594)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite angina</td>
<td>0</td>
<td>1.3</td>
<td>3.7</td>
<td>5.9</td>
<td>13.4</td>
<td>3.9</td>
<td>3.4</td>
<td>3.3</td>
</tr>
<tr>
<td>Possible angina</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
<td>3.3</td>
<td>0.7</td>
<td>0.6</td>
<td>0.4</td>
</tr>
</tbody>
</table>

*Standardised by the world population.

#### Figure 1  Distribution of total cholesterol. Study of cardiovascular risk factors in Gerona, Spain 1995.

**KEY POINTS**

- Despite low incidence and death rates of myocardial infarction, Gerona, Spain, has a relatively high cardiovascular risk factor prevalence.
- Physical activity might confer part of the protection that compensates the prevalence observed.
- The factors that protect for coronary heart disease, such as the interaction between environmental, particularly diet and physical activity, and genetic characteristics of the population, remain to be elucidated.
Cardiovascular risk factors in Gerona

HYPERTENSION, LIPIDS, FIBRINOGEN, AND SMOKING

The high prevalence of BP could be attributable to the recent modification of limits for the definition of BP (SBT ≥140 mm Hg, DBT ≥90). At the time of carrying out the field work, the Joint National Committee on detection, evaluation and treatment of high blood pressure had just been published, and therefore the majority of primary health care centres were probably applying the previous criterion (SBT ≥160, DBT ≥95). The low prevalence of BP treatment and control could be attributed, at least in part, to the same causes. When the old criterion are applied, results coincide with those of most Spanish studies, although they are higher than those of the MONICA Catalunya conducted in 1986 in the Barcelona area. BP levels both in men and women increase with age, which had already been established by previous studies.

The high prevalence of hypercholesterolaemia is noteworthy (approximately 68% of men and 67% of women of 25–74 years present total cholesterol concentrations above 5.17 mmol/l) (fig 1). Despite the hormone changes in the perimenopausal periods in women (45–54 years), no different patterns were observed in the distribution of total cholesterol means in men and women in these age groups. Total cholesterol was similar to that obtained in Spain although all these comparisons should be made with caution as the studies were conducted at different times and there were differences in laboratory methods.

HDL cholesterol concentration was high compared with other international studies but somewhat lower than that obtained in Castilla la Mancha.

An increase with age was observed for Lp(a), which despite being significant, cannot be considered clinically relevant. This finding concurs with that of other authors, although its biological interpretation is complicated based on current knowledge.

An increase with age was also observed in the case of fibrinogen. However, the decrease in women of 35–44 compared with those of 25 to 34 should be emphasised. This could be attributed to smoking in the younger age group, a fact that has been observed in other studies but somewhat lower than that obtained in Castilla la Mancha.

An increase with age was also observed in the case of fibrinogen. However, the decrease in women of 35–44 compared with those of 25 to 34 should be emphasised. This could be attributed to smoking in the younger age group, a fact that has been observed in other studies but somewhat lower than that obtained in Castilla la Mancha.

An increase with age was also observed in the case of fibrinogen. However, the decrease in women of 35–44 compared with those of 25 to 34 should be emphasised. This could be attributed to smoking in the younger age group, a fact that has been observed in other studies but somewhat lower than that obtained in Castilla la Mancha.

ANGINA AND MYOCARDIAL INFARCTION

As corresponds to a low incidence area, a prevalence of angina lower than in Iceland, Finland and similar to Italy was observed. Similarly, the proportion of participants with a definite or possible AMI was also low. Interestingly, women showed a greater prevalence of definite angina than men, which concurs with most studies. An explanation for this fact, as suggested by some authors, may be related to the different patterns of coronary heart disease manifestations between sexes: myocardial infarction and sudden death is more likely in men, while angina pectoris in women is more frequently uncomplicated.

OVERWEIGHT

Overweight and BMI distribution follow a pattern that can practically be superimposed on all the Spanish studies conducted. Marked obesity (BMI >30) implies a high risk of a coronary event independently of the other variables in southern Europe, and appears in 18.8% of all men and women in the present study (24–74 years).

Given that the material required for early detection and diagnosis is accessible from any field in primary health care, knowledge and control of overweight should be one of the main objectives of intervention. The mean of arm skin fold estimations increases with age in women, which may indicate that the increase in their BMI seems to be at the expense of adipose tissue.

HIGH PREVALENCE OF CRF AND LOW AMI INCIDENCE

It is important to point out that the high prevalence of CRF in our population contrasts with the low incidence of AMI (cumulated incidence per 100 000 inhabitants, standardised for age, in the 25–74 age group 207.5 in men and 48.5 in women). If the results obtained in our population are compared with those of international studies conducted in populations with higher AMI incidence and death rates than those of the area presented here it can be seen that, by age groups and sex, the total cholesterol, arterial pressure, smoking, and obesity in Gerona are lower than those of Nord-Karelia, Finland (fig 2). They are, however, higher than those of Minnesota, USA, where the AMI cumulated incidence in recent years was 915 per 100 000 inhabitants in men and 165 in women (five and four times higher than ours, respectively), and 613 per 100 000 inhabitants in men and 203 in women (three and four times higher than ours), respectively. Physical activity was somewhat higher in Gerona (table 5) than in Minnesota (298 kcal/day in men and 186 kcal/day in women aged 25 to 74) and might explain a small part of the different AMI incidence favouring Spain.

However, to account for this paradox, the fact that we are in a latency period between an increase in CRF and the rise in incidence and death rates by ICD cannot be ruled out although it seems unlikely in light of the absence of any age cohort effect demonstrated in the different age groups in Spain. Furthermore, in the Manresa study, 20 years ago a relatively high prevalence of risk factors was observed that should be reflected in a higher incidence or mortality from ICD at present than observed after this follow up. Finally, the trends in ICD death rates have been decreasing since 1976.
The “French paradox” (that is, apparent compatibility of a high fat diet with a low incidence of coronary atherosclerosis) could be extended to the paradoxical coexistence of high CRF prevalence and low AMI incidence and death rates found in our Southern Europe Mediterranean area. Besides dietary factors (wine, vegetable, and fruit consumption have been claimed to be in part responsible for the French paradox), another explanation is that unconsidered or unknown factors exist in populations of this European area that may produce greater resistance to the physiopathological mechanisms of arteriosclerosis. It is reasonable to direct future research towards the study of protective factors such as diet, physical activity or their interaction with genetic characteristics of the population.

**STUDY CHARACTERISTICS**

It is important to emphasise the high participation of the study population (72.7%). The results obtained are, therefore, representative of the area under study (Gerona) although, bearing in mind the possible variability among autonomous communities, generalisation of these data regarding the rest of Spain should be made with caution. However, results of other surveys conducted in Spain suggest that
minimal differences are to be expected among Spanish regions.

Standardised methods when available, were used for measurements, and results presented in such a form for easy comparison with other international studies.

CLINICAL AND PUBLIC HEALTH IMPLICATIONS

The prevalence of classic CRF in Gerona is relatively high. Despite the known low incidence and death rates of AMI in that area, it seems reasonable to promote measures for their control according to current recommendations. On the other hand, this paradoxical situation offers new opportunities for exploring the existence of unknown or unmeasured factors that might be protecting the Gerona population (and maybe other Southern European Mediterranean regions) from ICD. In light of comparative results, and apart from dietary habits that have been previously suggested, physical activity is a promising candidate factor to be analysed in detail. Furthermore, the interaction between genetic characteristics and environment should not be disregarded either. Deeper insight into these issues in international comparative studies may provide information relevant to ICD prevention and control.

The authors appreciate the English revision made by Ms. Christine O'Hara and are grateful to Josep Maria Manresa and Oriol Codina for their collaboration in statistical analyses and to Montserrat Capdevila, Isabel Cateura, Isabel Sole, Angeles Garrido, Jordi Capdevila, Montserrat Fauria, Nuria Puig, Gemma Hidalgo, and Cristina Costa for field work. We thank the administrative and health personnel from community health centres, hospitals, and town halls of the following cities for their cooperation: Agullana, Amer, Arbucies, Blanes, Calonge, Castell-Platja d’Aro, Castellóllit de la Roca, Figueres, Girona, Salt, Vilassar de Mar, Mont-ras, Olot, El-Arguèlles, Ptojoveses, Banjols, Roldells de la Sella, Roses, Sant Feliu de Guixols, Sant Feliu de Pallerols, La Vall d’ en Bas, Sant Feliu de Buxadé, Hostalric, Santa Cristina d’ Aro, Verges, Vilademuls, Basca, Llanca, Oix, Bescanó, Llagostera, Montagut, Cassa de la Selva, Selva, Cellera de Ter, Sant Pere Pescador, Olot, and Les Planes d’Hostoles.

REGICOR Investigators: C Ponsati, M Vicente, F Monzón (Hospital Comarcal de Figueres); J Bobe, P Cortés, A Agustí, M Barcons (Hospital Comarcal Sant Jaume d’Olot); N Constans, R Massa, M Vendrell (Hospital Comarcal de La Selva); P Bassó, A Masabre, J M Inorza (Hospital Comarcal de Palamós); C Martínez (Servei d’ Emergències Mèdiques); C Guerra (Hospital Comarcal de Santa Caterina); N Albert, R Massa, J Sala, L Gavaldà (Hospital Josep Trueta de Girona); C Aubó, M Bosch, M Cardona, O Codina, M I Covas, R Eloua, M Gil, J M Manresa, J Marreugat, S Marin, P Parex, A Pena, C Pérez, P Roset, M Senti, J Vila (Institut Municipal d’Investigació Mèdica).

Funding: the present work was funded by grant FIS 94/0539 from the Fondo de Investigación Sanitaria and supported by grant CIRIT 1995/SGR/00167. The present work was funded by grant FIS 94/0539 from the Fondo de Investigación Sanitaria and supported by grant CIRIT 1995/SGR/00167. The present work was funded by grant CIRIT 1995/SGR/00167.

10 Joint National Committee on detection, evaluation and treatment of high blood pressure. The fifth report of the Joint National Committee on detection, evaluation and treatment of high blood pressure (JNC V). Arch Intern Med 1993;153:154–83.
High prevalence of cardiovascular risk factors in Gerona, Spain, a province with low myocardial infarction incidence. REGICOR Investigators.

R Masiá, A Pena, J Marrugat, J Sala, J Vila, M Pavesi, M Covas, C Aubó and R Elosua

J Epidemiol Community Health 1998 52: 707-715
doi: 10.1136/jech.52.11.707