Eur J Nutr (2004) 43 : 77–85
DOI 10.1007/s00394-004-0443-9

ORIGINAL CONTRIBUTION

Helmut Schröder
Izabella Rohlfs
Eva Maria Schmelz
Jaume Marrugat
for the REGICOR investigators*

Relationship of socioeconomic status with cardiovascular risk factors and lifestyle in a Mediterranean population

* The REGICOR Investigators are: Covas MI, Elosua R, Fitó M, Gil M, Manresa JM, Marrugat J, Martín S, Masiá R, Pena A, Pérez G, Ramió I, Rohlfs I, Roset P, Sala J, Sentí M, and Vila J.

Summary *Background* Socioeconomic status greatly affects cardiovascular risk factors and lifestyle. *Aim of the study* To analyse the relationship between socioeconomic status and both cardiovascular risk factors and behavioural variables. *Methods* The present random sample of 838 men and 910 women of the 25 to 74 year old general population of Gerona according to the 1991 census, included cardiovascular risk factor measurements (total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, glycaemia, systolic blood pressure, diastolic blood pressure, body mass index, waist to hip ratio, and waist circumferences) and evaluation of dietary habits, alcohol consumption, smoking, and leisure-time physical activity with corresponding questionnaires. *Results* In this study, we used lifestyle factors (leisure-time physical activity, tobacco consumption, and alcohol drinking habits) in addition to dietary habits to determine whether changes in these factors correlate with the socioeconomic status, classified as degree of educational level, in a representative Spanish Mediterranean population. Multiple linear regression analysis adjusted for several confounders revealed a direct association of LDL-cholesterol ($p = 0.03$) and body mass index ($p = 0.02$) with low levels of educational status in men and women, respectively. A higher educational status was directly ($p = 0.04$) related to the smoking status in women. The two composite dietary scores, indicating overall dietary quality and cardiovascular protecting properties, were not associated with low socioeconomic status in our population. *Conclusion* Dietary habits, alcohol drinking, and leisure-time physical activity seems not to be affected by educational status in either gender. This finding might partially explain the relationship between cardiovascular risk factors and socioeconomic status in our population. The importance of cultural values in the rural area of the Spanish province seems to be the stronger factor compared with education.

Key words educational level – SES – cardiovascular risk factors – lifestyle – nutrient intake – Mediterranean diet

Received: 26 March 2003
Accepted: 10 July 2003
Published online: 6 January 2004

H. Schröder (✉) · J. Marrugat
Lipids and Cardiovascular Epidemiology Unit
Institut Municipal d'Investigació Mèdica, IMIM
c/Doctor Aiguader 80
08003 Barcelona, Spain
E-Mail: hschroeder@imim.es

H. Schröder
Sports Medicine Barcelona
Dept. of Nutrition
Barcelona, Spain

I. Rohlfs
Cardiology Unit
Hospital Universitari Josep Trueta
Gerona, Spain

E. M. Schmelz
Karmanos Center Institute
Wayne State School of Medicine
Detroit, USA

Introduction

Scientific evidence suggests that there are inequalities in the health status of the population as a result of their socioeconomic status [1–3]. Although a causal relationship between socioeconomic status and health is assumed, the mechanisms are still largely unclear. However, behavioural factors such as dietary habits, physical activity, and tobacco and alcohol consumption seem to play important roles. A strong and consistent relationship between socioeconomic status and risk factors has

EJN 443

European Journal of Nutrition (2004) Vol. 43, Number 2

been found for the level of education [4] and it has also been shown that education may be the most important single predictor for lifestyle [5, 6].

One of the major challenges of health policy is the reduction of the incidence of cardiovascular disease. In many industrialised countries, inverse associations between socioeconomic status and almost all cardiovascular risk factors has been observed [7]. Tobacco smoking, excessive alcohol drinking, low physical activity, and unhealthy eating habits were directly associated with an increased risk of coronary heart disease (CHD). Moreover, these behavioural factors were also inversely related to socioeconomic status [4, 8, 9].

There is general consensus in considering unhealthy diets a key factor in the progression of coronary heart disease [10–12]. Recent studies suggested that there are differences in the daily intake of micro- and macronutrients among groups of different socioeconomic status in the United States and North Europe. Less educated people have higher intakes of total and saturated fat and consume lower amounts of fibre and vitamins with antioxidant activity [13–16]. These dietary habits may contribute to a higher CHD mortality [17]. Several scientific studies concluded that the Mediterranean diet is an important factor for the low incidence and mortality of CHD found in this region [18].

Lifestyle factors like leisure-time physical activity, smoking, alcohol drinking, and dietary habits may mediate the association between socioeconomic status and cardiovascular risk factors. However, there are few available data on leisure-time physical activity, smoking, and dietary- and alcohol drinking habits, and cardiovascular risk factors among different groups of socioeconomic status, determined in the same population. Therefore, the aim of the present study was to investigate the relationship of socioeconomic status, characterised by educational level, with cardiovascular risk factors and behavioural variables in a representative population of the Mediterranean region.

Subjects and methods

Subjects

Non-institutionalised Spanish men and women between the ages of 25 and 74 participated in a cross-sectional population-based study conducted in the province of Gerona from September 1994 to January 1996. The Gerona province is located at the Northeast of the Catalonia region and has one of the highest standards of living in Spain. This region is characterised by its predominantly rural population. Details of the survey methods have been previously described [19]. In brief, 3,000 subjects were randomly selected from the general population of Gerona, according to the 1991 census. After excluding census errors, 2,404 eligible subjects remained: 1,748 (72.7 %) agreed to participate. Information of dietary intake was available from 1577 subjects. The protocol of the study was approved by the Ethics Committee of the Institut Municipal d'Investigació Mèdica, and all subjects gave written informed consent before entering in the study.

Methods

The sampling was stratified according to the years of schooling. Maximum level of education attained was elicited and for analysis purpose recorded as less than primary school (illiterate and less than 8 years of schooling), primary school (8 years of schooling), secondary school (9 to 12 years of schooling), and more than secondary school (more than 12 years of schooling) (Table 1). Information on education was missing from 48 subjects. All interviews and physical examinations were conducted by trained medical personnel.

Blood samples were obtained after a 14-hour fast. Serum was immediately frozen at –120 °C in liquid nitrogen for transportation and stored at –80 °C for final conservation. Total cholesterol and high-density lipoprotein (HDL) cholesterol were analysed by standardised enzymatic methods. Low-density lipoprotein (LDL) cholesterol was calculated by the Friedewald

Table 1 Main characteristics of participants according to educational status

	Less than primary school	Primary school	Secondary school	More than secondary school
Men				
Number of participants	83	144	277	219
Age (years)	59 ± 10	51 ± 14	52 ± 13	45 ± 14
Years of education	< 8	8	9–12	> 12
Women				
Number of participants	116	140	289	231
Age (years)	58 ± 12	49 ± 13	51 ± 13	45 ± 14
Years of education	< 8	8	9–12	> 12

equation. Interassay coefficients of variation were 2.47 %, 4.46 % and 3.20 % for total cholesterol and HDL cholesterol, respectively. External quality assessment was performed with EQA-WHO (World Health Organisation, Prague, Czech Republic).

Blood pressure determination was performed using a periodically calibrated mercury sphygmomanometer. The operator followed a certification process in the measurement technique at central laboratory and all determinations were made by the same person. A cuff adapted to upper arm perimeter (young, adult, obese) was selected for each participant, who was seated with the arm palm upwards and elbow resting on the table. Radial pulse was taken for 30 seconds. Measurements were performed after 5 minutes rest to avoid possible alterations produced by anxiety or the exercise. Systolic blood pressure was recorded at the start of Korotkoff phase I and diastolic at the start of Korotkoff phase V. 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.

A precision scale of easy calibration was used for weight measurement. Readings were rounded to 200 g. Individuals wore underwear. Height was measured in the standing position and measurements rounded to 0.5 cm. Body mass index (BMI) was determined as weight divided by squared height (kg/m^2). Waist perimeter was measured by locating the lower costal rib and the iliac crest, in the narrowest zone, in the supine decubitus and horizontal positions; measurement was taken with a tape measure in centimetres and rounded to 0.5 cm. Waist and hip perimeters were obtained taking the maximum circumferential length of the buttocks in centimetres, with the subject standing, rounded to 0.5 cm. The quotient between both measurements constitutes the waist/hip index.

Leisure-time physical activity was measured by the Minnesota physical leisure-time questionnaire, which has been previously validated for Spanish men and women [20, 21]. An estimation of energy expenditure in total leisure-time physical activity was obtained, also an estimation of energy expenditure in light- to moderate-intensity physical activity (≤ 6 Met) and in high-intensity leisure-time physical activity (≥ 6 Met). One Met corresponds to the energy expenditure during rest, about 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$ or broadly equivalent to 1 $kcal \cdot kg^{-1} \cdot min^{-1}$ in adult subjects [22].

Food intake was reported on a validated 72-h recall questionnaire [23] that was conducted by a trained interviewer. Participants were requested to describe precisely their food and non-alcoholic beverage intake during the previous three days. Each food listed was characterised by a full description of the usual serving size. Energy consumption and nutrient intake were calculated with the software *Diet Analysis Nutritionist IV* (N Squared Computing, San Bruno, CA). The database of this software includes 9,879 food items complemented with items from Spanish food composition tables.

Two *"a priori"* composite dietary scores were created. The first score based on recommended intakes [24, 25] of dietary protein, fibre, folate, vitamin C, vitamin E, riboflavin, niacin, cobalamine, pyridoxine, retinol, thiamine, magnesium, iron, selenium, zinc, copper, saturated fatty acids (expressed in percentage of energy intake), and cholesterol was computed. The score was calculated according to compliance of the dietary recommendations of these dietary variables. Meeting and not meeting the nutrient intake recommendation was coded as 1 and 0, respectively. The resulting score indicates the overall dietary quality and ranged from 0 to 18. The second composite dietary score based on intakes of dietary fibre, folate, vitamin C, β-carotene, vitamin E, saturated fatty acids, cholesterol, and sodium was computed. The score included nutrients associated with cardiovascular disease and was calculated according to the tertile distribution of these dietary variables. Lowest tertile was coded as 0, medium as 1, and highest as 2 for dietary fibre, folate, vitamin C, β-carotene, vitamin E, whereas highest tertile was coded as 0, medium as 1, and lowest as 2 for cholesterol, saturated fatty acids and sodium, respectively. Values of tertile distribution of all dietary components were calculated. The resulting dietary cardiovascular health score ranged from 0 to 16.

Information on smoking and alcohol drinking habits of the participants were obtained by a structured interview. Participants were categorised as people who had never smoked, former smokers, and current smokers. The latter were classified according to the number of cigarettes smoked per day (moderate smokers: less than 20 cigarettes/day; heavy smokers: equal or more than 20 cigarettes/day). Current alcohol intake was recorded separately by asking participants how many glasses of wine, bottles of beer, and drinks or shots of brandy or similar beverages, were consumed during the previous week. Average daily alcohol intake was calculated.

Statistical analysis

Analysis of co-variance (ANOVA) was used to estimate dietary intake, leisure-time physical activity, and tobacco smoking and alcohol drinking habits according to educational level. A *post hoc* Bonferroni correction for multiple comparisons was carried out to determine differences in nutrient intake among groups and between sexes.

Age adjusted linear regression analysis was carried out to evaluate the association of educational status (as the independent variable; 4 = less than primary school, 3 = primary school, 2 = secondary school, and 1 = more than secondary school) with cardiovascular risk factors

European Journal of Nutrition (2004) Vol. 43, Number 2

(as the dependent variables: total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, glycaemia, systolic blood pressure, diastolic blood pressure, body mass index, waist to hip ratio, and waist circumferences) and behavioural variables (as the dependent variables: smoking status, alcohol drinking, leisure-time physical activity, and diet). Multiple linear regression adjusted models were fitted to determine whether the cardiovascular risk factors and behavioural variables were independently related to educational level. For this purpose we adjusted all models including cardiovascular risk factors, for leisure time physical activity (kcal, continuous), smoking (non-smokers, former smokers, moderate smokers, and heavy smokers, categorical), alcohol drinking (in gram, continuous), body mass index (in units, continuous) and diet (diet quality score in units, continuous). Behavioural variables were mutually adjusted in multiple linear regression analysis to determine the independent relationship between educational status and these variables. Analyses of the data were conducted using SPSS for Windows (version 9.0) statistical software package (SPSS Inc, Chicago, IL). In all statistical tests performed P values of < 0.05 were considered significant.

Table 2 Characteristics of the study population by sex. Values are mean (s. d.) or percentage

	Men n = 765	Women n = 812
Age (years)	50.8 ± 13.9	50.2 ± 13.7
BMI (kg/m^2)	26.6 ± 4.1	26.5 ± 4.8
Waist circumferences (cm)	94.8 ± 11.1	85.5 ± 12.4
Waist to hip ratio (unit)	0.92 ± 0.08	0.82 ± 0.08
Total cholesterol (mg/dl)	223.4 ± 43.8	222.6 ± 46.2
LDL cholesterol (mg/dl)	151.9 ± 39.4	146.7 ± 41.5
HDL cholesterol (mg/dl)	47.4 ± 13.9	57.1 ± 14.4
Triglycerides (mg/dl)	125.7 ± 102.6	95.8 ± 49.4
Systolic blood pressure (mm/Hg)	133.2 ± 19.1	129.0 ± 21.2
Diastolic blood pressure (mm/Hg)	79.2 ± 10.8	75.2 ± 12.0
Glycaemia (mg/dl)	79.2 ± 10.8	75.2 ± 12.0
Leisure-time physical activity (MJ)	6.11 ± 5.97	3.65 ± 3.63
Current smoker (%)	34.4	16.0
Cigarettes consumption of current smoker (units/day)	16.9 ± 12.9	13.0 ± 9.2
Current alcohol consumers (%)	78.1	41.3
Alcohol intake of consumers	50.9 ± 40.5	22.5 ± 18.5

All parameters with the exception for age and BMI were statistically significantly different $p < 0.05$ between genders

Results

In Table 1, the main characteristics of participants according to educational status are summarised. Information on the educational status was available from 736 men and 793 women. Most participants attended at least secondary school or more than secondary school. There was no general difference between men and women in the educational level. However, more women than men had less than eight years of education.

Main characteristics of male and female study participants are shown in Table 2. Generally, there were no differences in age or body mass between men and women. Male subjects had higher triglyceride, total cholesterol, LDL cholesterol, glycaemia, systolic blood pressure, diastolic blood pressure, leisure-time physical activity, and lower HDL levels than females (Table 2). They also had higher body mass index, waist to hip ratio and waist circumferences. More men than women consumed alcohol, and the daily alcohol intake was higher in men. The same was seen for smoking habits: significantly more men than women reported tobacco use, and among users, men consumed more than double the number of cigarettes per day than women (Table 2).

Energy consumption and energy adjusted nutrient intake among groups of different educational status are presented in Table 3. There was a significant increase of saturated fatty acid intake, expressed as percentage of energy consumption, and cholesterol in women with increasing educational levels ($p = 0.04$ and $p = 0.02$ for men and women, respectively). A significant increasing and decreasing linear trend of cholesterol and unsaturated fat intake, respectively, across increasing levels of educational status was observed in men (Table 3).

The behavioural variables, physical activity, tobacco smoking and alcohol drinking habits as they relate to the educational levels are shown in Table 4. No differences in these lifestyle factors were observed among subjects of different educational levels. The highest prevalence of tobacco consumption was observed in women with highest educational level, although not statistically significant (Table 4).

Age adjusted linear regression analysis revealed a direct association of educational status with LDL cholesterol in men, and with body mass index, and systolic and diastolic blood pressures in women (Table 5). The relationships between socioeconomic status and LDL cholesterol in men, and body mass index in women remained significant after adjusting for several confounders including lifestyle variables (Table 6). In contrast, statistical significance disappeared for the association of socioeconomic status and blood pressures (Table 6).

Discussion

This study sought to investigate the relationship of socioeconomic status with lifestyle and cardiovascular

Table 3 Average daily energy consumption and selected nutrient (adjusted for energy consumption) intake by gender and educational status

	More than secondary school	Secondary school	Primary school	Less than primary school	P for linear trend
Men					
Energy (MJ)	9.76*	9.42	9.71	8.97	0.02
Carbohydrates (%)[a]	43.1	43.2	42.8	42.5	NS
Protein (%)[a]	21.6	21.7	21.9	21.7	NS
Fat (%)[a]	35.3	35.1	35.3	35.7	NS
Saturated fat (%)[a]	12.0	11.7	11.6	11.7	NS
Unsaturated fat (%)[a]	23.2	23.5	23.8	24.1	0.04
Cholesterol (mg)	444.2	417.9	426.1	403.3	0.02
Fibre (g)	17.6	16.8	17.9	17.0	NS
Thiamine (mg)	2.06	2.03	2.08	1.93	NS
Vitamin C (mg)	154.3	145.9	157.0	156.2	NS
Folate (μg)	276.1	271.2	289.6	286.8	NS
Sodium (mg)	2437	2341	2354	2303	NS
Magnesium (mg)	380.4	378.5	382.5	376.5	NS
Iron (mg)	18.6	18.6	18.5	18.5	NS
Diet quality score (unit)[b]	12.2	12.2	12.6	12.2	NS
Dietary cardiovascular health score (unit)[c]	7.7	7.9	8.3	8.2	NS
Women					
Energy (MJ)	8.9*†	8.39	8.81	8.28	0.03
Carbohydrates (%)[a]	42.2	42.7	42.3	43.0	NS
Protein (%)[a]	22.1	22.3	22.1	21.1	NS
Fat (%)[a]	35.7	35.0	35.6	35.1	NS
Saturated fat (%)[a]	12.3*	12.0	12.0	11.6	0.001
Unsaturated fat (%)[a]	23.3	23.0	23.6	23.6	NS
Cholesterol (mg)	414.3	393.1	407.3	376.1	0.001
Fibre (g)	17.7	17.1	18.2	17.4	NS
Thiamine (mg)	1.74	1.78	1.78	1.72	NS
Vitamin C (mg)	171.8	167.8	172.9	157.2	NS
Folate (μg)	295.4	275.0	295.5	288.8	NS
Sodium (mg)	1956	1949	1956	1905	NS
Magnesium (mg)	363.5	355.1	359.4	348.4	NS
Iron (mg)	16.1	15.8	16.1	15.7	NS
Diet quality score (unit)[b]	13.5	13.3	13.4	13.4	NS
Dietary cardiovascular health score (unit)[c]	8.0	7.8	8.3	8.2	NS

* $p < 0.05$ between more than secondary school and less than primary school
† $p < 0.05$ between more than secondary school and secondary school
[a] Percentage of total energy intake
[b] Composed of recommended intakes of protein, thiamine, riboflavin, pyridoxine, cobalamine, retinol, fibre, vitamin C, vitamin E, folate, magnesium, iron, selenium, zinc, copper, cholesterol, and saturated fatty acids (range: 0–18)
[c] Composed of tertiles of dietary intakes of fibre, vitamin C, vitamin E, folate, and β-carotene, cholesterol, saturated fatty acids, and sodium (range: 0–16)
NS not significant

risk factors. Interestingly, only LDL cholesterol in men and body mass index in women were independently related to lower levels of socioeconomic status in our population. In contrast to findings of previous studies unhealthy dietary habits, low leisure-time physical activity, smoking and high consumption of alcohol were not linked to low socioeconomic status.

In general, socioeconomic status is based on education, occupation and income. It has been shown that educational status usually was the most consistent and reliable measurement in predicting health behaviour [5, 6]. Compared to occupational status and income, educational level has the advantage that it can be applied to all subjects and is less susceptible to economic constraints [6].

Coronary heart disease is a multifactor disease and one of the most serious health concerns in the industrialised world. Several cardiovascular risk factors were related to socioeconomic status that in turn might partially explain the higher incidence, prevalence and cardiovascular mortality in the lower social classes [7, 26, 27]. Surprisingly, and in contrast to findings of previous studies [26, 28], only LDL cholesterol in men, and body mass index and systolic and diastolic blood pressures in women increased statistically significant with lower levels of socioeconomic status. Most importantly,

European Journal of Nutrition (2004) Vol. 43, Number 2

Table 4 Age-adjusted behavioural variables according to educational status

	More than secondary school	Secondary school	Primary school	Less than primary school	P for linear trend
Men					
LTPA (kcal)	352.8	382.4	348.4	304.7	NS
Moderate-intensity LTPA (kcal)	227.8	261.9	252.1	194.0	NS
High-intensity LTPA (kcal)	125.2	119.7	96.3	110.6	NS
Alcohol drinking (%)	78.2	78.1	83.4	72.2	NS
Heavy alcohol drinkers (%)[a]	31.1	37.4	36.9	36.7	NS
Alcohol intake (g/d)	35.6	40.5	40.8	43.2	NS
Alcohol (g/d) intake of consumers	47.6	52.0	49.2	60.1	NS
Smokers (%)	35.5	28.4	35.8	31.1	NS
Alcohol intake (g/d) from wine consumption among non abstainers	38.1	40.1	35.2	49.3	NS
Cigarettes smoked (units/d)	6.7	4.3	6.3	6.6	NS
Cigarettes smoked (units/d) among consumers	17.7	14.9	16.4	22.6	NS
Women					
LTPA (kcal)	197.7	201.8	211.8	216.9	NS
Moderate-intensity LTPA (kcal)	136.4	132.6	146.3	156.6	NS
High-intensity LTPA (kcal)	61.3	69.3	65.5	60.3	NS
Alcohol drinking (%)	45.0	39.5	46.7	36.5	NS
Heavy alcohol drinkers (%)[a]	15.4	11.7	15.0	9.9	NS
Alcohol intake (g/d)	10.0	8.6	11.2	7.5	NS
Alcohol (g/d) intake among consumers	22.1	21.9	23.7	20.4	NS
Smokers (%)	21.7	11.8	17.4	14.0	NS
Alcohol intake (g/d) from wine consumption of alcohol consumers	19.9	19.2	20.8	18.0	NS
Cigarettes smoked (units/d)	3.0	1.6	2.2	1.8	NS
Cigarettes smoked (units/d) among consumers	14.1	11.6	12.6	12.4	NS

[a] alcohol consumption of men > 40 g, alcohol consumption of women > 25 g/d
NS not significant; *LTPA* leisure-time physical activity

Table 5 Age adjusted association of cardiovascular risk factors and behavioural variables with educational status[1] by gender

	Men				Women			
Dependent variables	r^2	B	SD	p	r^2	B	SD	p
Total cholesterol	0.024	3.464	1.766	0.050	0.171	1.585	1.560	0.310
LDL cholesterol (mg/dl)	0.025	3.562	1.598	0.026	0.140	2.109	1.432	0.141
HDL cholesterol (mg/dl)	0.001	–0.508	0.569	0.372	0.008	–0.974	0.534	0.069
Triglycerides (mg/dl)	0.006	0.001	0.009	0.928	0.104	0.009	0.007	0.166
Glycaemia	0.055	0.434	1.035	0.675	0.013	0.118	0.627	0.851
Systolic blood pressure (mmHg)	0.237	1.184	0.665	0.075	0.422	1.534	2.282	0.009
Diastolic blood pressure (mmHg)	0.050	0.253	0.423	0.550	0.279	0.875	0.373	0.019
BMI (kg/m^2)	0.020	–0.129	0.164	0.432	0.128	0.501	0.163	0.002
Waist circumferences (cm)	0.092	0.445	0.426	0.296	0.216	0.787	0.402	0.050
Waist to hip ratio (unit)	0.144	0.005	0.003	0.067	0.115	0.002	0.003	0.464
Smoking	0.027	–0.035	0.042	0.398	0.199	–0.054	0.030	0.067
Alcohol consumption (g/d)	0.005	1.813	1.672	0.278	0.008	–0.327	0.592	0.581
Leisure-time physical activity (kcal)*	0.016	–0.026	0.019	0.171	0.005	0.008	0.018	0.672
Diet quality score (unit)[a]	0.207	–0.084	0.066	0.207	0.106	–0.063	0.059	0.282
Dietary cardiovascular health score (unit)[b]	0.169	–0.160	0.134	0.233	0.107	–0.094	0.199	0.430

[a] Composed of recommended intakes of protein, thiamin, riboflavin, pyridoxine, cobalamine, retinol, fibre, vitamin C, vitamin E, folate, magnesium, iron, selenium, zinc, copper, cholesterol, and saturated fatty acids (range: 0–18)
[b] Composed of tertiles of dietary intakes of fibre, vitamin C, vitamin E, folate, and β-carotene, cholesterol, saturated fatty acids, and sodium (range: 0–16)
* log transformed

Table 6 Association of cardiovascular risk factors and behavioural variables with educational status, adjusted for confounders, by gender

	Men				Women			
Dependent variables	r^2	B	SD	p	r^2	B	SD	p
Total cholesterol (mg/dl)[a]	0.078	3.372	1.969	0.087	0.189	2.225	1.762	0.207
LDL cholesterol (mg/dl)[a]	0.055	3.903	1.795	0.030	0.155	2.492	1.625	0.126
HDL cholesterol (mg/dl)[a]	0.104	–0.777	0.608	0.202	0.066	–0.958	0.581	0.100
Triglycerides (mg/dl)[a, *]	0.069	–2.170	4.034	0.591	0.162	2.971	1.940	0.126
Glycaemia	0.096	–2.038	1.063	0.056	0.037	0.228	0.624	0.715
Systolic blood pressure (mm/Hg)	0.267	1.270	0.666	0.057	0.464	0.695	0.581	0.232
Diastolic blood pressure (mm/Hg)	0.089	0.550	0.458	0.230	0.342	0.594	0.407	0.145
BMI (kg/m^2)[b]	0.053	–0.252	0.181	0.164	0.140	0.426	0.183	0.020
Waist circumferences (cm)[b]	0.124	0.164	0.443	0.712	0.236	0.556	0.437	0.203
Waist to hip ratio (unit)[b]	0.177	0.006	0.003	0.068	0.140	0.001	0.003	0.812
Smoking[c]	0.057	–0.059	0.046	0.196	0.217	–0.064	0.032	0.040
Alcohol consumption (g)[d]	0.045	2.866	1.781	0.108	0.035	0.279	0.655	0.671
Leisure-time physical activity (kcal)[e] *	0.041	–0.031	0.019	0.112	0.016	0.014	0.018	0.456
Diet quality score (unit)[f]	0.237	–0.089	0.072	0.215	0.122	–0.095	0.066	0.151
Dietary cardiovascular health score (unit)[g]	0.203	–0.196	0.147	0.183	0.118	–0.123	0.133	0.355

[a] Adjusted for age, leisure-time physical activity, body mass index, smoking, alcohol drinking, and diet (dietary quality score)
[b] Adjusted for age, leisure-time physical activity, smoking, alcohol drinking, and diet (dietary quality score)
[c] Adjusted for age, leisure-time physical activity, body mass index, alcohol drinking, and diet (dietary quality score)
[d] Adjusted for age, leisure-time physical activity, body mass index, smoking, and diet (dietary quality score)
[e] Adjusted for age, alcohol drinking, body mass index, smoking, and diet (dietary quality score)
[f] Composed of recommended intakes of protein, thiamine, riboflavin, pyridoxine, cobalamine, retinol, fibre, vitamin C, vitamin E, folate, magnesium, iron, selenium, zinc, copper, cholesterol, and saturated fatty acids (range: 0–18); adjusted for age, leisure-time physical activity, body mass index, smoking, alcohol drinking, and energy consumption (kcal)
[g] Composed of tertiles of dietary intakes of fibre, vitamin C, vitamin E, folate, and β-carotene, cholesterol, saturated fatty acids, and sodium (range: 0–16); adjusted for age, leisure-time physical activity, body mass index, smoking, alcohol drinking, and energy consumption (kcal)
* log transformed

only the mentioned relationships for LDL cholesterol and body mass index remained significant after adjusting for diet and other lifestyle variables. This was not the case for systolic and diastolic blood pressures. This indicates that the association of socioeconomic status with systolic and diastolic blood pressures might be mediated through lifestyle variables.

Socioeconomic variation in leisure-time physical activity, a protective factor for CHD, has been well documented over the past years. Evidence indicates that people from lower socioeconomic groups spent less time in leisure physical activity than higher socioeconomic groups [29]. Furthermore, low leisure-time physical activity is often associated with other unhealthy lifestyle factors like smoking and alcohol drinking [8, 30]. In the present study, and in contrast to previously published data [29], subjects of lower socioeconomic level engaged in leisure-time physical activity not significantly different than higher socioeconomic groups. This lack of differences and the inverse relationship between leisure-time physical activity and several cardiovascular risk factors like low HDL cholesterol levels and obesity [31–33], might partially account for the CHD risk profile observed in our population.

Smoking and alcohol drinking habits have been shown to be different among groups of socioeconomic status [34, 35]. Recently, we had been shown that smoking was related to a worse lipid profile in our population [36]. However, in the present study, neither smoking nor alcohol drinking was related to socioeconomic status in men, nor either gender, respectively. Interestingly, smoking was inversely associated with socioeconomic status in women. This pattern reflects a trend observed in other western countries several years ago [37], and starting with some delay in Spain.

Diet has a mayor role to play in the prevention of the leading causes of mortality and morbidity in the western societies such as CHD and cancer. Several studies indicate that dietary patterns are different among groups of educational status [13–16]. Intakes of total- and saturated fat were directly related to socioeconomic status, whereas dietary fibre, mineral and vitamin consumption revealed an inverse association [14–16]. However, all of these studies were conducted in North Europe. The Mediterranean diet has been associated with healthy lifestyle and a lower risk of CHD. Dietary habits in the Mediterranean population forms part of their tradition; however, there is little information on how socioeconomic differences influenced diet in this region. Agudo and colleagues [38] found little differences in the vegetable and fruit consumption in Spain among different groups of educational level. The adherence to a Mediterranean dietary pattern was not influenced through educational level in subjects from north and southern Spain [39]. Furthermore, there was no unhealthier nutrient intake pattern in low-educated female Italian women as observed by D'Avanzo and colleagues [40]. In the present study, diet quality, characterised through a composite score of recommended intakes of 16 nutrients, was not affected by socioeconomic level. This was also observed for a second composite dietary score, including nutrients associated with CHD. Cultural values and preferences, learned generation by generation, are playing an important role in food consumption. Bredal and Grunert [41] documented that nearly 70% of the Spanish population buy and eat only food they are familiar with. In Spain, eating is considered a social event to meet people and enjoy food. In Mediterranean regions, with the exception of Islamic populations, wine consumption is typical during meals and could be considered characteristic for the Mediterranean diet. In our population, we found no differences in the amount of wine consumption among male and female alcohol consumers of different socioeconomic status. Interestingly, heavy alcohol drinking was not associated with lower educational level as observed by Droomers and colleagues [34]. A particular characteristic of the present Mediterranean region was the rural character of a large part of their population. Findings from previous studies suggested a tendency to healthier dietary habits in European rural compared to urban regions [42, 43]. One might speculate that the rural character of a population conserved to a greater extent traditional lifestyles than the urban counterpart, and that the traditional Mediterranean lifestyle is less influenced by socioeconomic inequalities. Dietary and alcohol drinking habits do not seem to be affected by educational level in the present population. Furthermore, the lack of differences in dietary and alcohol drinking habits might also partially account for the observed associations between cardiovascular risk factors and socioeconomic status.

In fact, lifestyle variables like diet, physical activity, smoking and alcohol drinking can be considered as indicators of a healthy behaviour. Based on the absence of significant differences of these variables among groups of different educational levels, our study suggests that men, and women with a lower socioeconomic status are not prone to be a potential risk-enhancing behaviour. However, because of the heterogeneous pattern of lifestyle among Spanish Mediterranean regions, results of the present study can only be considered specific for our population of Gerona. Furthermore, the cross-sectional design of the study cannot provide conclusive evidence of causal relationship. More large epidemiological studies, including not only cardiovascular risk factor measurements but also dietary and other lifestyle assessments are needed to address the complex relationship of socioeconomic status with lifestyle and cardiovascular risk.

In conclusion, LDL cholesterol in men and body mass index in women were independently and directly related to lower levels of socioeconomic status. Leisure-time physical activity, and dietary- and alcohol drinking habits were similar among different groups of educational level. This fact might partially explain the associations between CHD risk factors and socioeconomic status in our population.

Acknowledgement The present work was funded by grant FIS 94/0539 from the Fondo de Investigación Sanitaria and supported by grant CIRIT 1999 SGR/00243.

References

1. Marmot MG, Smith GD, Stansfeld S, Patel C, North F, Head J, White I, Brunner E, Feeney A (1991) Health inequalities among British civil servants: the Whitehall II study. Lancet 337:1387–1393
2. Smith GD, Bartley M, Blane D (1999) The black report on socioeconomic inequalities in health 10 years on. BMJ 301:373–377
3. Borrell C, Domínguez-Berjón F, Pasarín MI, Ferrando J, Rohlfs I, Nebot M (2000) Social inequalities in health related behaviors in Barcelona. J Epidemiol Community Health 54:24–30
4. Liberatos P, Link PG, Kelsey J (1988) The measurement of social class. Epidemiology Epidemiologic Rev 10:87–122
5. Winkleby MA, Jatulis DE, Frank E, Fortmann SP (1992) Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. Am J Public Health 82:816–820
6. Lahelma E, Manderbacka K, Rahkonen O, Karisto A (1994) Comparisons of inequalities in health: evidence from national surveys in Finland, Norway and Sweden. Soc Sci Med 38:517–524
7. Kaplan GA, Keil JE (1993) Socioeconomic factors and cardiovascular disease: a review of the literature. Circulation 88:1973–1998
8. Blaxter M (1990) Health and lifestyles. London: Routledge
9. Fernandez E (2000) Trends in social class inequalities in health status, health-related behaviors, and health services utilization in a Southern European urban area (1983–1994). Prev Med 31:691–701
10. Rimm EB, Stampfer MJ, Ascherio A, Giovannucci E, Colditz GA, Willett WC (1993) Vitamin E consumption and the risk of coronary heart disease in men. N Engl J Med 328:1450–1456
11. Kromhout D, Katan MB, Havekes L, Groener A, Hornstra G, de Lecene Coulander C (1996) The effect of 26 years of habitual fish consumption on serum lipid and lipoprotein levels (The Zutphen Study). Nutr Metab Cardiovasc Dis 6:65–71

12. Borgia MC, Medici F (1998) Perspectives in the treatment of dyslipidemias in the prevention of coronary heart disease. Angiology 49:339–348
13. Kushi LH, Folsom AR, Jacobs DR Jr, Luepker RV, Elmer PJ, Blackburn H (1988) Educational attainment and nutrient consumption patterns: the Minnesota Heart Survey. J Am Diet Assoc 88:1230–1236
14. Hulshof KFAM, Löwik MRH, Kok FJ, Wedel M, Brants HAM, Hermus RJJ, ten Hoor F (1991) Diet and other life-style factors in high and low socioeconomic groups (Dutch nutrition surveillance system). Eur J Clin Nutr 45:441–450
15. Hupkens CLH, Knibbe RA, Drop MJ (1997) Social class differences in women's fat and fiber consumption: a cross-national study. Appetite 28: 131–149
16. van Rossum CT, van de Mheen H, Witteman JC, Grobbee E, Mackenbach JP (2000) Education and nutrient intake in Dutch elderly people. The Rotterdam Study. Eur J Clin Nutr 54:159–165
17. Davey Smith G, Shiply MJ, Rose G (1990) Magnitude and causes of socioeconomic differentials in mortality from the Whitehall study. J Epidemiol Community Health 44:265–270
18. Barringer TA (2001) Mediterranean diets and cardiovascular disease. Curr Atheroscler Rep 3:437–445
19. Masiá R, Pena A, Marrugat J, Sala J, Vila J, Pavesi M, Covas M, Aubó C, Elosua R (1998) High prevalence of cardiovascular risk factors in Gerona, Spain, a province with low myocardial infarction disease. J Epidemiol Community Health 52:707–715
20. Elosua R, Garcia M, Aguilar A, Molina L, Covas MI, Marrugat J (2000) Validation of the Minnesota leisure time physical activity questionnaire in Spanish women. Med Sci Sports Exerc 32: 1431–1437
21. Elosua R, Marrugat J, Molina L, Pons S, Pujol E (1994) Validation of the Minnesota leisure time physical activity questionnaire in Spanish men. The MARATHOM investigators. Am J Epidem 139:1197–1209
22. Mc Ardle W, Katch F, Katch V (2001) Exercise Physiology, 5th edition, Lippincott, Williams and Wilkins, Baltimore, USA, pp 187–200
23. Schröder H, Covas MI, Marrugat J, Pena A, Alcántara M, Masiá R (2001) Use of a three-day estimated food record, a 72-hour recall, and a food frequency questionnaire for dietary assessment in a Mediterranean Spanish population. Clin Nutr 20:429–437
24. Standing Committee on the Scientific Evaluation of Dietary Reference intakes, Food and Nutrition Board, Institute of Medicine (1997) Dietary reference intakes for calcium, phosphorous, magnesium, vitamin D, and fluoride. National Academy Press, Washington DC
25. Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, Food and Nutrition Board, Institute of Medicine (2002) Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, manganese, molybdenum, nickel, silicon, vanadium, and zinc. National Academy Press, Washington DC
26. Hoeymans N, Smit HA, Verkleij H, Kromhout D (1996) Cardiovascular risk factors in relation to educational level in 36 000 men and women in The Netherlands. Eur Heart J 17:518–525
27. Kilander L, Berglund L, Boberg M, Vessby B, Lithell H (2001) Education, lifestyle factors and mortality from cardiovascular disease and cancer. A 25-year follow-up of Swedish 50-year-old men. Int J Epidemiol 30:1119–1126
28. Cirera L, Tormo MJ, Chirlaque MD, Navarro C (1998) Cardiovascular risk factors and educational attainment on Southern Spain: a study of a random sample of 3091 adults. Eur J Epidemiol 14:755–763
29. Droomers M, Schrijvers CTM, Mackenbach JP (2001) Educational level and decrease in leisure time physical activity: predictors from longitudinal GLOBE study. J Epidemiol Community Health 55:562–568
30. Sallis JF, Hovell MF, Hofstetter CR (1992) Predictors of adaptation and maintenance of vigorous physical activity in men and women. Prev Med 21: 237–251
31. Marrugat J, Elosua R, Covas MI, Molina L, Rubies-Prat J (1996) Amount and intensity of physical activity, physical fitness, and serum lipids in men. The MARATHOM Investigators. Am J Epidemiol 143:562–569
32. Schmitz K, French SA, Jeffery RW (1997) Correlates of changes in leisure time physical activity over 2 years: The Healthy Worker Project. Prev Med 26: 570–579
33. Rabkin SW, Chen Y, Leiter L, Liu L, Reeder BA (1997) Risk factor correlates of body mass index. Canadian Heart Health Surveys Research Group. CMAJ 157(Suppl 1):S26–S31
34. Droomers M, Schrijvers CT, Stronks K, van de Mheen D, Mackenbach JP (1999) Educational differences in excessive alcohol consumption: the role of psychosocial and material stressors. Prev Med 29:1–10
35. Fernandez E, Garcia M, Schiaffino A, Borras JM, Nebot M, Segura A (2001) Smoking initiation and cessation by gender and educational level in Catalonia, Spain. Prev Med 32:218–223
36. Schröder H, Marrugat J, Elosua R, Covas MI (2002) Tobacco and alcohol consumption: impact on cardiovascular risk factors in a southern European Mediterranean population. Br J Nutr 88: 273–281
37. Pierce JP, Fiore MC, Novotny TE, Hatziandreu EJ, Davis RM (1989) Trends in cigarette smoking in the United States. JAMA 261:56–60
38. Agudo A, Amiano P, Barcos A, Barricarte A, Beguiristain JM, Chirlaque MD, Dorronsoro M, Gonzáles CA, Lasheras C, Martínez C, Navarro C, Pera G, Quiros JR, Rodríguez M, Tormo MJ (1999) Dietary intake of vegetables and fruits among adults in five regions of Spain. Eur J Clin Nutr 53:174–180
39. Gonzales CA, Argilaga S, Agudo A, Amiano P, Barricarte A, Berguiristain JM, Chirlaque MD, Dorronsoro M, Martinez C, Navarro C, Quiros JR, Rodriguez M, Tormo MJ (2002) Diferencias sociodemográficas en la adhesión al patron de dieta mediterránea en poblaciones de España. Gac Sanit 16: 214–221
40. D'Avanzo B, Vecchia C, Braga C, Franceschi S, Negri E, Parpinel M (1997) Nutrient intake according to education, smoking, and alcohol in Italian women. Nutr Can 28:46–51
41. Bredahl L, Grunert RG (1997) Identificación de los estilos de vida alimenticios en España. Investigación agraria. Economia 12:247–263
42. Morgan K, Armstrong GK, Huppert FA, Brayne C, Solomou W (2000) Healthy ageing in urban and rural Britain: a comparison of exercise and diet. Age Ageing 29:341–348
43. Avellone G, Di Garbo V, Cordova R, Panno AV, Verga S, Bompiani G (1997) Food habits and cardiovascular risk factors in 2 population samples of western Sicily. Ann Ital Med Int 12:210–216