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ORIGINAL

Relationship between healthy habits and sociodemographic variables in the values of different atherogenic indices

Relación entre hábitos saludables y variables sociodemográficas en los valores de diferentes índices aterogénicos

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Abstract

Introduction: Atherosclerosis is the pathological lesion responsible for most cardiovascular diseases.
Methods: A descriptive, cross-sectional study was carried out in 1457 Spanish workers to assess the effect of healthy habits (physical exercise determined with the IPAQ questionnaire, Mediterranean diet, and tobacco consumption) and sociodemographic variables (age, sex, and social class) on the values of different atherogenic indices.
Results: The mean values and the prevalence of altered values in all the atherogenic indices analyzed were lower the higher the level of physical activity and also the greater the adherence to the Mediterranean diet. In men there was a greater risk of presenting elevated values in all atherogenic indices, whereas the highest social class only increased this risk in some indices.
Conclusion: Healthy habits such as physical exercise and the Mediterranean diet improve atherogenic indices and reduce the risk of presenting arteriosclerosis.

Keywords: Atherogenic index, Mediterranean diet, Physical activity, social class.

Resumen

Introducción: La aterosclerosis es la lesión patológica responsable de la mayoría de las enfermedades cardiovasculares.
Métodos: Se realizó un estudio descriptivo y transversal en 1457 trabajadores españoles para evaluar el efecto de los hábitos saludables (ejercicio físico determinado con el cuestionario IPAQ, dieta mediterránea y consumo de tabaco) y variables sociodemográficas (edad, sexo y clase social) sobre los valores de diferentes índices aterogénicos.
Resultados: Los valores medios y la prevalencia de valores alterados en todos los índices aterogénicos analizados fueron menores cuanto mayor era el nivel de actividad física y también cuanto mayor era la adherencia a la dieta mediterránea. En los hombres hubo un mayor riesgo de presentar valores elevados en todos los índices aterogénicos, mientras que la clase social más alta sólo aumentó este riesgo en algunos índices.
Conclusiones: Los hábitos saludables como el ejercicio físico y la dieta mediterránea mejoran los índices aterogénicos y reducen el riesgo de presentar arteriosclerosis

Palabras clave: Índice aterogénico, dieta mediterránea, actividad física, clase social.

Introduction

Atherosclerosis is the anatomopathological process underlying most cardiovascular diseases, in which accumulations of lipids, monocytes, and T lymphocytes are observed in the intima, causing migration and proliferation of smooth muscle cells, and the elaboration of collagen. Atherosclerotic disease, which begins in the first decade of life, is relatively benign and slowly progressive, remaining asymptomatic until there is a significant reduction in the vascular lumen, an abrupt occlusion, or thrombotic complications. Like most diseases whose prevalence increases with age, it is a complex pathology that depends on the interaction of genetic and environmental factors[1,2]. The combination of an unhealthy diet and low physical activity are the main risk factors for arteriosclerosis[3,4]. The two parameters most associated with cardiovascular disease, both strongly correlated with each other, are the proportion of calories in the diet, – supplied by saturated fatty acids – and blood cholesterol levels[5-7]. For this reason, international organizations consider that 30 minutes of moderate physical activity a day and diets in which the percentage of lipids is less than 30% are essential to reduce the risk of developing cardiovascular disease[8].

Although the multifactorial origin of arteriosclerosis is known, it is also recognized that almost half the risk of developing cardiovascular disease is related to the lipid metabolism[9]. In the search for a greater degree of prediction of cardiovascular disease, the need arose to develop different instruments to better assess it, and atherogenic indices are framed in this context. These indices provide important information on risk factors that are difficult to quantify by classical systematic analyses and are a better reflection of the clinical and metabolic interactions of lipid fractions. We believe that lipoprotein indices have been little used in cardiovascular prevention although they can provide valuable information on risk assessment. Their use as important predictors of cardiovascular risk is based on a large number of epidemiological studies that have shown that these indices have a higher correlation with cardiovascular disease and, as such, are better predictors of cardiovascular disease than simple lipid parameters[10-12]. Therefore, in an attempt to improve the degree of knowledge of these tools, the main objective of the present study was to determine the influence of certain hygienic habits, such as tobacco consumption, diet, and physical exercise, on the values of different atherogenic indices in the Spanish Mediterranean population.

Material and methods

A retrospective, cross-sectional study was performed in 1584 Spanish workers from different productive sectors in the period between January 2017 and December 2017. One hundred and tweny-seven workers were excluded (69 for not accepting to participate and 58 for being under 18 years old), leaving 1457 workers finally included in the study, 718 women (mean age 43.30 years) and 739 men (mean age 46.02 years). The workers were selected from among those who attended periodic occupational medical check-ups.

Inclusion criteria

- Aged between 18 and 67 years.
- Being an active worker.
- Belonging to one of the companies collaborating in the study.
- Accepting to participate in the study.

The different measurements (anthropometric, clinical, and analytical) were performed by health personnel from the participating occupational health units after homogenizing the measurement techniques.

Weight (in kilograms) and height (in cm) were obtained with a SECA 700 measuring scale with a capacity of 200 kg, which incorporated a SECA 220 telescopic measuring rod with millimetric division and a 60-200 cm interval.

Abdominal and hip girth were measured in both cases with a SECA model 200 tape measure with the person in a standing position with their feet together and trunk erect, abdomen relaxed, and upper limbs hanging on both sides of their body. For the former, the tape measure was placed parallel to the ground at the level of the last floating rib; and for the latter, horizontally at the level of the hip.

Blood pressure was obtained with an OMRON M3 automatic sphygmomanometer with the person in the supine position after 10 minutes of rest. Three measurements were taken at one-minute intervals and the mean of the three was obtained. Blood tests were obtained after 12 hours of fasting. Samples were sent to reference laboratories. Glycemia, total cholesterol and triglycerides use automated enzymatic methods, and the values are expressed in mg/dl. HDL was determined by precipitation with dextran sulfate Cl2Mg, and values are also expressed in mg/dl. LDL was calculated using the Friedewald formula (provided that triglycerides were less than 400 mg/dl). Values are expressed in mg/dl.

Friedewald formula: LDL= total cholesterol – HDL – triglycerides/5

The different atherogenic indices have different cutoff points[13]:

Total cholesterol/HDL-c index: low risk: < 5 in men and < 4.5 in women; moderate risk: between 5 and 9 in men and between 4.5 and 7 in women; and high risk: > 9 in men and > 7 in women. LDL-c/HDL-c ratio: low risk: < 3 and high risk ≥ 3. Triglycerides/HDL-c ratio is considered

high risk from 3%. Cholesterol-HDL-c index: high risk as from 130.

CHOLINDEX=LDL-C-HDL-C (Triglycerides<400 mg/dL), LDL-C-HDL-C + 1/5 of Triglycerides (Triglycerides ≥ 400 mg/dL)[14].

Cholindex is considered high at 80 and above.
A smoker was a person who regularly consumed at least 1 cigarette/day (or the equivalent in other types of consumption) in the previous month, or had stopped smoking in the preceding 12 months.

Social class was obtained from the 2011 National Classification of Occupations (CNO-11) based on the proposal made by the Spanish Society of Epidemiology[15]. We chose the classification in 3 categories: Class I. Directors/managers, university professionals, athletes and artists. Class II. Intermediate occupations and self-employed workers without employees. Class III. Unskilled workers.

Diet was assessed using the questionnaire on adherence to the Mediterranean diet[16] which contains 14 questions with values of 0 or 1 point each. Values below 9 indicate low adherence and above 9 indicate good adherence.

Physical activity was assessed with the International Physical Activity Questionnaire (IPAQ)[17], a self-administered questionnaire consisting of seven questions that assesses the physical activity performed in daily life in the previous seven days.

Results

Table I shows the values of the anthropometric, clinical, analytical, sociodemographic, and healthy habit variables of the population studied, where it can be observed that the values were more unfavorable, except for total cholesterol and tobacco consumption, among men.

All the atherogenic indices analyzed showed a decrease in the mean values as the level of physical activity increased, and this situation appeared in both women and men, as shown in **table II**.

Something similar to that observed with physical activity was seen with the Mediterranean diet, in that people, both men and women, who presented high scores in the questionnaire on adherence to the Mediterranean diet would present better values in all the atherogenic indices. The complete data are shown in **table III**.

The prevalence of altered values of all the atherogenic indices decreased as the level of physical exercise increased; this situation was seen in both men and women. (see **table IV**).

The prevalence of elevated values of the atherogenic indices also demonstrated better results in people with a high adherence to the Mediterranean diet, as shown in **table V**.

Sex, physical activity, and Mediterranean diet were the only variables to show an influence in all the scales

Table I: Characteristics of the population.

	Women (n=718) mean (SD)	Men (n=739) mean (SD)	Total (n=1457) mean (SD)	p-value
Age (years)	43.30 (8.44)	46.02 (8.50)	44.68 (8.57)	<0.0001
Height (kg)	66.29 (12.29)	82.24 (13.81)	74.38 (15.32)	<0.0001
Weight (m)	1.62 (0.06)	1.73 (0.07)	1.68 (0.09)	<0.0001
BMI (kg/m²)	25.36 (4.61)	27.40 (4.13)	26.39 (4.49)	<0.0001
Waist (cm)	89.44 (16.36)	97.00 (10.65)	93.27 (14.27)	<0.0001
Hip (cm)	105.78 (13.22)	108.77 (10.27)	107.29 (11.91)	<0.0001
Systolic Blood Pressure (mm Hg)	121.31 (17.05)	133.76 (18.11)	127.62 (18.66)	<0.0001
Diastolic Blood Pressure (mm Hg)	75.03 (10.58)	80.63 (11.43)	77.87 (11.36)	<0.0001
Cholesterol (mg/dl)	186.02 (31.14)	183.37 (31.72)	184.67 (31.46)	0.108
HDL (mg/dl)	60.18 (13.55)	49.83 (12.16)	54.93 (13.86)	<0.0001
LDL (mg/dl)	107.88 (28.16)	108.94 (29.15)	108.42 (28.66)	0.483
Triglycerides (mg/dl)	86.57 (43.59)	119.55 (87.42)	103.30 (71.28)	<0.0001
Glycemia (mg/dl)	92.16 (16.31)	98.68 (19.54)	95.47 (18.30)	<0.0001
	Percentage	**Percentage**	**Percentage**	**p-value**
<35 years	16.71	10.42	13.52	<0.0001
35-49 years	57.80	51.01	54.36	
≥ 50 years	25.49	38.57	32.12	
Social class I	18.94	8.80	13.80	<0.0001
Social class II	63.65	82.67	73.30	
Social class III	17.41	8.53	12.90	
No tobacco	71.87	72.94	72.41	<0.0001
Yes tobacco	28.13	27.06	27.59	
MET low	23.68	19.08	21.35	<0.0001
MET moderate	48.05	36.4	42.14	
MET high	28.27	44.52	36.51	
Predimed low	36.49	48.17	42.42	<0.0001
Predimed high	63.51	51.83	57.58	

analyzed. Of these, the one showing the greatest influence was age, with odds ratios ranging from 1.64 (95% CI 1.32-2.06) for high non-HDL/HDL cholesterol to 6.04 (95% CI 4.26-8.58) for high triglycerides/HDL. Age only revealed an influence for high non-HDL/HDL cholesterol. All results are presented in **table VI**.

Discussion

In our study, all the atherogenic indices analyzed improved as the level of physical activity determined with the IPAQ questionnaire increased. Something similar was observed when adherence to the Mediterranean diet increased.

Table II: Mean values of the different atherogenic index scales according to physical activity by gender.

	Women				Men			
	MET low n=170 mean (SD)	MET moderate n=345 mean (SD)	MET high n=203 mean (SD)	p-value	MET low n=141 mean (SD)	MET moderate n=269 mean (SD)	MET high n=329 mean (SD)	p-value
Cholesterol/HDL-c	3.65 (0.91)	3.18 (0.76)	2.92 (0.65)	<0.0001	4.36 (1.14)	3.94 (1.05)	3.60 (0.90)	<0.0001
LDL-c/HDL-c	2.25 (0.75)	1.87 (0.65)	1.64 (0.58)	<0.0001	2.65 (0.89)	2.35 (0.86)	2.16 (0.74)	<0.0001
Triglycerides/HDL-c	1.97 (1.63)	1.50 (0.96)	1.36 (0.89)	<0.0001	3.50 (2.85)	2.79 (2.36)	2.23 (1.82)	<0.0001
HDL-c/LDL-c+VLDL-c	0.42 (0.16)	0.51 (0.18)	0.58 (0.20)	<0.0001	0.33 (0.12)	0.39 (0.17)	0.44 (0.18)	<0.0001
Cholesterol-HDL-c	140.64 (31.22)	124.63 (29.07)	115.50 (27.10)	<0.0001	144.45 (31.84)	136.12 (33.82)	126.76 (28.84)	<0.0001
Triglycerides/LDL-c	0.87 (0.51)	0.81 (0.39)	0.77 (0.56)	<0.0001	1.53 (2.83)	1.38 (2.82)	1.03 (0.72)	<0.0001
Cholesterol no HDL-c/HDL-c	0.71 (0.07)	0.67 (0.07)	0.64 (0.08)	<0.0001	0.76 (0.06)	0.73 (0.08)	0.70 (0.08)	<0.0001
Cholindex	64.52 (33.22)	46.94 (30.87)	35.83 (31.19)	<0.0001	70.70 (31.84)	62.03 (35.55)	55.12 (35.77)	<0.0001

Table III: Mean values of the different atherogenic index scales according to healthy food by gender.

	Women			Men		
	Predimed low n=262 mean (SD)	Predimed high n=456 mean (SD)	p-value	Predimed low n=356 mean (SD)	Predimed high n=383 mean (SD)	p-value
Cholesterol/HDL-c	3.29 (0.84)	3.18 (0.79)	<0.0001	4.02 (1.07)	3.73 (1.00)	<0.0001
LDL-c/HDL-c	1.95 (0.70)	1.87 (0.69)	<0.0001	2.42 (0.86)	2.23 (0.80)	<0.0001
Triglycerides/HDL-c	1.69 (1.25)	1.51 (1.10)	<0.0001	2.93 (2.55)	2.44 (2.00)	<0.0001
HDL-c/LDL-c+VLDL-c	0.50 (0.19)	0.52 (0.19)	<0.0001	0.38 (0.15)	0.42 (0.18)	<0.0001
Cholesterol-HDL-c	126.21 (30.61)	125.63 (30.32)	<0.0001	135.62 (33.01)	131.61 (30.91)	<0.0001
Triglycerides/LDL-c	0.87 (0.50)	0.82 (0.46)	<0.0001	1.41 (2.97)	1.11 (0.89)	<0.0001
Cholesterol no HDL-c/HDL-c	0.68 (0.08)	0.67 (0.08)	<0.0001	0.73 (0.07)	0.71 (0.08)	<0.0001
Cholindex	49.44 (32.48)	47.12 (33.52)	<0.0001	63.32 (34.44)	58.08 (36.15)	<0.0001

Table IV: Prevalence of altered values in the different atherogenic index scales according to physical activity by gender.

	Women				Men			
	MET low n=170 Percentage	MET moderate n=345 Percentage	MET high n=203 Percentage	p-value	MET low n=141 Percentage	MET moderate n=269 Percentage	MET high n=329 Percentage	p-value
Cholesterol/HDL-c moderate	14.71	6.96	2.46	<0.0001	27.66	13.01	7.60	<0.0001
Cholesterol/HDL-c high	0.59	0.00	0.00		0.00	0.00	0.00	
LDL-c/HDL-c high	15.88	6.96	2.46	<0.0001	34.04	24.10	13.67	<0.0001
Triglycerides/HDL-c high	10.59	6.38	3.45	<0.0001	41.13	31.97	20.06	<0.0001
Cholesterol no HDL-c/HDL-c high	62.35	42.32	28.57	<0.0001	67.38	57.25	43.77	<0.0001
Cholindex high	29.41	12.17	8.37	<0.0001	37.59	25.65	20.67	<0.0001

Table V: Prevalence of altered values in the different atherogenic index scales according to healthy food by gender.

	Women			Men		
	Predimed low n=262 Percentage	Predimed high n=456 Percentage	p-value	Predimed low n=356 Percentage	Predimed high n=383 Percentage	p-value
Cholesterol/HDL-c moderate	9.54	6.36	<0.0001	16.57	10.44	<0.0001
Cholesterol/HDL-c high	0.00	0.00		0.00	0.22	
LDL-c/HDL-c high	9.54	6.80	<0.0001	24.44	17.23	<0.0001
Triglycerides/HDL-c high	8.78	5.26	<0.0001	34.55	22.72	<0.0001
Cholesterol no HDL-c/HDL-c high	46.95	41.01	<0.0001	54.21	52.22	<0.0001
Cholindex high	16.41	14.47	<0.0001	28.65	22.98	<0.0001

Table VI: Logistic regression analysis.

	Men OR (CI 95%)	Age ≥50 years OR (CI 95%)	Smokers OR (CI 95%)	MET low-moderate OR (CI 95%)	Predimed low OR (CI 95%)	Social class II-III OR (CI 95%)
Cholesterol/HDL-c moderate-high	2.26 (1.56-3.26)	ns	1.73 (1.21-2.48)	2.69 (1.74-4.15	1.53 (1.08-2.17)	ns
LDL-c/HDL-c high	3.81 (2.70-5.38)	ns	ns	2.40 (1.67-3.44)	1.48 (1.08-2.01)	0.60 (0.39-0.92)
Triglycerides/HDL-c high	6.04 (4.26-8.58)	ns	1.65 (1.21-2.25)	1.90 (1.37-2.63)	1.69 (1.26-2.26)	ns
Cholesterol no HDL-c/HDL-c high	1.64 (1.32-2.06)	1.97 (1.56-2.50)	ns	1.85 (1.47-2.34)	1.24 (1.01-1.54)	0.47 (0.34-0.65)
Cholindex high	2.16 (1.63-2.85)	ns	ns	1.65 (1.23-2.22)	1.32 (1.01-1.72)	0.50 (0.35-0.72)

In the multivariate analysis, the variable that most increased the risk of presenting high values of all the atherogenic indices was being over 50 years of age, followed by low or moderate physical activity and low adherence to the Mediterranean diet.

Practically, all the studies consulted reveal a beneficial effect of physical activity on the values of the atherogenic indices, as we have found.

A study carried out in the same geographical area as ours and also in the working population, specifically in more than 60.000 workers, assessed the influence of physical activity and a diet rich in vegetables and fruit on the prevalence of elevated values of different atherogenic indices, showing that both high cholesterol/HDL and LDL/HDL or triglycerides/HDL were more frequent in the groups that did not engage in frequent physical activity or in those who did not consume high amounts of fruit and vegetables[18]. These results are similar to ours. Another study in more than 200 Norwegian adults also found a beneficial effect of physical exercise, in this case on the atherogenic LDL/HDL index[19]. Data from two health surveys, one in the United States[20] and the other in Chile,[21] assessed the effect of physical activity on the values of the log triglyceride/HDL atherogenic index, also finding, like us, a beneficial effect. Similar data were found in another study, in this case carried out in a younger population, specifically in almost a hundred Colombian recruits, in whom physical exercise improved the values of several atherogenic indices[22].

The joint effect of physical activity and a low-calorie diet was evaluated in 327 overweight Romanian adults in whom an improvement in lipid profile and atherogenic indices was also observed[23]. Something similar was found in the American National Health and Nutrition Examination Survey[24] conducted in more than 2700 adults in which an improvement in atherogenic indices was observed with physical exercise and healthy eating, although in this case an additive effect of both was not observed.

A sub study of the PREDIMED study carried out in 772 participants who were given a Mediterranean diet supplemented with olive oil and nuts showed that after 3 months there was an improvement in the lipid profile (increase in HDL and decrease in LDL) as well as a decrease in the markers of inflammation related to arteriosclerosis[25].

The effect of the different types of fat in the diet on the values of the log triglyceride/HDL atherogenic index were also studied[26] and the consumption of less healthy fats (saturated) was found to worsen their values.

Among the strengths of this study are the large sample size, the number of atherogenic indices analyzed (specifically eight), and the fact that the assessment of physical activity and adherence to the Mediterranean diet was conducted with validated questionnaires (IPAQ and Predimed).

The main limitation of the study is that it was carried out in a very specific geographical area, which may make it difficult to extrapolate the results to other countries.

Conclusions

High physical activity (high METs) and high adherence to the Mediterranean diet decrease the values of all the atherogenic indices analyzed in this study and thus the risk of suffering arteriosclerosis. People in social class I have a higher risk of presenting elevated values of LDL/HDL, non-HDL/HDL cholesterol, and Cholindex.

Interests conflict

The researchers declare that they have no conflict of interest.

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