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ORIGINAL

Influence of tobacco consumption and other variables on the values of different cardiovascular risk factors in 418,343 spanish workers

Influencia del consumo de tabaco y otras variables en los valores de diferentes factores de riesgo cardiovascular en 418.343 Trabajadores españoles

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Summary

Introduction and objectives: Cardiovascular risk factors (CVRF) are understood to be the factors that increase the appearance of cardiovascular disease. There are many CVRF, particularly diabetes, arterial hypertension (AHT), dyslipidemia, obesity, sedentary lifestyle, and tobacco consumption. The aim of this study was to assess the influence of different sociodemographic variables and tobacco consumption on CVRF.

Methods: A descriptive, cross-sectional study was carried out in a large group of Spanish workers from different regions in which three classic CVRF were assessed: diabetes, dyslipidemia, and arterial hypertension, along with their relationship with sociodemographic variables such as age, sex, social class, and tobacco consumption.

Results: All the sociodemographic variables, but especially age, sex, and tobacco consumption, increased the risk of presenting these CVRF.

Conclusions: The profile of the person at greatest risk for dyslipidemia, high blood glucose levels, and arterial hypertension would be an older male, with a low socioeconomic level, and a smoker.

Key words: hypertension, dyslipidemia, prediabetes, diabetes, smoking.

Resumen

Introducción y objetivos: Entendemos por factores de riesgo cardiovascular (FRCV) aquellos que incrementan la aparición de enfermedades cardiovasculares. Existen muchos FRCV entre los que podemos destacar la diabetes, la hipertensión arterial (HTA), las dislipemia, la obesidad, el sedentarismo o el consumo de tabaco. El objetivo de este estudio es valorar la influencia de diferentes variables sociodemográficas y el consumo de tabaco sobre los FRCV.

Material y métodos: Se realiza un estudio descriptivo y transversal en un amplio colectivo de trabajadores españoles de distintas regiones en los que se valoran tres FRCV clásicos como la diabetes, la dislipemia y la hipertensión arterial y su relación con variables sociodemográficas como la edad, el sexo y la clase social y el consumo de tabaco.

Resultados: Todas la variables sociodemográficas, pero especialmente la edad y el sexo, y el consumo de tabaco van a incrementar el riesgo de presentar estos FRCV.

Conclusiones: El perfil de persona con mayor riesgo para presentar dislipemia, valores elevados de glucemia e hipertensión arterial sería un varón de edad avanzada, con un nivel socioeconómico bajo y fumador.

Palabras clave: Hipertensión arterial, dislipemia, prediabetes, diabetes, tabaco.

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Introduction

Cardiovascular disease (CVD) is currently the leading etiological factor in morbidity and mortality worldwide[1]. Cardiovascular disease refers to a very broad term that encompasses problems of the heart[2,3] and blood vessels[4,5]. Atherosclerosis[6,7] is often the cause of these problems. This condition occurs when fats and cholesterol build up on the walls of the arteries[8]. This buildup is known as plaque[9]. Plaque can narrow blood vessels over time, causing problems throughout the body. A heart attack or stroke can occur if an artery becomes clogged[10].

The etiology of CVD is very diverse and usually multifactorial, therefore, using population-wide strategies, most CVD can be prevented by acting on behavioral risk factors, such as tobacco use[11], unhealthy diets[12], obesity[13], sedentary lifestyle[14], and harmful use of alcohol[15] or other drugs[16].

The aim of this study was to assess the influence of different sociodemographic variables such as age, sex, social class, and tobacco consumption on some factors that increase cardiovascular risk in a large group of Spanish workers.

Methods

Between the months of January 2017 and December 2019, this descriptive, cross-sectional study was conducted in 418,343 Spanish workers from various autonomous communities and different productivity sectors. The participants in the research were selected from among those who attended the periodic health surveillance carried out in all the participating companies.

The criteria for inclusion in the study were: being at least 18 and no more than 69 years of age, having an employment contract with one of the companies participating in the study, not being in a situation of temporary incapacity at the time, and accepting by informed consent to participate in the study and the use of the data collected for epidemiological purposes.

The flow chart of the workers who participated in the study is shown in **figure 1**.

Figure 1: Flowchart.

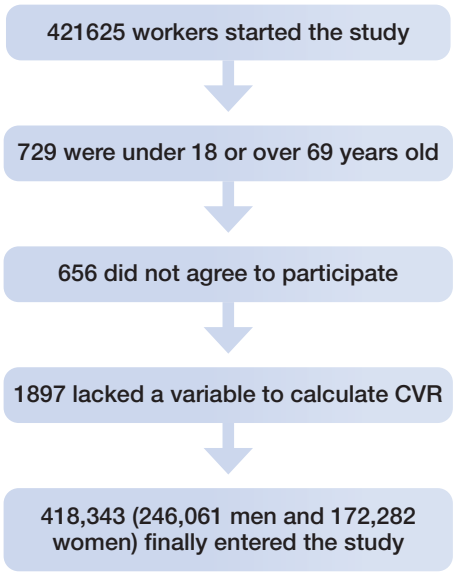

Table I shows the characteristics of the population, with all anthropometric, clinical, and analytical variables revealing higher or less favorable values in men. The most frequent age was between 30 and 49 years. Most of the employees belonged to social class III. Approximately every third person in the study smoked.

Measurement and data collection

Medical and nursing professionals from the companies included in the study were responsible for taking anthropometric (height, weight, and waist circumference), clinical, and analytical measurements with prior standardization of measurement techniques.

Weight and height were obtained using a SECA 700 model measuring scale. A SECA model measuring tape was used while the person was standing upright, with the lower extremities together, the trunk erect, and the abdomen relaxed to determine the abdominal waist circumference. To obtain an accurate measurement, the tape measure was placed parallel to the floor at the level of the last floating rib.

Blood pressure was obtained with the worker seated and after a minimum rest period of 10 minutes using a calibrated OMRON M3 automatic sphygmomanometer. Three measurements were obtained 60 seconds apart and the mean was used. The different analytical values were obtained after a fasting period of no less than 12 hours. Total cholesterol, glycemia, and triglycerides were determined using automated enzymatic techniques. High-density lipoprotein (HDL) values were obtained using dextran sulfate-MgCl2 precipitation techniques. Low-density lipoproteins (LDL) were calculated indirectly by applying the Friedewald formula. All these analytical parameters are expressed in mg/dL.

Friedewald's formula: LDL = cholesterol - HDL - triglycerides/5

The following cardiovascular risk factors were determined:

- Arterial Hypertension

Blood pressure figures were classified according to the criteria of the seventh Joint National Committee for the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7)[17] as shown in **table I**.

Table I: Classification of blood pressure values according to the JNC-7.

Category	Systolic (mmHg)		Diastolic (mmHg)
Normal	<120	and	<80
Prehypertension	120–139	or	80–89
Hypertension			
Stage 1	140–159	or	90–99
Stage 2	>160	or	>100

*Adapted from JNC 7 Express: The Seventh Report of the Joint National Committee

- Glycemia

Values were classified according to the criteria of the American Diabetes Association (ADA)[18] which considers values to be normal when they are less than 100mg/dL; altered basal glycemia or prediabetes if values are between 100 and 125 mg/dL; and diabetes if values exceed 125 mg/dL.

- Dyslipidemia

In order to classify the values of lipid parameters, the recommendations of the Spanish Heart Foundation[19] were used.

Total cholesterol is classified as:
- Normal values below 200 mg/dL
- Borderline values between 200-239 mg/dL
- High values when the figures exceed 239 mg/dL

LDL is classified as:
- Normal values below 100 mg/dL
- Borderline values between 100 and 159 mg/dL
- High values when they exceed 159 mg/dL

Triglycerides are classified as:
- Normal values when less than 150 mg/dL
- Borderline values between 100 and 199 mg/dL
- High values when above 200 mg/dL.

In this study we considered as smokers those persons who had consumed at least one cigarette daily (or the equivalent in other varieties of consumption) in the previous 30 days or who had quit smoking less than one year before.

The social determinants group of the Spanish Society of Epidemiology, based on the type of work included in the 2011 national classification of occupations (CNO-11)[20] established a classification of social classes. For this study we opted for classification in three categories:

- Social class I. Managers, sportsmen and artists, university professionals, and skilled self-employed workers.
- Social class II. Unskilled self-employed workers and so-called intermediate occupations.
- Social class III. Unskilled workers.

Statistical analysis

The frequency and distribution of categorical variables were calculated, and a descriptive analysis of these variables was performed. The mean and standard deviation of the quantitative variables were calculated as they presented a normal distribution.

For independent samples, Student's t-test and Chi-squared test were used. When circumstances required it, Fisher's exact statistic was corrected. Calculation of odds ratios with their 95% confidence intervals was used to conduct multivariate analysis using multinomial logistic regression. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 28.0 for Windows, which had an accepted statistical significance level of 0.05.

Ethical aspects

The study investigators were committed at all times to strict compliance with all the standards of ethics in health sciences research that are established both in Spain and internationally and that are included in the Declaration of Helsinki, paying special attention to the anonymity of the participants and the confidentiality of the data collected. The study was approved by the Ethics and Research Committee of the Balearic Islands (CEI-IB) with indicator IB 4383/20. Since participation in the research was voluntary, it was necessary to obtain oral and written consent after participants had received clear and sufficient information on the characteristics and content of the study, for which a model of informed consent and a sheet with information on the objectives of the research were provided.

The study data were identified by a code, and only the principal investigator was in a position to establish a connection between these and the participants. The identity of the participants cannot be revealed at any time during the research, since the investigators have the obligation and commitment not to divulge any information that could identify them. At all times, the researchers are committed to strict compliance with Organic Law 3/2018, of December 5, on the protection of personal data and guarantee of digital rights, ensuring that the people participating in the study have the right to access, rectify, cancel, and oppose the data collected.

Results

Table II shows the anthropometric and clinical characteristics of the 418343 employees in the study (246061 men and 172282 women). The group had a mean age of 40.2 ± 11.0 years with most of the participants aged between 30 and 49 years. All variables had more negative values in men. One out of every three employees smoked, and three out of four belonged to social class III.

Table II: Characteristics of the population.

	Women n=172.282 Mean (SD)	Men n=246.061 Mean (SD)	Total n=418.343 Mean (SD)	p-value
Age	39.6 (10.8)	40.6 (11.1)	40.2 (11.0)	<0.0001
Height	161.8 (6.5)	174.6 (7.0)	169.4 (9.3)	<0.0001
Weight	66.2 (14.0)	81.4 (14.7)	75.1 (16.2)	<0.0001
Waist	74.8 (10.6)	86.2 (11.1)	81.5 (12.2)	<0.0001
SBP	117.4 (15.7)	128.2 (15.5)	123.7 (16.5)	<0.0001
DBP	72.6 (10.4)	77.8 (11.0)	75.6 (11.0)	<0.0001
Cholesterol	190.6 (35.8)	192.6 (38.9)	191.8 (37.7)	<0.0001
HDL-c	56.8 (8.7)	50.3 (8.5)	53.0 (9.1)	<0.0001
LDL-c	116.1 (34.8)	118.0 (36.7)	117.2 (35.9)	<0.0001
Triglycerides	89.1 (46.2)	123.7 (86.4)	109.5 (74.6)	<0.0001
Glycemia	87.8 (15.1)	93.3 (21.3)	91.0 (19.2)	<0.0001
	%	%	%	p-value
18-29 years	20.7	18.8	19.6	<0.0001
30-39 years	29.7	27.6	28.4	
40-49 years	29.6	30.0	29.9	
50-59 years	16.8	19.7	18.5	
≥60 years	3.2	3.9	3.6	
Social class I	6.9	4.9	5.7	<0.0001
Social class II	23.4	14.9	18.4	
Social class III	69.7	80.3	75.9	
Non-smokers	67.2	66.6	66.9	<0.0001
Smokers	32.8	33.4	33.2	

Table III: Mean values of different cardiovascular risk factors according tobacco consumption by sex.

	Men			Women		
	Non-smokers n=163920 Mean (SD)	Smokers n=82141 Mean (SD)	p-value	Non-smokers n=115727 Mean (SD)	Smokers n=56555 Mean (SD)	p-value
Age	40.2 (11.1)	40.8 (11.0)	<0.0001	39.3 (10.8)	39.7 (10.8)	<0.0001
SBP	128.0 (15.5)	128.2 (15.5)	<0.0001	117.2 (15.7)	117.5 (15.6)	<0.0001
DBP	77.6 (11.0)	77.8 (10.9)	<0.0001	72.4 (10.4)	72.7 (10.4)	<0.0001
Cholesterol	192.3 (39.2)	192.7 (38.7)	0.034	190.2 (35.9)	190.9 (35.8)	<0.0001
HDL-c	50.2 (8.5)	50.3 (8.5)	0.003	56.7 (8.6)	56.8 (8.7)	0.034
LDL-c	117.8 (36.9)	118.2 (36.6)	0.008	115.7 (34.7)	116.3 (34.8)	<0.0001
Triglycerides	124.4 (87.8)	123.4 (85.7)	0.007	89.2 (46.4)	89.1 (46.1)	0.835
Glycemia	93.1 (21.3)	93.4 (21.2)	0.003	87.7 (15.0)	87.9 (15.2)	0.052

Table IV: Prevalence of values of different cardiovascular risk factors according to tobacco consumption by sex.

	Men			Women		
	Non-smokers n=163920 %	Smokers n=82141 %	p-value	Non-smokers n=115727 %	Smokers n=56555 %	p-value
Normal	21.7	21.1	0.006	51.2	50.6	0.017
Pre AHT	51.7	51.8		37.1	37.4	
Hypertension 1	20.7	21.0		9.2	9.6	
Hypertension 2	5.9	6.1		2.4	2.5	
High Cholesterol	39.9	40.2	0.01	36.6	37.1	0.07
High LDL	35.7	36.3	0.003	31.5	32.2	0.002
High Triglycerides	23.8	24.1	0.041	7.9	8.0	0.039
Glycemia 100-125	18.5	18.9	0.007	10.1	10.1	0.001
Glycemia > 125	3.5	3.6		1.3	1.3	

Table V: Multinomial logistic regression.

	Hypertension OR (95% CI)	High Cholesterol OR (95% CI)	High LDL-c OR (95% CI)	High Triglycerides OR (95% CI)	Diabetes OR (95% CI)	Glycemia > 100 OR (95% CI)
18-29 years	1	1	1	1	1	1
30-39 years	1.59 (1.54-1.65)	1.33 (1.25-1.41)	1.05 (1.01-1.09)	1.07 (1.03-1.11)	1.73 (1.63-1.83)	1.56 (1.51-1.62)
40-49 years	3.37 (3.26-3.50)	1.61 (1.56-1.67)	1.69 (1.63-1.75)	1.40 (1.35-1.46)	4.62 (4.33-4.92)	3.03 (2.93-3.14)
50-59 years	7.27 (7.01-7.55)	3.28 (3.17-3.40)	3.47 (3.35-3.59)	2.11 (2.03-2.20)	11.30 (10.45-12.22)	5.74 (5.53-5.95)
60-69 years	10.80 (10.37-11.24)	8.03 (7.73-8.34)	8.67 (8.34-9.00)	4.17 (3.98-4.36)	23.03 (20.62-25.73)	10.07 (9.65-10.51)
Female	1	1	1	1	1	1
Male	2.57 (2.53-2.62)	1.09 (1.08-1.11)	1.14 (1.13-1.16)	3.53 (3.46-3.60)	2.46 (2.35-2.58)	2.14 (2.10-2.18)
Social class I	1	1	1	1	1	1
Social class II	1.17 (1.15-1.20)	1.06 (1.03-1.10)	1.04 (1.02-1.06)	1.15 (1.13-1.18)	1.78 (1.60-1.98)	1.44 (1.41-1.48)
Social class III	1.40 (1.34-1.45)	1.14 (1.11-1.17)	1.07 (1.04-1.10)	1.38 (1.33-1.44)	1.83 (1.72-1.95)	1.48 (1.42-1.54)
Non-smokers	1	1	1	1	1	1
Smokers	1.02 (1.00-1.04)	1.03 (1.01-1.05)	1.07 (1.04-1.11)	1.03 (1.01-1.06)	1.08 (1.05-1.11)	1.04 (1.01-1.07)

Table III shows the mean values of the different cardiovascular risk factors analyzed in this study, according to smoking and sex. It can be observed that in all cases, in both women and men, these mean values we re higher in the group of smokers. The differences found were statistically significant in all cases.

Table IV, which shows the prevalence of elevated values of the different cardiovascular risk factors, reveals the same trend already described for the mean values, that is, a higher prevalence in smokers.

Table V shows the results of the multivariate analysis using multinomial logistic regression, revealing that all the sociodemographic variables –especially age, sex, and tobacco consumption– increased the risk of presenting elevated values of the different cardiovascular risk factors

In this analysis, the reference variables were younger age, female sex, social class I, and being a non-smoker.

Discussion

The appearance of the different risk factors analyzed in this study were favored by all the sociodemographic variables studied, that is, age, sex, and social class, and also by smoking.

The prevalence of arterial hypertension in our study was around 27% in men and 12% in women; these figures are lower than those found in Di@bet.es, a national study seeking to measure the prevalence of diabetes mellitus and other cardiovascular risk factors in Spanish adults[21]. That study analyzed 5048 Spanish adults and calculated the prevalence of arterial hypertension at 49.9% in men and 37.1% in women; these higher figures could be explained by the fact that persons aged over 69 years were included in that study.

Data from the Spanish Ministry of Health[22] show an overall prevalence of diabetes of 7.5% in the year 2020, higher values than those found by us, which are 3.5% in men and 1.3% in women; this disparity in the figures could be due to the exclusion in our study of persons aged 70 years and older. The prevalence of prediabetes was 23.7% in a study of 616 Mexicans[23], figures somewhat higher than those obtained by us. A very recent meta-analysis[24] that included 7014 studies assessed the global prevalence of prediabetes in the world, estimating it at 5.8%, a lower figure than ours. Data from the Spanish national health survey of 2017[25] show a prevalence of hypercholesterolemia of 19.8%, figures well below those obtained by us.

Sex hormones and sex chromosomes have an impact on the regulation of blood pressure (BP) and the distribution of cardiovascular (CV) risk factors, which explains why the prevalence of arterial hypertension is higher in men, as seen in our study[26]. This higher prevalence in men has been observed in two studies carried out in the Spanish working population[27,28].

The China-PAR (Prediction for Atherosclerotic Cardiovascular Disease Risk in China) project, which included 53891 people, assessed the effect of socioeconomic level (classified in three levels) on the prevalence of arterial hypertension, observing that the lower the socioeconomic level, the higher the prevalence of arterial hypertension[29]. Similar data were found in the Jackson Heart Study carried out in 4761 people[30].

In our study, we found a negative effect of smoking on blood pressure, and these data are supported by the results obtained in the United Kingdom Biobank cohort, which included 98039 individuals (45457 men and 52582 women). Arterial stiffness levels and blood pressure figures were higher in men than in women and showed a stronger relationship with smoking[31]. Similar data were found in a study of US adults[32].

The risk of presenting diabetes in our study increased the lower the socioeconomic level; these data are similar to those obtained in a systematic review[33] in which the complications of diabetes were assessed but differ from those found in another review[34]. The prevalence of prediabetes and diabetes in a study conducted in Iran was higher in people with lower socioeconomic status[35].

According to the available evidence, smoking increases the risk of prediabetes and diabetes and all-cause mortality in the general population[36-39], along with aggravating chronic diabetic complications and glycemic control among people with diabetes.

Dyslipidemia in our study was higher in people of social class III, data that agree with a study conducted in China in almost 10000 adults[40]. A study conducted in poorly developed countries showed that dyslipidemia was more prevalent in people with a higher socioeconomic status[41].

Data from the Korean National Health and Nutrition Examination Survey for the years 2013 to 2019 including 8398 men showed a clear relationship between smoking and dyslipidemia[42].

As strengths of the study, it is worth highlighting the large sample size, over 418000 people, which gives great power to the results obtained.

The main limitation of the study is the exclusion of persons under 18 years of age and those aged 70 years and older, since the study was carried out in the working population, which could prevent extrapolation of the results to the general population, especially those over 69 years of age.

Conclusions

All sociodemographic variables, including age, sex, and social class, have an impact on the increase in cardiovascular risk factors, especially age and sex. Tobacco use also increases these risk factors, although less significantly.

An older male, belonging to social class III, and a smoker has a high probability of presenting cardiovascular risk factors.

Conflict of Interest

The authors declared that there is no conflict of interest.

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