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ORIGINAL

Influence of tobacco consumption on the values of different cardiometabolic risk scales in 418,343 spanish workers

Influencia del consumo de tabaco en los valores de diferentes escalas de riesgo cardiometabólico en 418.433 trabajadores españoles

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Summary

Introduction and objectives: Cardiometabolic diseases are very prevalent and include different pathologies such as elevated blood pressure, obesity, dyslipidemia, and elevated blood glucose. All these entities make up what is known as the metabolic syndrome (MS) and some associated conditions such as hypertriglyceridemic waist circumference (CHTG) and diabesity, among others. The aim of the study was to assess the influence of some sociodemographic variables and tobacco consumption on these pathological entities.

Material and methods: A descriptive, cross-sectional study in a large group of Spanish workers in which the prevalence of MS was assessed by applying several criteria, CHTG, diabesity and high values of atherogenic indices and a prediabetes risk scale. The influence of different sociodemographic variables (age, sex, and social class) and tobacco consumption on these pathologies was assessed.

Results: All the sociodemographic variables increased the risk of presenting these cardiometabolic disorders, with sex and age showing higher odds ratios in all cases. Tobacco consumption also had an influence, but to a lesser extent.

Conclusions: The profile of the person with the highest risk of presenting these cardiometabolic disorders is an older male, belonging to social class III, and a smoker.

Key words: Metabolic syndrome, hypertriglyceridemic waist, diabesity, atherogenic index, prediabetes, smoking.

Resumen

Introducción y objetivos: Las enfermedades cardiometabólicas son muy prevalentes y engloban diferentes patologías como la elevación de la tensión arterial, la obesidad, la dislipemia y la elevación de la glucemia. Todas estas entidades conforman lo que conocemos como síndrome metabólico (SM) y algunos cuadros asociados como la cintura hipertrigliceridémica (CHTG) o la diabesidad entre otras. El objetivo del estudio es valorar la influencia de algunas variables sociodemográficas y el consumo de tabaco sobre estas entidades patológicas.

Material y métodos: Estudio descriptivo y transversal en un amplio colectivo de trabajadores españoles en los que se valora la prevalencia de SM aplicando varios criterios, CHTG, diabesidad y valores elevados de índices aterogénicos y de una escala de riesgo de prediabetes. Se valora la influencia que distintas variables sociodemográficas (edad, sexo y clase social) y el consumo de tabaco tienen sobre estas patologías.

Resultados: Todas las variables sociodemográficas incrementan el riesgo de presentar estos trastornos cardiometabólicos siendo el sexo y la edad las que muestran valores de odds ratio superiores en todos los casos. El consumo de tabaco también influye pero con una potencia menor.

Conclusiones: El perfil de persona con mayor riesgo de presentar estas alteraciones cardiometabólicas es un varón de edad avanzada, perteneciente a la clase social III y fumador.

Palabras clave: Síndrome metabólico, cintura hipertrigliceridémica, diabesidad, índice aterogénico, prediabetes, tabaco.

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Introduction

Cardiometabolic diseases are a group of pathologies that are highly prevalent throughout the world[1] and cause a high morbidity and mortality rate in both sexes[2,3]. These pathologies include very prevalent conditions such as obesity[4], hyperglycemia,[5,6] dyslipidemia[7], and elevated blood pressure[8], all of which are included in what is known as the metabolic syndrome (MS)[9].

MS has been known for many decades and is not easy to define since there are numerous criteria for its diagnosis, namely: WHO[10] (World Health Organization), EGIR[11] (European Group for the Study of Insulin Resistance), NCEP ATPIII[12] (National Cholesterol Education Program Adult Treatment Panel III), IDF[13] (International Diabetes Federation), JIS[14] (Joint Interim Statement), among others.

There are also other parameters that are closely related to MS since they share some of its elements, such as hypertriglyceridemic waist circumference (CHTG)[15] (elevated triglyceride values and abdominal waist circumference), diabesity[16] (presence of diabetes and obesity), and atherogenic indices[17].

The aim of this study was to determine how different sociodemographic variables such as age, sex, social class, and tobacco consumption affect the appearance of MS, CHTG, diabesity, and elevated values of atherogenic indices.

Methods

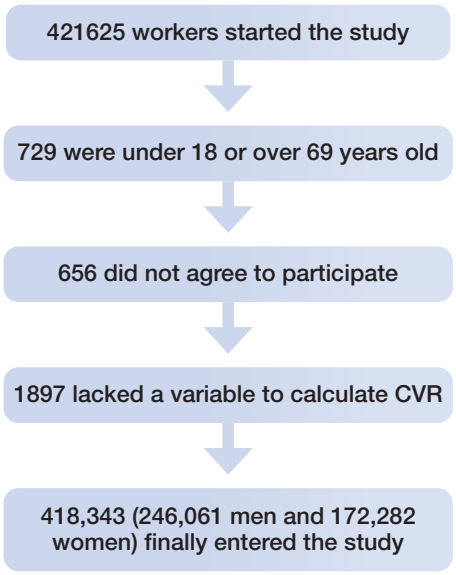
Between January 2017 and December 2019, a descriptive, cross-sectional study was conducted in 418,343 Spanish employees from different regions and productive sectors. Individuals were selected from among those who underwent regular health examinations in the different participating companies.

The following were the requirements to participate in the study: being aged 18 to 69 years, working for a company included in the study, not being temporarily incapacitated, and signing the informed consent to participate in the study and to use their data for epidemiological purposes.

The flow diagram of the study participants is shown in **Figure 1**.

Table I shows the characteristics of the population, with all anthropometric, clinical, and analytical variables showing 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 and had only a primary education. Approximately every third person in the study smoked.

Figure 1: Flowchart.



Measurement and data collection

Anthropometric measurements (height, weight, and waist circumference) were performed clinically and analytically by health professionals in all the companies participating in the study; measurement techniques had previously been standardized.

Weight and height were obtained with a SECA 700 measuring scale. A SECA measuring tape was used, with the person standing, feet together, trunk erect, and abdomen relaxed to measure waist circumference. The tape was placed parallel to the ground and more or less at the end floating rib.

Blood pressure was obtained with the person seated and after a rest of at least 10 minutes, using a calibrated OMRON M3 automatic sphygmomanometer. Three measurements were taken with a period of one minute between them and the mean of the three was recorded. Analytical parameters were obtained after at least 12 hours of fasting. Total cholesterol, triglycerides, and blood glucose were acquired using automated enzymatic methods. Meanwhile, a precipitation process with dextran sulfate-MgCl2 was used to obtain HDL-c. The Friedewald formula was used to calculate LDL-c indirectly. Each analysis parameter was expressed in mg/dL.

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

The presence or absence of MS was assessed by applying the validated diagnostic criteria of the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) of the International Diabetes Federation (IDF) and the Joint Interim Statement (JIS)[18].

Hypertriglyceridemic waistline[19] is defined as the coexistence of elevated triglyceride values (over 150 mg/

dL) and elevated abdominal waist circumference values (over 102 cm in men and over 88 cm in women).

Diabesity[20] is established when diabetes and obesity (body mass index over 30 kg/m^2) are found in the same person.

The risk of prediabetes was determined by applying the PRISQ (prediabetes risk score Qatar)[21] scale.

The following atherogenic indices were calculated[22]: Total cholesterol/HDL-c index: low risk is considered as values lower than 5 in men and lower than 4.5 in women; moderate risk: between 5 and 9 in men and between 4.5 and 7 in women; and high risk: higher than 9 in men and higher than 7 in women. LDL-c/HDL-c ratio: low risk below 3 and high risk above 3.

Smokers were those who had consumed at least one cigarette a day (or its equivalent in any of the consumption modalities) in the previous month or if they had quit smoking less than one year before.

The Spanish Society of Epidemiology[23] establishes three categories of social classes according to profession, as proposed by the social determinants group. Directors, managers, sportsmen and artists, university professionals and skilled self-employed workers belong to Class I. Unskilled self-employed workers and intermediate occupations belong to Class II. Unskilled workers belong to Class III.

Statistical analysis

The frequency and distribution of categorical variables were calculated, and a descriptive analysis was performed. The mean and standard deviation of quantitative variables were calculated by presenting the variables with a normal distribution.

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

Ethical considerations and/or aspects

The research group is committed to compliance with national and international ethical standards for health sciences research (Declaration of Helsinki), paying special attention to the anonymity of the participants and the confidentiality of the data collected. The Ethics and Research Committee of the Balearic Islands (CEI-IB) approved the study with number IB 4383/20. Since participation in the study was voluntary, participants gave their consent verbally and in writing after receiving sufficient information about its nature. To achieve this, they were given an informed consent form as well as an information sheet explaining the purpose of the study. By using codes to identify the survey data, only the survey administrator can link them to the participants. The identity of participants will not be disclosed in any report of this study. The researchers will refrain from disclosing information that could identify them. In any event, the research group undertook to comply with the provisions of the Organic Law 3/2018, of December 5, on the protection of personal data and guarantee of digital rights, which guarantees research participants the rights of access, rectification, cancellation, and objecting to the data set.

Results

The anthropometric and clinical characteristics of the 418,343 workers (246,061 men and 172,282 women) who participated in the study are shown in **table I**.

Most of the participants in this group were between 30 and 49 years old, with a mean age of 40.2 ± 11 years. In men, all variables showed more negative values. One third of the workers smoked and three quarters belonged to the most disadvantaged social class.

Table II shows the prevalence of MS, CHTG, diabetes, high values of atherogenic indices, and high values of PRISQ according to smoking in both sexes. In all cases, the prevalence was higher in the group of smokers (statistically significant differences). Moreover, prevalence was always higher in men.

Table III shows the results of the multivariate analysis using multinomial logistic regression. The reference variables were aged under 30 years, female sex, social class I, and being a non-smoker.

All the sociodemographic variables included in the study, especially age and sex, and tobacco use, increased the risk of presenting MS when applying the three criteria; and also CHTG, diabesity, high risk of the two atherogenic indices, and high risk of prediabetes when applying the PRISQ scale.

Discussion

In our study, the risk of presenting MS applying any of the criteria, such as CHTG, diabetes or high values of atherogenic indices, or the risk of prediabetes applying the PRISQ scale is influenced by all the sociodemographic variables analyzed, and fundamentally by age and sex (those with the highest odds ratios). Tobacco consumption also increases all of the above, although to a lesser extent.We found a prevalence of MS that ranges in men between 13.2% if we apply the IDF criteria and slightly more than 27% if we use the ISB criteria; whereas

Table I: 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 II: Mean values of the insulin resistance, non-alcoholic fatty liver disease, and liver fibrosis scales according to smoking by sex.

	Women			Men		
	Non-smokers n=115727 %	Smokers n=56555 %	p-value	Non-smokers n=163920 %	Smokers n=82141 %	p-value
MS NCEP ATPIII	9.4	9.7	<0.0001	16.7	16.9	<0.0001
MS IDF	9.2	9.4	<0.0001	13.2	13.3	<0.0001
MS JIS	11.0	11,2	<0.0001	27.3	27.7	<0.0001
HTGW	1.5	1.6	<0.0001	8.2	8.4	<0.0001
High AI CT/HDL	0.1	0.2	<0.0001	0.2	0.3	<0.0001
High AI LDL/HDL	7.6	13.1	<0.0001	25.8	25.9	<0.0001
Diabesity	1.6	1.7	<0.0001	3.2	3.4	<0.0001
High PRISQ	6.2	6.9	<0.0001	14.0	14.7	<0.0001

MS metabolic syndrome; NCEP ATPIII National Cholesterol Education Program Adult Treatment Panel III; IDF International Diabetes Federation; JIS Joint Interim Statement; HTGW hypertriglyceridemic waist circumference; AI atherogenic index; TC/HDL total cholesterol/high-density lipoprotein; LDL/HDL low-density lipoprotein/high-density lipoprotein; PRISQ prediabetes risk score Qatar

Table III: Multinomial Logistic Regression.

	MS NCEP ATPIII OR (CI 95%)	MS IDF OR (CI 95%)	MS JIS OR (CI 95%)	HTGw OR (CI 95%)	High AI CT/HDL OR (CI 95%)	High AI LDL/HDL OR (CI 95%)	Diabesity OR (CI 95%)	High PRISQ OR (CI 95%)
Women	1	1	1	1	1	1	1	1
Men	1,81 (1.77-1.85)	1.39 (1.36-1.42)	3,04 (2.99-3.10)	5.52 (5.30-5.75)	1.38 (1.27-1.47)	2.31 (2.27-2.35)	1.83 (1.75-1.91)	2.48 (2.42-2.54)
18-29 years	1	1	1	1	1	1	1	1
30-39 years	1.64 (1.58-1.70)	1.11 (1.06-1.15)	1.62 (1.56-1.68)	1.06 (1.04-1.08)	1.56 (1.20-2.04)	1.24 (1.19-1.28)	1.60 (1.51-1.70)	1.58 (1.47-1.69)
40-49 years	3.35 (3.23-3.47)	1.56 (1.50-1.63)	3.34 (3.23-3.47)	1.11 (1.04-1.19)	2.89 (2.20-3.79)	2.16 (2.08-2.23)	4.26 (4.00-4.53)	4.16 (4.01-4.32)
50-59 years	7.59 (2.85-3.11)	2.98 (2.85-3.11)	6.94 (6.69-7.20)	1.66 (1.55-1.77)	4.82 (3.58-6.49)	4.53 (4.37-4.70)	15.58 (14.31-16.97)	18.30 (17.59-19.03)
60-69 years	17.92 (17.04-18.85)	6.17 (5.86-6.50)	13.78 (13.20-14.38)	3.74 (3.46-4.04)	16.44 (10.33-26.14)	12.93 (12.36-13.53)	72.95 (60.91-87.39)	60.70 (57.83-63.71)
Social class I	1	1	1	1	1	1	1	1
Social class II	1.35 (1.32-1.39)	1.27 (1.24-1.30)	1.34 (1.31-1.37)	1.07 (1.31-1.37)	1.07 (1.03-1.11)	1.16 (1.13-1.18)	1.79 (1.69-1.91)	1.19 (1.16-1.23)
Social class III	1.53 (1.46-1.60)	1.44 (1.38-1.51)	1.46 (1.41-1.52)	1.28 (1.41-1.52)	1.32 (1.21-1.43)	1.27 (1.21-1.33)	2.19 (1.95-2.46)	1.35 (1.28-1.43)
Non-smokers	1	1	1	1	1	1	1	1
Smokers	1.04 (1.01-1.08)	1.05 (1.03-1.08)	1.06 (1.04-1.09)	1.05 (1.02-1.09)	1.15 (1.08-1.23)	1.04 (1.01-1.08)	1.06 (1.01-1.11)	1.03 (1.01-1.05)

MS metabolic syndrome; NCEP ATPIII National Cholesterol Education Program Adult Treatment Panel III; IDF International Diabetes Federation; JIS Joint Interim Statement; HTGW hypertriglyceridemic waist circumference; AI atherogenic index; TC/HDL total cholesterol/high-density lipoprotein; LDL/HDL low-density lipoprotein/high-density lipoprotein; PRISQ prediabetes risk score Qatar

in women the prevalence is lower, slightly more than 9% applying the NCEP ATPIII and IDF criteria, and about 11% if the criteria are the ISB ones.

With regard to data from the National Health and Nutrition Examination Survey (NHANES), in the US adult population, the prevalence of MS experienced a large increase in recent decades, going from 22% between 1988 and 1994, to 33% between the years 2007 and 2012[24,25]. For the period 2011-2016, the figure rose to 34.7%. In South America, an overall prevalence of MS is estimated to be between 18.8-43.3%[26]. A Colombian study conducted in Medellín observed a prevalence in adults of almost 40%[27].

The higher prevalence of MS in men was also found in another Colombian study conducted in young university students[28]. The results of a meta-analysis that included different studies carried out in ten Spanish autonomous communities[29] showed that the prevalence of MS was 31% (32% in men and 29% in women).

Data from the China Nutrition and Health Surveillance[30] (2015-2017), which included a total of 130,018 residents aged 20 years or older using NCEP ATPIII criteria found that the factors that most influenced the occurrence of MS were female sex, older age, high socioeconomic status, and tobacco use, data that in some cases differ from those found by us.

A study carried out in Iran[31] in which more than 10,000 persons were included found no relationship between MS and socioeconomic level. However, another study carried out in the same country[32] did find a higher prevalence of MS in people with a lower socioeconomic level. A Spanish study[33] conducted in 42,146 workers also found that MS was more prevalent in people with low socioeconomic status, and this effect of social class was stronger in women.

There is evidence of the relationship between the smoking habit in pregnant women and the subsequent appearance of metabolic disorders in their children when they reach adulthood. The children of women who smoke are born with lower birth weight, which increases the risk of being overweight or obese in adulthood. Some studies have shown an increased risk of insulin resistance, type 2 diabetes, and hypertension, although this evidence is weaker than for overweight[34]. A Palestinian study in refugee youth associated tobacco use with an increased prevalence of MS[35]. Another study in India also found an association between smoking and MS[36].

In a Chinese study[37] conducted in more than 3000 persons aged 40 years and older, the prevalence of HTGW was 7.5% (7.4% in men and 7.5% in women), this higher overall prevalence could be due to the fact that the waist circumference values applied in that study were much lower than those applied by us. A Brazilian study carried out in people aged 60 years and older found a prevalence of HTGW of 21.7%, which was also higher in women[38].

A Brazilian study conducted in more than 1000 adolescents with low socioeconomic status found a high prevalence of HTGW[39].

Data from the PREDIMED-Plus study conducted in almost 7000 people aged between 45 and 65 years showed an increased prevalence of HTGW in smokers[40].

An Egyptian study carried out in 2003 as part of the Africa Wits-INDEPTH Association for Genomic Research (AWI-Gen)[41] revealed, as we did, that the prevalence of elevated values of atherogenic indices was higher in men.

The strengths of the study include, on the one hand, the large sample size, which gives great power to the results obtained in the study, and on the other hand, the large number of cardiometabolic risk scales used.

As a main limitation it is worth noting that by including people in the study only between 18 and 69 years of age, our results may not be able to be extrapolated to the general population.

Conclusions

All the cardiometabolic risk scales analyzed (metabolic syndrome, hypertriglyceridemic waist circumference, diabesity, atherogenic indices, and prediabetes) are influenced by all the sociodemographic variables included in the study, such as social class, and especially age and sex. Tobacco consumption also has an influence, although in a less intense manner.

The profile of a person at high risk of presenting MS, hypertriglyceridemic waist circumference, diabetes, high values of atherogenic indices or high risk of prediabetes he would be an elderly male, belonging to social class III and a smoker.

Conflict of Interest

The authors declared that there is no conflict of interest.

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