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ORIGINAL

Sociodemographic variables influencing the prevalence of insulin resistance in the italian population

Variables sociodemográficas que influyen en la prevalencia de resistencia a la insulina en población italiana

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Abstract

Introduction: Insulin resistance (IR) is a very common pathology that is usually related to different cardiometabolic disorders such as obesity or non-alcoholic fatty liver disease. Its frequency is increasing worldwide. The aim of this study was to determine the prevalence of IR in the Italian population and to determine the influence of certain sociodemographic variables such as age, sex and social status on its occurrence.

Methods: Descriptive and cross-sectional study in 20774 Italian workers with a mean age of 40.1 years. The risk of developing insulin resistance was assessed with three scales: Metabolic score-insulin resistance (METS-IR), triglyceride-glucose index (T&G index) and triglyceride/HDL-c ratio. The sociodemographic variables analyzed were age, sex and social class.

Results: The prevalence of IR ranged from 11.3% (METS-IR) to 28% (TGA index) in men and 6.3% (METS-IR) to 18% (Triglycerides/HDL). The sociodemographic variable that most increased the risk of presenting IR was age 50 years and older, with OR ranging from 1.92 (95% CI 1.74-2.13) using the METS-IR scale to 2.61 (95% CI 2.43-2.81) if the TyG index was used.

Conclusion: The Italian population shows a low prevalence of high risk values for insulin resistance. The variables that most increase this risk are age, sex and social class.

Keywords: Insulin resistance, social class, gender.

Resumen

Introducción: La resistencia a la insulina (RI) es una patología muy frecuente que suele relacionarse con diferentes alteraciones cardiometabólicas como la obesidad o el hígado graso no alcohólico. Su frecuencia va en aumento en todo el mundo. El objetivo de este estudio fue determinar la prevalencia de IR en la población italiana determinado también la influencia que tienen determinadas variables sociodemográficas como la edad, el sexo y la case social en su aparición.

Metodología: Estudio descriptivo y transversal en 20774 trabajadores italianos con una edad media de 40,1 años. Se valora el riesgo de presentar resistencia a la insulina con tres escalas: Score metabólico- resistencia a la insulina (METS-IR), índice triglicéridos-glucosa (índice TyG) y cociente triglicéridos/HDL-c. las variables sociodemográficas analizadas son la edad, el sexo y la clase social.

Resultados: La prevalencia de RI osciló entre 11,3% (METS-IR) y 28% (índice TyG) en hombres y 6,3% (METS-IR) y 18% (Triglicéridos/HDL). La variable sociodemográfica que más incrementó el riesgo de presentar RI fue la edad a partir de los 50 años con OR que van de 1,92 (IC 95% 1,74-2,13) aplicando la escala METS-IR a 2,61 (IC 95% 2,43-2,81) si se emplea el índice TyG.

Conclusión: La población italiana muestra una baja prevalencia de valores de alto riesgo de resistencia a la insulina. Las variables que más aumentan este riesgo son la edad, el sexo y la clase social.

Palabras clave: Resistencia a la insulina, clase social, género.

Introduction

Insulin resistance is a very common pathology that often accompanies obesity[1], prediabetes, type 2 diabetes, polycystic ovary syndrome[2], cardiovascular disease and other metabolic disorders, such as hypertension and nonalcoholic fatty liver disease. Insulin resistance has also been associated with an increased risk of developing various cancers, Alzheimer's disease, mental disorders and other chronic disorders[3].

Some authors estimate that up to 45% of the population in the United States and other countries currently have insulin resistance[4,5]. In studies of obese women, they found that more than 70% are insulin resistant and among people with type 2 diabetes, the figure rises to more than 80%[6].

Genetic, environmental and lifestyle risk factors are known to contribute to the development of insulin resistance7. Although some people may be genetically more prone to develop insulin resistance, perhaps the greatest impact has been the change in our food environment in recent decades. There is greater availability of cheap hypercaloric food and beverages, and this may have led to whole populations adopting an unhealthy lifestyle characterized by the consumption of high levels of sugar and other refined carbohydrates. Carbohydrates are broken down into large amounts of glucose that we may not need for energy, and some of it is stored in our cells.

The importance of this health problem has led us to carry out this study whose objective is to determine the prevalence of insulin resistance in the Italian population, assessing the sociodemographic variables that influence it.

Methods

A retrospective and cross-sectional study was carried out in 20.774 Italian workers between January 2019 and December 2020. The workers were selected based on their attendance to periodic occupational medical examinations.

Selection criteria:

- Belongs to one of the participating companies.
- Accepts participating in the study.

Of the 22.689 workers initially included in the study, 1.749 were excluded due to not having data from all the necessary variables to calculate the insulin resistance scales; and 166 did not give permission to participate in the study. The final number of workers included in the study was 20.774.

All anthropometric and analytical determinations were performed by health professionals from the different occupational health units that participated in the study, after standardizing the measurement techniques.

Weight and height were determined with a height bar scale (model: SECA 700 to which a SECA 220 telescopic height bar was added. Body mass index (BMI) was calculated by dividing weight by height in squared meters.

Blood glucose, total cholesterol and triglycerides: These were determined by peripheral venipuncture and after fasting for at least 12 hours. Automated enzymatic methods were used. HDL were determined by precipitation with Cl2Mg dextran sulfate.

Three scales were used to assess insulin resistance.

- Metabolic score for Insulin resistance (METS-IR)[8] whose formula is

Ln [(2*glucose) + Triglycerides]*BMI)/(Ln[HDLc]) High risk is considered to be values from 50

- Triglyceride glucosa index[9] (TyG index) whose formula is

Ln [triglycerides (mg/dL)*glucose (mg/dL)/2] The cut-off points for high values are set at 8.7 for women and 8.8 for men.

- Atherogenic index Triglycerides/HDL-c10 The cut-off points for high values are set at 2.2 for women 3.1 for men.

Statistical analysis

A descriptive analysis of the categorical variables was carried out, calculating the frequency and distribution of responses for each of them. For quantitative variables, the mean and standard deviation were calculated, and for qualitative variables the percentage was calculated. A bivariate association analysis was performed using the x^2 test (with a correction with the Fisher's exact statistical test, when conditions required so) and a Student's t-test for independent samples. For the multivariate analysis, binary logistic regression was used with the Wald method, with the calculation of the Odds-ratio and the Hosmer-Lemeshow goodness-of-fit test was performed. Correlation and agreement between the scales were determined with Pearson's correlation index and Cohen's Kappa index respectively. Statistical analysis was performed with the SPSS 27.0 program, and a p value of <0.05 was considered as statistically significant.

Considerations and ethical aspects

The study was approved by the Clinical Research Ethics Committee. The procedures were performed following the ethical standards of the institutional research committee and with the 2013 Declaration of Helsinki. All patients signed written informed consent documents before participating in the study.

The anthropometric, analytical, clinical and sociodemographic characteristics of the population are presented in **table I**. Most of the variables, with the exception of LDL cholesterol, show more unfavorable values in men. The majority of the patients were between 30 and 49 years of age and belonged mainly to the most disadvantaged social class (social class III). All data are shown in **table I**.

The mean values of the three insulin resistance scales increase in value with increasing age. This situation is observed in both sexes and the differences observed are statistically significant. There is also an increase in the values of the three scales as one descends in social class in both sexes, although the differences are only statistically significant in women. The complete data can be found in **table II**.

The prevalence of high values of the three scales follows a pattern similar to that observed with the mean values, i.e., there is an increase in prevalence as age increases and as one moves down the social scale. This situation is seen in both men and women and in all cases the differences are statistically significant. The mean prevalence of insulin resistance ranged from 11.5% in men and 6.3% in women when using the METS-IR scale to 28.0% with the TyG index scale in men and 18.8% with the Triglycerides/HDL-c scale in women.The complete data are available in **table III**.

Table I: Characteristics of the population.

	Women (n=8.500) mean (SD)	Men (n=12.274) mean (SD)	Total (n=20.774) mean (SD)	p-value
Age (years)	39.5 (10.9)	40.5 (11.1)	40.1 (11.0)	<0.0001
Height (cm)	161.9 (6.5)	174.7 (7.0)	169.4 (9.3)	<0.0001
Weight (kg)	66.2 (14.0)	81.3 (14.8)	75.1 (16.2)	<0.0001
BMI (kg/m²)	25.3 (5.2)	26.6 (4.5)	26.1 (4.8)	<0.0001
Waist circumference (cm)	74.7 (10.5)	86.2 (11.2)	81.5 (12.3)	<0.0001
Waist to height ratio	0.46 (0.06)	0.49 (0.06)	0.48 (0.06)	<0.0001
Sistolic blood pressure (mmHg)	117.3 (15.7)	128.2 (15.7)	123.7 (16.6)	<0.0001
Diastolic blood pressure (mmHg)	72.5 (10.5)	77.7 (11.1)	75.6 (11.1)	<0.0001
Total cholesterol (mg/dl)	190.9 (35.6)	192.7 (39.1)	191.9 (37.7)	0.001
HDL-c (mg/dl)	56.8 (8.8)	50.4 (8.6)	53.0 (9.2)	<0.0001
LDL-c (mg/dl)	116.2 (34.5)	118.1 (36.7)	117.3 (35.8)	<0.0001
Triglycerides (mg/dl)	89.7 (46.5)	123.5 (83.5)	110.7 (72.7)	<0.0001
Glycaemia (mg/dl)	87.7 (14.1)	93.4 (22.2)	91.1 (19.5)	<0.0001
	%	%	%	p-value
18-29 years	21.3	18.9	19.9	<0.0001
30-39 years	29.2	27.9	28.4	
40-49 years	29.0	29.2	29.1	
50-59 years	17.2	20.1	18.9	
60-69 years	3.4	3.9	3.7	
Social class I	6.8	5.0	5.8	<0.0001
Social class II	23.4	14.7	18.3	
Social class III	69.8	80.2	76.0	

Table II: Mean values of indicators of insulin resistance according sociodemographic variables by sex.

		TG/HDL		TyG index		METS-IR	
Men	**n**	**Mean (SD)**	**p-value**	**Mean (SD)**	**p-value**	**Mean (SD)**	**p-value**
18-29 years	2317	1.8 (1.2)	<0.0001	8.2 (0.5)	<0.0001	34.7 (7.4)	<0.0001
30-39 years	3430	2.4 (1.8)		8.4 (0.5)		38.0 (7.9)	
40-49 years	3580	2.9 (2.4)		8.6 (0.6)		40.6 (8.7)	
50-59 years	2465	3.2 (2.3)		8.7 (0.6)		42.4 (8.6)	
60-69 years	482	3.3 (2.1)		8.8 (0.6)		43.3 (7.9)	
Social class I	619	2.6 (2.2)	0.113	8.5 (0.5)		38.7 (7.6)	0.078
Social class II	1808	2.6 (2.5)		8.5 (0.6)		38.8 (8.0)	
Social class III	9847	2.6 (2.0)		8.5 (0.6)		39.3 (8.8)	
Women	**n**	**Mean (SD)**	**p-value**	**Mean (SD)**	**p-value**	**Mean (SD)**	**p-value**
18-29 years	1811	1.4 (0.7)	<0.0001	8.0 (0.4)	<0.0001	32.7 (7.7)	<0.0001
30-39 years	2478	1.5 (0.7)		8.1 (0.4)		34.1 (8.5)	
40-49 years	2462	1.7 (1.0)		8.2 (0.5)		35.9 (8.2)	
50-59 years	1461	2.0 (1.3)		8.4 (0.5)		37.7 (8.3)	
60-69 years	288	2.2 (1.3)		8.5 (0.5)		40.0 (8.5)	
Social class I	578	1.4 (0.8)	0.025	8.1 (0.4)		32.5 (6.8)	0.001
Social class II	1987	1.6 (1.0)		8.1 (0.5)		33.9 (8.0)	
Social class III	5935	1.7 (1.0)		8.2 (0.5)		35.8 (8.6)	

Table III: Prevalence of high values of indicators of insulin resistance according sociodemographic variables by sex.

		TG/HDL high		TyG index high		METS-IR high	
Men	**n**	**% (95% CI)**	**p-value**	**% (95% CI)**	**p-value**	**% (95% CI)**	**p-value**
18-29 years	2317	9.8 (9.1-10.5)	<0.0001	10.4 (9.8-11.0)	<0.0001	4.4 (3.7-5.2)	<0.0001
30-39 years	3430	20.0 (19.6-20.4)		21.6 (21.2-22.0)		8.4 (8.0-8.8)	
40-49 years	3580	29.3 (28.9-29.7)		31.6 (31.2-32.0)		13.5 (13.0-13.9)	
50-59 years	2465	35.8 (35.3-36.3)		39.2 (38.7-39.8)		17.7 (17.2-18.2)	
60-69 years	482	40.5 (39.0-42.0)		45.2 (43.7-46.7)		17.6 (16.0-19.1)	
Social class I	619	23.3 (21.4-25.2)	0.041	24.2 (22.3-26.2)		9.4 (8.5-10.3)	<0.0001
Social class II	1808	22.7 (22.0-23.4)		23.1 (22.4-23.8)		9.4 (8.7-10.1)	
Social class III	9847	25.2 (25.0-25.5)		27.7 (27.5-27.9)		11.8 (11.6-12.0)	
Total	12274	25.3 (25.0-25.6)		28.0 (27.7-28.3)		11.3 (11.0-11.6)	
Women	**n**	**% (95% CI)**	**p-value**	**% (95% CI)**	**p-value**	**% (95% CI)**	**p-value**
18-29 years	1811	9.6 (8.9-10.3)	<0.0001	5.3 (4.6-6.0)	<0.0001	4.0 (3.4-4.6)	<0.0001
30-39 years	2478	13.2 (12.7-13.7)		8.2 (7.7-8.8)		5.3 (4.8-5.8)	
40-49 years	2462	19.5 (19.0-20.0)		13.3 (12.8-13.9)		6.3 (5.8-6.8)	
50-59 years	1461	30.3 (29.6-31.0)		25.5 (24.8-26.2)		7.8 (7.2-8.4)	
60-69 years	288	36.8 (35.0-38.6)		31.9 (30.1-33.8)		12.5 (10.7-14.3)	
Social class I	578	10.4 (9.5-11.3)	<0.0001	7.4 (6.5-8.3)	<0.0001	2.6 (1.9-3.3)	<0.0001
Social class II	1987	15.9 (15.3-16.5)		11.4 (10.8-12.0)		5.0 (4.4-5.6)	
Social class III	5935	19.4 (19.1-19.7)		13.9 (13.6-14.2)		7.0 (6.7-7.3)	
Total	8500	18.0 (17.6-18.4)		12.6 (12,2.13.0)		6.3 (5.9-6.7)	

The degree of correlation between the three scales shows a very high value between TyG index and Triglycerides/HDL and somewhat lower between METS-IR and the other two scales. The specific data are presented in **table IV**. Something similar can be observed with Cohen's kappa concordance index (see **table V**).

In the multivariate analysis using binary logistic regression, age 50 years and older, social class II-III and male were established as covariates.

Figure 1 shows that the variable that most increases the risk of presenting insulin resistance with the three scales used is age over 50 years (with OR ranging from 2.61 (95% CI 2.43-2.81) in the case of the T&G index to 1.92 (95% CI 1.74-2.13) in the case of METS-IR) followed by male sex. The variable with the least influence was social class.

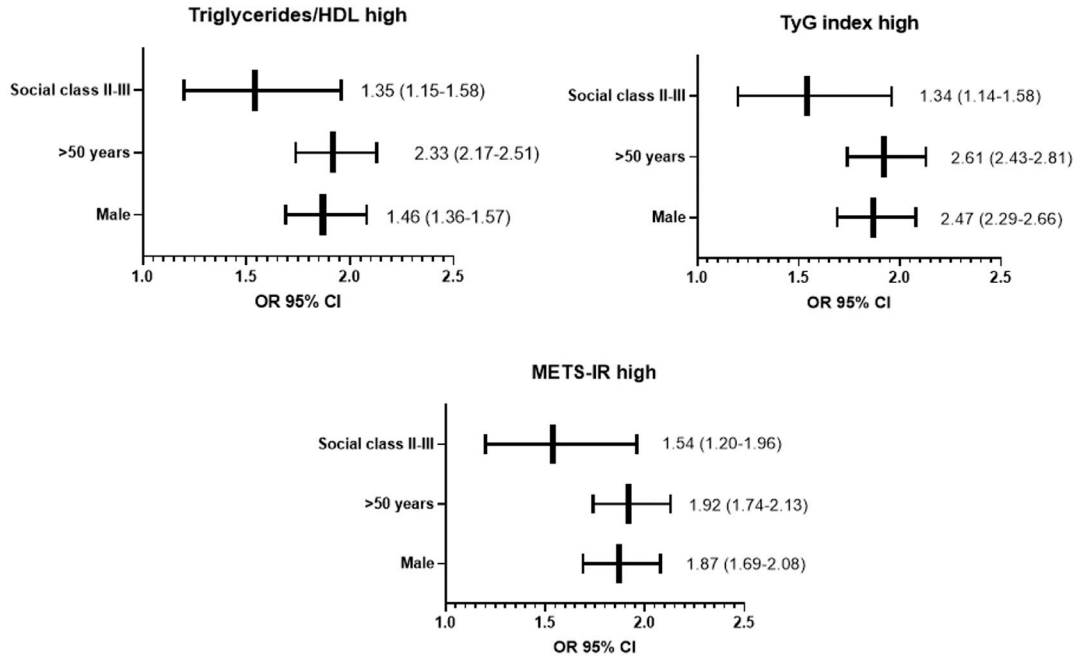
Table IV: Pearson's correlation coefficient of different scales of insulin resistance.

	TG/HDL	TyG index	METS-IR
TG/HDL	1	0.831	0.553
TyG index		1	0.572
METS-IR			1

Table V: Kappa Cohen index of different scales of insulin resistance.

	TG/HDL	TyG index	METS-IR
TG/HDL	1	0.757	0.315
TyG index		1	0.289
METS-IR			1

Figure 1: Binary Logistic regression analysis.



Discussion

The prevalence of insulin resistance is higher in men and varies according to the scale applied, ranging from 11.5% to 28% in men and 6.3% to 18.8% in women.

The sociodemographic variables that most increase the risk of insulin resistance are age 50 years and older, followed by male sex and social classes II-III.

The prevalence of insulin resistance varies from country to country. A Danish population study showed a prevalence of 15.5%[11], while the highest prevalence rates were reported in other countries reaching 23.3%, 39.1% and 46.5% in Thailand, Texas-USA and Venezuela[12-14] respectively. A study from Lebanon with people of a similar mean age to our study reported one of the highest prevalence rates compared to other countries, reaching 44.6%[15].

In our study, belonging to the male sex increases the risk of presenting insulin resistance between 1.46 and 2.47 times, being this figure lower than that reported in a Lebanese study which was 3.9 times[16]. Similar figures were obtained in another study carried out in the USA[17]. However, Naja et al[15] showed no differences by sex.

In our study, the most disadvantaged social classes have a higher prevalence of insulin resistance; these data are consistent with those found by Lawlor[18] in Scotland, Goodman in the USA[19] and Buitrago-López, although the latter was conducted in children[20].

We have found that age increases the prevalence of insulin resistance, which is similar to data obtained several decades ago in a systematic review[21].

The strengths of the study include the large sample size (more than 20,000 people) and the large number of scales used and sociodemographic variables analyzed.

As a main limitation, we can point out that the study was carried out in the working population between 18 and 70 years of age, so that it cannot be extrapolated to the entire population.

Conclusión

The prevalence of high-risk values of insulin resistance in the Italian population can be considered low. The variables that most increase this risk are, in order, age, sex and social class.

Interests conflict

The researchers declare that they have no conflict of interest.

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