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ORIGINAL

Relationship between different scales related to cardiovascular risk and Finrisk test values in workers

Relación entre diferentes escalas relacionadas con el riesgo cardiovascular y valores del test de Finrisk en trabajadores

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Abstract

Introduction: Cardiovascular diseases are the main cause of death in developed countries and one of the risk factors most closely related to them is diabetes. The aim is to study the relationship between the values of a test that determines the risk of suffering diabetes mellitus and the values of different scales related to cardiovascular risk.

Methods: Cross-sectional study in 59,042 workers in which the values of the Finrisk test were related to the values of some cardiovascular risk scales such as the body shape index, conicity index, visceral adiposity index, Cholindex and hypertriglyceridemic waist among others.

Results: All the scales included in this study increase their values in parallel to the increase in the values of the Finrisk test. This situation occurs in both women and men.

Conclusion: There is a relationship between the values of the Finrisk test and all the scales analyzed in this study.

Key words: Finrisk test, diabetes mellitus, cardiovascular diseases.

Resumen

Introducción: Las enfermedades cardiovasculares son la principal causa de muerte en los países desarrollados y uno de los factores de riesgo que más se relaciona con ellas es la diabetes. El objetivo es estudiar la relación entre los valores de un test que determina el riesgo de sufrir diabetes mellitus y los valores de diferentes escalas relacionadas con el riesgo cardiovascular.

Material y métodos: Estudio transversal en 59,042 trabajadores en los que se relacionan los valores del test de Finrisk con los valores de algunas escalas de riesgo cardiovascular como el índice de forma del cuerpo, índice de conicidad, índice de adiposidad visceral, Cholindex y cintura hipertrigliceridémica entre otros.

Resultados: Todas las escalas incluidas en este estudio van incrementando su valor paralelamente al incremento de los valores del test de Finrisk. Esta situación se produce tanto en las mujeres como en los hombres.

Conclusión: Existe una relación entre los valores del test de Finrisk y todas las escalas analizadas en este trabajo.

Palabras clave: Test Finrisk, diabetes mellitus, enfermedades cardiovasculares.

Introduction

Cardiovascular diseases (CVD) cause great morbidity and mortality both in the developed and undeveloped countries. In recent years 80 percent of deaths from CVD have occurred in countries with medium or low income, and the number is growing[1]. The cardiovascular risk (CVR) is defined as the likelihood of an event in a given period, usually 10 years, for its determination generally scales are based on cohort studies are used. Determining the CVR it is based on clinical guidelines that address cardiovascular prevention.

In the occurrence of CVD is influenced by different factors such as tobacco consumption, obesity, dyslipidemia and diabetes. The risk of diabetes can be determined with different scales among which we highlight the FINRISK (FINnish Diabetes RIsk Score) questionnaire for being perhaps the most widely used. FINRISK has been successfully implemented as a practical screening instrument to assess diabetes risk and to detect undiagnosed type 2 diabetes in European populations[2-4]. However it has also become evident that it is not universally applicable among all ethnic groups and populations[5,6].

There are many indexes that help predict CVD from classic Body Mass Index (BMI), waist circumference and waist to height ratio to the most recent Body Adiposity Index (BAI) [7,8]. There are other indices that could perhaps be useful in predicting these CVD among which are the Body Shape Index (ABSI) at some authors they have linked to an increased risk of cardiovascular mortality[9], the Visceral Adiposity Index (VAI) which has been linked with visceral fat levels[10], type 2 diabetes[11] and coronary artery disease[12], Cholindex which has been linked with coronary artery disease[13], the Conicity Index (CI)) which has been linked with high coronary risk[14] and Hypertriglyceridemic waist (HTGW) has been associated with type 2 diabetes[15], coronary artery disease[16] and even acute myocardial infarction[17].

An analysis of the scientific literature shows that previous indexes have not been used too much in cardiovascular prevention but perhaps can provide valuable information on the assessment of CVR.

For all these reasons, and trying to improve cardiovascular prevention, this study presents the main objective is to determine what relationship exists between FINRISK test values and the values of these indices.

Materials and Methods

Subjects and study protocol

A cross-sectional study with adult workers (ages, 20-69 years) was performed. All subjects were belong to different productive sectors. Participants in the study were systematic selected during their work health periodic examination between January 2018 and December 2019. Every day each worker was assigned a number and half of the examined workers were randomly selected using a random number table. Thus, from a total population of 130487 workers, 65200 of them were invited to participate in the study. 4402 (6.8%) refused to participate and 1756 (2.8%) they are excluded to be diabetic and not being able to perform the FINRISK test, being the final number of participants 59042 (90.4%), with 25510 women (43.2%) and 33532 men (56.8%). The mean of age of participants in the study was 39.70 years (SD±10.25). All participants were informed of the purpose of this study before they provided written informed consent to participle. Following the current legislation, members of the Health and Safety Committees were informed as well. The study protocol was in accordance with the Declaration of Helsinki and was approved by the relevant research ethics committee. After acceptance, a complete medical history, including family and personal history and FINRISK questionnaire, was recorded. The following inclusion criteria were considered: age between 18 and 70 (working age population), no diabetic, agreement to participate in the study and to be gainfully employed. Subjects who did not meet any of the inclusion criteria and those who refused to participate were excluded from the study.

Measurements and calculations

All anthropometric measurements were made in the morning, after an overnight fast, at the same time (9 a.m.), and according to the recommendations of the International Standards for Anthropometric Assessment (ISAK)[18]. Furthermore, all measurements were performed by well trained technicians or researchers to minimize coefficients of variation. Each measurement was made three times and the average value was calculated. Weight and height were determined according to recommended techniques mentioned above. Body weight was measured to the nearest 0.1 kg using an electronic scale (Seca 700 scale, Secagmbh, Hamburg). Height was measured to the nearest 0.5 cm using a stadiometer (Seca 220 (CM) Telescopic Height Rod for Column Scales, Secagmbh, Hamburg). BMI was calculated as weight (kg) divided by height (m) squared (kg/m^2). Criteria to define overweight were the ones of the World Health Organization (WHO)[19] which considers obesity when BMI ≥ 30 kg/m^2. Abdominal waist was measured using a flexible steel tape (Lufkin Executive Thinline W 606). The plane of the tape was perpendicular to the long axis of the body and parallel to the floor. Waist circumference was measured at the level of the umbilicus and superior iliac crest. The measurement was made at the end of a normal expiration while the subject stood upright, with feet together and arms hanging freely at the sides. Waist circumference (WC) was measured using a tapeline at the level midway between the lateral lower rib margin and iliac crest. Waist-to-height ratio (WtHR) was calculated by dividing WC by height in cm.

Venous blood samples were taken from the antecubital vein with suitable vacutainers without anticoagulant to obtain serum. Blood samples were taken following a 12 h overnight fast. Participants were seated at rest for at least 15 minutes before blood samples were taken. Serum was obtained after centrifugation (15 min, 1,000 g, 4°C) of blood samples. Serum was stored at -20°C and analysis were performed within 3 days. Concentrations of glucose, cholesterol and triglycerides were measured in serum by standard procedures used in clinical biochemistry laboratory using a clinical system Beckman Coulter SYNCHRON CX®9 PRO (Beckman Coulter, Brea, CA, USA).

Blood pressure was determined after a resting period of 10 minutes in the supine position using an automatic and calibrated sphygmomanometer OMRON M3 (OMRON Healthcare Europe, Spain). As indicated for the anthropometrical measures, blood pressure was measured three times with a one-minute gap between each measurement and an average value was calculated.

FINRISK questionnaire value 8 items: age, BMI, waist circumference, physical activity, dietary consumption of fruits, vegetables, and berries, Use of antihypertensive medication, previously measured high blood glucose and family history of diabetes. The maximum achievable score is 26. Less than 7 points is considered low risk, 7-11 point slightly elevated risk, 11-14 points moderate risk, 15-20 points high risk and 21-26 points very high risk.

Real Body shape index (ABSI)[9] was calculated using the equation:

- Waist circumference (cm)/BMI$^{2/3}$ weight$^{1/2}$ (kg)

Theoretical ABSI is set based on sex and age. The ratio between real and theoretical ABSI is called ABSI relative risk (ABSI RR). ABSI RR <1 is considered abnormal.

Conicity index(CI)[14] was calculated using the equation:

- Waist circumference (m)/ (0,109 √ weight (kg)/height (m))

The cut-off to consider high CI were 1.18 for women and 1.25 for men.

Visceral Adiposity Index (VAI)[20] was calculated using the equations:

Women (Waist circumference /(39.68+(1.89 BMI)) x (triglycerides/1.03) x (1.31/HDL-C)

Men (Waist circumference /(36.58+ (1.89 BMI)) x (triglycerides /0.81) x (1.52/HDL-C)

The cut-off to consider optimal VAI[21] were < 30 years (≥2.52) 30-42 years (≥ 2.23) 43-51 years (≥1.92) 52-65 years (≥ 1.93) ≥ 66 years (≥ 2.00)

Cholindex13 was calculated using the equations:

- LDLC-HDL-C (if triglycerides <400 mg/dl) or LDL-C-HDL-C+TG/5 (if triglycerides ≥ 400 mg/dl)

The cut-off to consider high Cholindex was 80 mg/dl

We believe that there are Hypertriglyceridemic waist (HTGW)[15] when:

- Waist circumference ≥ 88cm in women and ≥102 cm in men and triglycerides ≥ 150 mg/dl.

Statistical analyses

All the data were tested for their normal distribution (Kolmogorov-Smirnov test). Results are expressed as means and standard deviations (SD) and, when required, in percentages. Student t test for unpaired data was used to evaluate differences in anthropometric and biochemical characteristics between genders. Chi-square test was used for the difference of proportions. The existence of significant bivariate correlations between parameters such as ABSI, CI, VAI and Cholindex and FINRISK questionnaire was ascertained by determining Pearson or Spearman correlation coefficients. Statistical analysis was carried out using IBM SPSS Statistics 27.0 software (SPSS/IBM, Chicago, IL, USA). Significance was accepted at $p<0.05$.

Results

Age and anthropometrical and clinical characteristics of the participants in the study as a whole and categorized by gender are shown in **table I**. Significant differences between men and women were found in all parameters analyzed with higher values of age, anthropometric characteristics (height, weight, body mass index, waist circumference, and waist to height ratio), systolic and diastolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol and triglycerides in men.

The mean values for the different indices according FINRISK questionnaire are shown in **table II**. The ABSI, VAI and Cholindex values in women are worsening in parallel with FINRISK test values, the same applies to men. The Conicity index values behave differently in men and women, in men also they are getting worse with increasing the value of the FINRISK test, however in women no clear relationship with the test was observed.

The prevalence of normal and altered values of the different indices according FINRISK questionnaire values are shown in **table III**. In women, the prevalence of high

VAI, HTGW and high Cholindex is increasing in parallel with the increase in the value of the FINRISK test, in men we can observe the same with high VAI, HTGW, high CI and high Cholindex. ABSI altered shows no clear relationship with the FINRISK questionnaire values in women and men. In women this relationship was not seen with the high CI.

The Pearson correlations between parameters such as ABSI, CI, VAI and Cholindex and FINRISK questionnaire was -0.087 ABSI, 0.242 CI, 0.398 VAI and, 0.329 Cholindex , p-value <0.01.

Discussion

Tanto los valores medios como la prevalencia de valores elevados de todas las escalas analizadas en este estudio van aumentando a medida que lo hacen los valores del test de Finrisk, esta situación se puede apreciar tanto en las mujeres como en los hombres.

Sólo hemos encontrado un estudio que relacione los valores del test de Finrisk con escalas relacionadas con el riesgo cardiovascular como hemos hecho nosotros , aunque no empleando las mismas escalas. Este estudio

Table I: Anthropometric, clinical and analytical characteristics of participants in the study.

Characteristics[1]	Women (n=25,510)	Men (n=33,532)	Total (n=59,042)	p value[1]
Age (years)	39.30 ± 10.10	40.01 ± 10.35	39.70 ± 10.25	<0.0001
Weight (kg)	161.32 ± 6.51	173.94 ± 7.04	168.49 ± 9.25	<0.0001
Height (cm)	64.87 ± 12.94	81.06 ± 13.75	74.06 ± 15.62	<0.0001
BMI (kg/m²)	24.94 ± 4.84	26.78 ± 4.16	25.98 ± 4.56	<0.0001
Waist circumference (cm)	75.24 ± 9.66	88.37 ± 9.54	82.69 ± 11.59	<0.0001
WtHR	0.47 ± 0.06	0.51 ± 0.06	0.49 ± 0.06	<0.0001
Systolic BP (mmHg)	114.36 ± 14.94	124.91 ± 15.36	120.35 ± 16.06	<0.0001
Diastolic BP (mmHg)	70.29 ± 10.34	75.77 ± 10.74	73.40 ± 10.91	<0.0001
Total cholesterol (mg/dl)	192.78 ± 36.39	196.74 ± 38.63	195.03 ± 37.73	<0.0001
HDL-C (mg/dl)	55.03 ± 9.17	50.68 ± 7.53	52.56 ± 8.56	<0.0001
LDL-C (mg/dl)	120.39 ± 36.92	121.82 ± 37.18	121.20 ± 37.07	<0.0001
Triglycerides (mg/dl)	86.98 ± 43.77	123.24 ± 85.76	107.58 ± 72.99	<0.0001

BMI, Body mass index. WHtR, waist-to-height-ratio. Systolic BP, Systolic blood pressure. Diastolic BP, Diastolic blood pressure.
HDL-C, high-density lipoprotein cholesterol. LDL-C, low-density lipoprotein cholesterol.
1. Data are expressed as means ± standard deviation.
2. Statistical significance was estimated by independent t-test

Table II: Mean values of the different indices according FINRISK test.

			ABSI		CI		VAI		Cholindex	
		n[2]	Mean (SD)	p value[1]	Mean (SD)	p value[1]	Mean (SD)	p value[1]	Mean (SD)	p value[1]
Women	Low	19,057	0.090 (0.080)	<0.0001	1.08 (0.08)	<0.0001	2.14 (1.09)	<0.0001	60.75 (40.78)	<0.0001
	Slightly raised	4,777	0.091 (0.012)		1.14 (0.14)		3.01 (1.94)		77.08 (41.26)	
	Moderate	1,017	0.088 (0.011)		1.12 (0.13)		3.33 (2.10)		84.26 (40.31)	
	Hight	643	0.088 (0.012)		1.15 (0.14)		4.15 (2.83)		88.81 (41.27)	
	Very hight	16	0.084 (0.090)		1.11 (0.11)		6.06 (3.74)		99.66 (45.81)	
Men	Low	22,465	0.094 (0.070)	0.010	1.17 (0.07)	<0.0001	2.53 (1.63)	<0.0001	66.36 (39.56)	<0.0001
	Slightly raised	8,117	0.094 (0.090)		1.23 (0.11)		4.48 (3.96)		84.35 (43.70)	
	Moderate	1,856	0.093 (0.080)		1.24 (0.10)		5.17 (4.26)		89.74 (44.86)	
	Hight	960	0.093 (0.090)		1.25 (0.11)		6.28 (5.67)		90.37 (49.95)	
	Very hight	134	0.092 (0.080)		1.25 (0.10)		7.14 (5.56)		99.63 (46.40)	

ABSI, Body shape index. CI, Conicity index.
1. Statistical significance was estimated by independent t-test
2. Number of participants in the study.

Table III: Cataloging the various indices according on the value of FINRISK test by sex.

	Women					Men					
	Low	Slightly raised	Moderate	High	Very high	Low	Slightly raised	Moderate	High	Very high	p value
High VAI	37.7	66.0	74.6	84.9	93.8	48.7	79.6	86.3	88.2	94.0	<0.0001
Normal VAI	62.3	34.0	25.4	15.1	6.3	51.3	20.4	13.7	11.8	6.0	
HTGW absence	99.9	90.1	85.1	71.2	43.8	98.3	76.6	67.6	57.2	44.0	<0.0001
HTGW presence	0.1	9.9	14.9	28.8	56.3	1.7	23.4	32.4	42.8	56.0	
ABSI Relative Risk altered	89.9	76.7	85.3	81.0	100.0	82.8	74.2	81.6	76.3	84.3	<0.0001
Normal ABSI Relative Risk	10.1	23.3	14.7	19.0	0.0	17.2	25.8	18.4	23.8	15.7	
High Conicity index	11.2	35.1	28.0	39.5	37.5	14.5	41.0	47.7	48.6	48.5	<0.0001
Normal Conicity index	88.8	64.9	72.0	60.5	62.5	85.5	59.0	52.3	51.4	51.5	
High Cholindex	31.0	46.8	51.4	60.2	75.0	34.9	51.9	57.5	54.4	68.7	<0.0001
Normal Cholindex	69.0	53.2	48.6	39.8	25.0	65.1	48.1	42.5	45.6	31.3	

VAI, Visceral Adiposity Index. HTGW, Hypertriglyceridemic waist. ABSI, Body Shape Index.

realizado en población Española determinó los valores de diferentes parámetros antropométricos, clínicos (índice de masa corporal, perímetro de cintura, índice cintura altura, tensión arterial), analíticos (perfil lipídico y glucemia) y escalas relacionadas con riesgo cardiovascular (índices aterogénicos, síndrome metabólico, REGICOR, SCORE, edad del corazón y edad vascular) en más de 68.000 personas y al igual que nosotros observó como todas las escalas aumentaban sus valores a medida que lo hacían los valores del test de Finrisk.

Entre las fortalezas de este estudio destacaremos el gran tamaño de la muestra que supera las 59.000 personas y la variedad de escalas que se han tenido en cuenta.

Como limitación principal es que se ha realizado en población laboral por lo que se han excluido personas menores de 18 y mayores de 69 años lo que impide extrapolar los resultados a la población general.

Conclusiones

Existe una relación directa entre los valores del test de Finrisk y los valores de todas las escalas relacionadas con el riesgo cardiovascular analizadas en este trabajo, de manera que a medida que se incrementan los valores del test lo hacen también los valores de todas las escalas.

Interests conflict
The researchers declare that they have no conflict of interest.

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