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ORIGINAL

Values of different index related to cardiovascular risk according the Findrisc test scores in caucasian

Valores de diferentes índices relacionados con riesgo cardiovascular según las puntuaciones del test Findrisc en caucásicos

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Abstract

Introduction: Diabetes is a very prevalent disease and therefore it is very important to have tools to assess the risk of suffering from it.
Methods: A descriptive and cross-sectional study was carried out on 59,042 workers from different productive sectors. The relationship between different scales of overweight, obesity and cardiovascular risk such as waist circumference, waist to height ratio, body shape index, visceral adiposity index, conicity index, hypertriglyceridemic waist and Cholindex with the Findrisk type 2 diabetes risk scale was evaluated.
Results: A worsening in the mean values of the different scales analyzed is observed as the value of the Findrisk test increases in both sexes. An increase in the prevalence of altered values of these same scales is also observed as the values of the Findrisk test increase and equally in both sexes.
Conclusion: As expected, the Findrisk test is directly related to the different scales of overweight, obesity and cardiovascular risk analyzed.

Keywords: Cardiovascular diseases, diabetes, obesity, abdominal obesity, Finrisk test.

Resumen

Antecedentes: La Diabetes es una enfermedad prevalente y por lo mismo es muy importante tener las herramientas para evaluar el riesgo de sufrirla.
Material y métodos: Se realizó un estudio descriptivo y transversal en 59,042 trabajadores de diferentes sectores productivos. Se evaluó la relación entre diferentes escalas de sobrepeso, obesidad y riesgo cardiovascular como circunferencia de la cintura, índice cintura/altura, índice de forma corporal, índice de adiposidad visceral, índice de conicidad, cintura hipertrigliceridemica y cholindex con la escala findrisk de riesgo de diabetes tipo 2.
Resultados: Se observó un empeoramiento de los valores medios en las diferentes escalas analizadas cuando los valores del test findrisk aumentaban en ambos sexos. Se observó también un incremento en la prevalencia de valores alterados en estas mismas escalas cuando los valores del Findrisk test se incrementaban, igualmente en ambos sexos.
Conclusiones: El test Finrisk se relaciona directamente con las escalas de sobrepeso, obesidad y riesgo cardiovascular analizadas.

Palabras clave: Enfermedades cardiovasculares, diabetes mellitus, obesidad, obesidad abdominal, test de Finrisk.

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 FINDRISC (FINnish Diabetes RIsk Score) questionnaire for being perhaps the most widely used. FINDRISC 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.

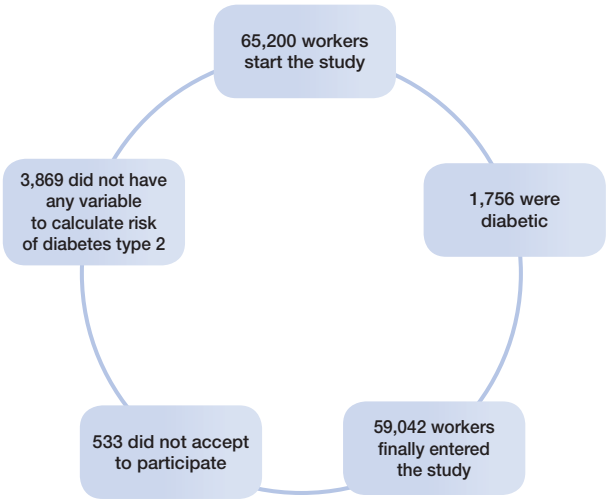
For all these reasons, and trying to improve cardiovascular prevention, this study presents the main objective is to determine what relationship exists between FINDRISC test values and the values of these indices.

Materials and Methods

Subjects and Study Protocol

A cross-sectional study with Caucasians adult workers was performed. All subjects were from different productive sectors. Participants in the study were systematic selected during their work health periodic examination between January 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 130,487 workers, 65,200 of them were invited to participate in the study. 3,869 They do not have any parameter necessary to calculate any of the scales. 533 refused to participate and 1,756 they are excluded to be diabetic and not being able to perform the FINDRISC test, being the final number of participants 59,042 (see flowchart in **figure 1**), with 25,510 women (43.2%) and 33,532 men (56.8%). The mean of age of participants in the study was 39.7 years (SD±10.30).

Figure 1: Flowchart of participants.



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/m². 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.

FINDRISC 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 were < 30 years (≥2.52) 30-42 years (≥ 2.23) 43-51 years (≥1.92) 52-65 years (≥ 1.93) ≥ 66 years (≥ 2.00)

Cholindex[13] 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 FINDRISC 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 $p<0.05$.

Ethical considerations and aspects

The study was approved by the Institutional Review Board of the Region. All procedures were performed in accordance with the ethical standards of the institutional research committee and with the 2013 Declaration of Helsinki. All patients signed written informed consent documents prior to participation in the study.

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 FINDRISC questionnaire are shown in **table II**. The ABSI, VAI and Cholindex values in women are worsening in parallel with FINDRISC 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 FINDRISC test, however in women no clear relationship with the test was observed.

The prevalence of normal and altered values of the different indices according FINDRISC 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 FINDRISC 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 FINDRISC questionnaire values in women and men. In women this relationship was not seen with the high CI.

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

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

Characteristics[1]	Women (n=25,510)	Man (n=33,532)	Total (n=59,042)	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 (cm) circumference	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
Dyastolic BP (mmHg)	70.29 ± 10.34	75.77 ± 10.74	73.40 ± 10.91	<0.0001
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. WtHR, waist-to-height-ratio. Systolic BP, Systolic blood pressure. Dyastolic BP, Diastolic blood pressure.
HDL-C, high-density lipoprotein cholesterol. LDL-C, low-density lipoprotein cholesterol.
[1] data are expressed as means ± standard deviation.
Statistical significance was estimated by independent t-test

Discussion

Despite the evident relationship between overweight and obesity with the onset of diabetes, we have not found in the literature consulted, and in the different databases, any study that establishes relationships between any type 2 diabetes risk scale, whether Findrisk or other, with scales that assess overweight and obesity such as those assessed in this study.

Although there are a large number of studies that analyze the Findrisk test, almost none relate it to this type of scales. We found two studies carried out in the Spanish population[22,23] that related the values of this test with cardiovascular risk scales such as atherogenic indices, metabolic syndrome, REGICOR, SCORE, heart age and vascular age.

The strengths of the study include the large sample size, almost 60,000 workers, and the fact that for the first time

Table II: Mean values of the different indices as FINDRISC test.

			ABSI		CI		VAI		Cholindex	
		n²	Mean (SD)	p value[1]	Mean (SD)	p value[1]	Mean (SD)	p value[1]	Mean (SD)	p value[1]
Women	Low	19057	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	4777	0.091 (0.012)		1.14 (0.14)		3.01 (1.94)		77.08 (41.26)	
	Moderate	1017	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	22465	0.094 (0.070)		1.17 (0.07)		2.53 (1.63)		66.36 (39.56)	
	Slightly raised	8117	0.094 (0.090)		1.23 (0.11)		4.48 (3.96)		84.35 (43.70)	
	Moderate	1856	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 FINDRISC test by gender. VAI, Visceral Adiposity Index. HTGW, Hypertriglyceridemic waist. ABSI, Body Shape Index.

			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 Riskaltered	89.9	76.7	85.3	81.0	100.0	82.8	74.2	81.6	76.3	84.3	<0.0001
Normal ABSI RelativeRisk	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	

a type 2 diabetes risk scale such as the Findrisk is related to other scales related to overweight and cardiovascular risk such as the body shape index, visceral adiposity index, conicity index and Cholindex, which makes this study a future reference for further research.

The limitations of this study are that it was carried out in a specific region and in a working population, so that the results cannot be extrapolated to the general population and to other regions.

Authorship contributions

PATRÓN O, HECTOR.: conception, study design, data collection and drafting of the original version of the manuscript.
KE A. EDMUNDO: study conception, data collection and analysis, and critical revision of the paper.
MANZANERO F. ZOE: conception and design of the study, analysis of the data, critical revision of the manuscript and writing of the final version of the manuscript. All authors approved the final version of the manuscript.

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