

ORIGINAL ARTICLE

Are Body Fat and Uric Acid associated with Cardiovascular Risk Scores? Cross-Sectional Analysis in the PROCARDIO-UFV Trial

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Abstract

Background: Risk scores are tools used to indicate the probability of occurrence of a certain cardiovascular event and to previously identify individuals at low, medium, and high risk for the development of cardiovascular diseases.

Objective: To establish the cardiovascular risk of users of a cardiovascular health attention program of a university, and assess its association with lifestyle, clinical, sociodemographic data, and other cardiometabolic risk markers.

Methods: Cross-sectional study with a sample of 197 participants. Demographic, anthropometric, clinical, and metabolic data, eating habits and lifestyle information were collected using the Global Risk Score and the Framingham Risk Score. P-value < 0,05 was considered statistically significant.

Results: According to the Framingham Risk Score, 84% of the assessed population was considered low risk and 16% as intermediate/high risk. However, according to the Global Risk Score, 18% of the participants were low risk, 45% were intermediate risk and 37% were high risk for infarction or death from coronary heart disease in 10 years.

Conclusion: Excess body weight and uric acid serum levels showed to be significant cardiovascular risk markers in addition to those of the score and, consequently, they should be considered in clinical practice. (Int J Cardiovasc Sci. 2017;30(4):313-324)

Keywords: Cardiovascular Diseases/mortality; Obesity; Uric Acid; Life Style; Risk Factors.

Introduction

According to the World Health Organization (WHO), cardiovascular diseases (CVD) accounted for 33% of deaths in Brazil in 2011.¹ In Brazil, the cost of treating chronic arterial diseases has a large budgetary impact on the health sector. Moreover, it is known that Risk Factors (RF) have great influence on CVD onset.²

Therefore, over the years, several studies were carried out and, based on them, different Risk Scores (RS) were created. To prevent underestimation or overestimation of the individual's risk, some algorithms, based on regression analyses of population studies, have been created to identify individuals at low, medium, and high risk in advance.³ In 1948, the Framingham

Heart Study, of which objective was to identify the common factors or characteristics that contribute to CVD, led to the identification of the main RF for CVD: age, gender, systemic arterial hypertension (SAH), hypercholesterolemia, smoking, obesity, diabetes, and sedentary lifestyle.⁴

Another score used and recommended by the V Brazilian Guideline on Dyslipidemia and Atherosclerosis Prevention of 2013 is the Global Risk Score (GRS), which estimates the risk of myocardial infarction, cerebrovascular accident, peripheral vascular failure, or heart failure in 10 years.⁵ RS are low-cost and easy-to-use tools because they estimate the risk based on simple, clinical, and laboratory variables routinely used in clinical practice.⁶

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From the nutritional point of view, it is important to identify the RF that influence CVD, to help with adequate diet intervention, both to prevent and treat them, whereas the RS allows an adequate intervention to improve the individual's metabolism, lipid profile, and lifestyle, which associated with dietary therapy, may reduce the incidence and prevalence of new cardiovascular events.⁵

The present study aimed to establish the cardiovascular risk of the users of a cardiovascular health care program of a university, as well as to evaluate their association with lifestyle, clinical, and sociodemographic factors and other cardiometabolic risk markers.

Methods

Subjects

This is a cross-sectional study, with data collection between November 2012 and March 2016, based on a subsample of the Cardiovascular Health Care Program of Universidade Federal de Viçosa (PROCARDIO-UFV). PROCARDIO-UFV is a program that promotes nutritional and cardiovascular health intervention and education to the UFV community. The program's inclusion criteria are: patients of both genders, age ≥ 20 years, being an UFV employee/employee's spouse or offspring or UFV student, having been diagnosed with CVD or occurrence of cardiometabolic RF, such as excess weight (Body Mass Index - BMI ≥ 25 kg / m²); hypertriglyceridemia (≥ 150 mg / dL); hypercholesterolemia (≥ 200 mg / dL), low HDL (men < 40 mg / dL and women < 50 mg / dL), blood pressure ≥ 130 / ≥ 85 mmHg or SAH diagnosis (systolic blood pressure - SBP ≥ 140 and / or Diastolic Blood Pressure - DBP ≥ 90 mmHg), fasting blood glucose ≥ 100 mg/dL or diagnosis of Diabetes Mellitus (DM) (fasting blood glucose ≥ 126 mg / dL) and / or medical referral. The program is registered in the Brazilian Registry of Clinical Trials (ReBEC) under the primary identifier RBR-5n4y2g.⁷

The data used were related to the first consultation. Of the 417 program users, 197 (116 women) were selected for having complete data on SBP, DBP, Total Cholesterol (TC), and fractions (HDL-c, LDL-C), triacylglycerols, age, presence or not of smoking and DM - all factors used in the evaluation of the assessed scores.

The study was approved by the UFV Ethics Committee on Human Research (Of. Ref. 066/2012/CEPH), on June 27, 2012, in accordance with Resolution 466/2012 of the National Health Council on research involving human

beings. All subjects who agreed to participate in the study signed the Free and Informed Consent form, in accordance with the Helsinki Declaration principles.

Sociodemographic and lifestyle variables

Sociodemographic and lifestyle variables were collected through the patients' self-report and from medical records. Variables such as age, gender, marital status, and professional link with UFV were collected. Lifestyle variables included smoking (smokers or nonsmokers), regular physical activity (yes or no), and hours of sleep a day.

Anthropometric and body composition evaluation

Weight, height, and waist circumference were measured according to a protocol established in PROCARDIO-UFV.⁸ BMI was calculated by dividing weight by squared height and classified according to the WHO criteria for adults.⁹ For the elderly, the classification was made according to Lipschitz.¹⁰ For the classification of abdominal obesity and cardiovascular risk, the criteria recommended by Alberti et al.¹¹, WC ≥ 80 cm for women and ≥ 90 cm for men, were used.

Percentage of Body Fat (%BF) (20/30 for men and women, respectively) was obtained through analysis of horizontal tetrapolar electrical bioimpedance (Biodynamics BIA 310 Model, Washington, USA), carried out with a standardized protocol.¹²

Biochemical and blood pressure evaluation

SBP and DBP levels were measured using a mechanical sphygmomanometer with a mercury column, according to the technique described in the VI Brazilian Hypertension Guidelines. SAH classification was also made according to the criteria of the VI Brazilian Hypertension Guidelines¹³, with a cutoff point ≥ 140 and ≥ 90 mmHg.¹³ The diagnosis of DM (fasting glycemia ≥ 126 mg / dL) followed the guidelines of the Report of The Expert Committee on Diagnosis and Classification of Diabetes Mellitus.¹⁴

For the metabolic evaluation, the following markers were analyzed: glucose, triacylglycerols, TC and fractions, Uric Acid (UA), platelets and leukocytes. LDL-c was calculated using Friedewald et al.'s equation.¹⁵ The criteria of the V Brazilian Guidelines for Dyslipidemia and Prevention of Atherosclerosis and the National Cholesterol Education Program's

Adult Treatment Panel III (NCEP-ATP III) were used to classify these variables.⁵

Food survey assessment

The volunteers answered a questionnaire about food habits, in which they were asked about the consumption of salt (little, normal, too much), fat (type of fat consumed) and alcohol.

Risk stratification

The present study used the Framingham Risk Score (FRS) and the GRS stratification, according to the IV and V Brazilian Guidelines for Dyslipidemias and Prevention of Atherosclerosis, respectively.^{3,5}

The values of TC and HDL-c for the classification of dyslipidemias were defined according to the V Brazilian Guideline on Dyslipidemias and Prevention of Atherosclerosis.⁵ Individuals were considered smokers when they self-reported smoking.

Global Risk Score

The variables associated to the risk of developing CVD that were incorporated into the GRS are: SBP, smoking, TC, HDL-c, glucose intolerance, gender, and age. For the classification of PROCARDIO-UFV users according to the GRS, the following criteria were used: age (zero to +15 and zero to +12 points, respectively, for men and women), HDL-c (-2 to +2 points), TC (zero to +4 and zero to +5 points, respectively, for men and women), untreated SBP (-2 to +3 points and -3 to +5 points respectively for men and women), treated SBP (zero to +5 points and -1 to +7, respectively, for men and women), smoking (zero to +4 points and zero to +3 points respectively for men and women) and diabetes (zero to +3 points and zero to +4 points, respectively, for men and women).

According to the sum of the points obtained, each subject was assigned a percentage probability of having cardiovascular events. Individuals whose probability of having major cardiovascular events (coronary artery disease, cerebrovascular disease, peripheral obstructive arterial disease, or heart failure) in 10 years was less than 5% were considered as low risk. Those who were classified in this category and who reported a family history of premature CVD were reclassified to intermediate risk. Men with a calculated risk $\geq 5\%$ and $\leq 20\%$ and women with calculated risk $\geq 5\%$ and $\leq 10\%$

of occurrence of any of the aforementioned events were considered as intermediate risk. Those with a calculated risk $> 20\%$ for men and $> 10\%$ for women over a 10-year period were considered as high risk.⁵

Framingham Risk Score

The assignment of points according to the FRS occurred according to the criteria of the Brazilian Society of Cardiology (SBC).³

For the classification of users of PROCARDIO-UFV using the FRS, age (-9 to +13 and -7 to +16 points, respectively, for men and women), TC (zero to +11 and zero to +13 for men and women, respectively), smoking (zero to +8 and zero to +9 points, for men and women respectively), HDL-c (-1 to 2 points for men and women) and untreated SBP (zero to 2 and zero to +4 points, respectively, for men and women) and treated SBP (zero to +3 and zero to +6 points, respectively, for men and women).

In the second phase of the calculation, after these steps, the points acquired were added up and the absolute risk in 10 years was obtained. Men who scored < 0 to 12 points were classified as low risk ($< 10\%$); as intermediate risk ($\geq 10\% \leq 20\%$) those who scored 13 to 15 points; and high risk ($> 20\%$) those who scored more than 16 points. Women who scored < 9 to 19 points were classified as low risk ($< 10\%$); as intermediate risk ($\geq 10\% \leq 20\%$) those who scored 20 to 22 points; and high risk ($> 20\%$) those who scored more than 23 points.

Statistical analysis

Data were shown as mean \pm standard deviation, or as median (25th and 75th percentiles), according to the normality of each variable, which was evaluated by the Kolmogorov-Smirnov normality test. The unpaired Student's t tests and Analysis of Variance (ANOVA) followed by Tukey's post hoc were used to compare the variables between the groups according to normality and the number of comparison groups. The chi-square test was used for comparison of frequencies. Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS), version 20.0, and the level of statistical significance was set at 5%.

The categorical variables were shown, as follows: professional link with the UFV (employee, student or family member); marital status (single, married, widowed or divorced); hypercholesterolemia if CT

≥ 200 mg / dL (yes or no); hypertriglyceridemia if TG ≥ 150 mg/dL (yes or no); diabetes if fasting glycemia ≥ 126 mg / dL (yes or no); SAH if blood pressure ≥ 130 and ≥ 85 mmHg (yes or no); physical activity (yes or no); smoking (never smoked, used to smoke, yes); alcohol (never drink, drink occasionally, drink every day, others); salt consumption (normal, little, a lot, not reported); use of fat (lard, vegetable oil, all options); and hours of sleep (not reported, ≤ 4 hours, 4 to 6 hours, 6 to 8 hours, ≥ 8 hours).

Results

In our sample, 58.9% of the subjects were females (Tables 1 and 2). According to the calculated FRS, 16% of the population was of intermediate/high risk. However, according to the FRS, 37% of the population was at high risk of infarction or death from coronary disease in 10 years.

The median age for individuals with low risk at the FRS was 38 years (25-53) and for intermediate /high risk, 60 years (56.2-67.7) with $p < 0.001$. In the GRS, the low risk group was 37 years (32 to 44); intermediate risk, 52 years (48 to 57); and high risk, 60 years (55 to 65), with $p < 0.001$. As for the professional link with the university, in the FRS 100% of the students were classified as low risk ($p < 0.05$), but the GRS showed that 50% were in the high-risk group ($p < 0.05$). Regarding university employees, 39.1% were classified as intermediate / high risk according to the FRS and 49.2% as high risk according to the GRS. Regarding SAH, according to the FRS, 25.9% of the individuals who were hypertensive were classified as intermediate/ high risk, and according to the GRS, 51.5% were classified as high risk ($p < 0.05$).

The median fasting glycemia (mg/dL), according to the FRS for the individuals classified as intermediate / high risk, was 99.5 (91 to 115) and in the GRS, 106 (96 to 126) for high risk ($p < 0.05$). As for triglycerides (mg/dL), according to the FRS, the median values were 156.5 (119.3 to 252.7) for individuals at intermediate/high risk and, in the GRS, 151 (117.3 to 227.5) for individuals at high risk ($p < 0.05$). UA values were significantly high in the intermediate/high risk groups in both scores. The mean and standard deviation of the UA values (mg / dL) in the intermediate / high risk group according to the FRS were 5.4 ± 1.4 and according to the GRS, they were 5.0 ± 1.2 for the high group. In the GRS, 81.3% of diabetics were classified as high risk ($p < 0.05$) ($p < 0.05$) (Tables 1 and 2).

Tables 3 and 4 are related to lifestyle and show that, according to the FRS, 30% of the smokers were classified as intermediate / high risk, and among those who smoked, 33.3% were also included in this risk group ($p < 0.05$). According to the GRS, 80% of the individuals who smoked were classified as high risk, and among those who used to smoke, 47.1% were classified as high risk ($p < 0.05$). Regarding the use of fats in FRS, 86% of the individuals using vegetable oil were classified as low risk ($p < 0.05$).

Regarding the nutritional status, among those classified according to the FRS as intermediate/high risk, 72.1% had excess weight ($BMI \geq 25 \text{ kg/m}^2$), whereas in the GRS, 80.9% of individuals with excess weight were classified as high risk. Regarding abdominal obesity ($WC \geq 88/102 \text{ cm}$ for women and men, respectively), in the FRS, 96.9% of the subjects were classified as intermediate/high risk, whereas in the GRS, 95.7% of those classified as high risk had abdominal obesity. Considering the excess body fat ($BF\% > 20/30$ for men and women, respectively), a prevalence of 76.9% was found in the individuals in the intermediate / high risk group of the FRS and 71.4% in the GRS.

In the intermediate / high risk group of the FRS, the mean and standard deviation of the BMI (kg/m^2) were higher when compared with the low-risk group ($p < 0.05$). According to this same score, $BF\%$ was also higher in the intermediate/high risk group, when compared to the low risk group ($p < 0.05$). In the high-risk group of the GRS, the mean WC was higher when compared to the other groups ($p < 0.05$). (Table 5)

Discussion

To know the prevalence of RF and assess the overall risk of developing CVD are crucial for effective prevention with the correct definition of therapeutic goals, aiming to minimize risks and maximize benefits.¹⁶

When comparing the risk stratification between the scores, it was observed that the risk distribution was higher in the GRS, whereas in the FRS, the number of individuals classified as low risk was very high, a fact that was also identified in the study by Oliveira et al.¹⁷

The FRS was carried out with measures of almost half a century ago. Therefore, there is a real possibility that the risk has changed over time. Moreover, the absolute risk of the participants in the Framingham study (North-American) is not necessarily the same as in other populations.⁴

Table 1 – Demographic, clinical, and lifestyle characteristics, according to the Framingham Risk Score

Variables	Framingham Risk Score		p value
	Low risk (n = 165)	Intermediate/high risk (n = 32)	
Gender, n (%)			
Male	56 (69.3)	25 (30.7)	< 0.001*
Female	109 (93.9)	7 (6.1)	
Age, years	38 (25-53)	60 (56-68)	< 0.001*
Professional link, n (%)			
Employee	42 (60.9)	27 (39.1)	< 0.001*
Student	79 (100)	–	
Family member	43 (89.6)	5 (10.4)	
Marital status, n (%)			
Single	78 (97.5)	2 (2.5)	0.028*
Married	73 (72.3)	28 (27.7)	
Widowed	6 (85.7)	1 (14.3)	
Divorced	6 (85.7)	1 (14.3)	
Hypercholesterolemia (TC ≥ 200 mg/dL)			
Yes	86 (81.9)	19 (18.1)	0.453
No	79 (85.9)	13 (14.1)	
Hypertriglyceridemia (TG ≥ 150 mg/dL)			
Sim	67 (80.7)	16 (19.3)	0.296
Não	89 (86.4)	14 (13.6)	
Diabetes (fasting glucose ≥ 126 mg/dL)			
Yes	11 (68.7)	5 (31.3)	0.089
No	144 (85.2)	25 (14.8)	
Arterial hypertension (BP ≥ 130 and ≥ 85 mmHg)			
Yes	57 (74.1)	20 (25.9)	0.003*
No	108 (90)	12 (10)	
Fasting glucose, mg/dL	89 (81-100)	99.5 (91-115)	0.004*
TC/HDL ratio	4.1 (3.4-4.9)	5.0 (4.0-6.0)	0.017*
LDL/HDL ratio	2.6 ± 1.0	3.2 ± 1.5	0.021*
Triglycerides, mg/dL	138.5 (100-199.7)	156.5 (119.3-252.7)	0.033*
Uric acid, mg/dL	4.4 ± 1.6	5.4 ± 1.4	0.001*
Leukocytes, mm ³	6.382.9 ± 1.673.6	6.201.4 ± 1.661.1	0.601
Platelets, mm ³	248.9 ± 51.8	239.72 ± 53.3	0.391

Data shown as mean (standard deviation), median, 25th and 75th percentiles, and frequencies; P value using Student's t-test or chi-square test.

* p < 0.05. TC: total cholesterol; TG: triglycerides; BP: blood pressure; HDL: high-density lipoprotein; LDL: low-density lipoprotein.

Table 2 – Demographic, clinical and lifestyle characteristics, according to the Global Risk Score

Variables	Global Risk Score			p value
	Low risk (n = 23)	Intermediate risk (n = 56)	High risk (n = 47)	
Gender, n (%)				
Male	6 (10.2)	27 (45.8)	26 (44.06)	0.031
Female	17 (25.4)	29 (43.3)	21 (31.34)	
Age, years	37 (32-44) ^a	52 (48-57) ^b	60 (55-65) ^c	< 0.001*
Professional link, n (%)				
Employee	5 (7.7)	28 (43.1)	32 (49.2)	0.040*
Student	9 (50)	9 (50)	–	
Family member	9 (21.4)	18 (42.9)	15 (35.7)	
Marital status, n (%)				
Single	10 (52.6)	7 (36.9)	2 (10.5)	0.043*
Married	12 (13.0)	42 (45.1)	39 (41.9)	
Widowed	1 (14.2)	3 (42.9)	3 (42.9)	
Divorced	–	4 (57.1)	3 (42.9)	
Hypercholesterolemia (TC ≥ 200 mg/dL)				
Yes	9 (14.5)	30 (48.4)	23 (37.1)	0.590
No	14 (21.9)	26 (40.6)	24 (37.5)	
Hypertriglyceridemia (TG ≥ 150 mg/dL)				
Yes	14 (26.9)	15 (28.9)	23 (44.2)	0.980
No	9 (13.2)	38 (55.9)	21 (30.9)	
Diabetes (fasting glucose ≥ 126 mg/dL)				
Yes	–	3 (18.7) ^a	13 (81.3) ^b	< 0.001*
No	23 (20.9)	53 (48.2)	34 (30.9)	
Arterial hypertension (BP ≥ 130 and ≥ 85 mmHg)				
Yes	8 (12.1)	24 (36.4)	34 (51.5)	0.001*
No	15 (25)	32 (53.3)	13 (21.7)	
Fasting glucose, mg/dL	89 (81-96) ^a	92 (85.2-102.5) ^b	106 (96-126) ^c	< 0.001*
TC/HDL ratio	4.4 (3.2-5)	4.1 (3.5-5.4)	4.6 (3.6-5.5)	0.390
LDL/HDL ratio	2.7 ± 1.1	2.8 ± 0.9	2.9 ± 1.4	0.495
Triglycerides, mg/dL	168 (112-214)	120 (91.5-189.5)	151 (117.3-227.5)	0.091
Uric acid, mg/dL	4.3 ± 1.0 ^a	4.2 ± 1.5 ^b	5.0 ± 1.2 ^b	0.016*
Leukocytes, mm ³	7.004.5 ± 1.636.3 ^a	6.055.6 ± 1.640.5 ^b	5.888.2 ± 1.517.3 ^b	0.028*
Platelets, mm ³	247.0 ± 54.2	235.2 ± 48.7	246.8 ± 52.4	0.521

Data are shown as mean (standard deviation), median, 25th percentile and 75th percentile and frequencies. Value of p through Analysis of Variance (ANOVA) or chi-square test. Letters a, b, and c: median / mean followed by different letters on the same line differ from each other at Tukey's test at the 5% probability level. * p < 0.05. TC: total cholesterol; BP: blood pressure; HDL: high-density lipoprotein; LDL: low-density lipoprotein.

Table 3 – Lifestyle and food variables according to the Framingham Risk Score

Variable	Framingham Risk Score		p value
	Low Risk (n=165)	Intermediate/High risk (n=32)	
Physical activity, n (%)			
Yes	91 (88.3)	12 (11.7)	0.093
No	74 (79.6)	19 (20.4)	
Smoking status, n (%)			
Never smoked	120 (92.3)	10 (7.7)	< 0.001*
Ex-smoker	38 (66.7)	19 (33.3)	
Smoker	7 (70.0)	3 (30.0)	
Alcohol consumption, n (%)			
Never drinks alcohol	64 (85.3)	11 (14.7)	0.289
Drinks sporadically	93 (83.8)	18 (16.2)	
Drinks everyday	3 (50)	3 (50)	
Other	1 (100)	–	
Salt consumption n (%)			
Normal	85 (85)	15 (15)	0.529
Little	52 (82.5)	11 (17.5)	
A lot	23 (79.3)	6 (10.7)	
Did not report	1 (100)	–	
Use of fats/oils, n (%)			
Lard	1 (100)	–	0.001*
Vegetable oil	153 (86.0)	25 (14.0)	
All options	7 (50)	7 (50)	
Hours of sleep, n (%)			
Did not report	1 (50)	1 (50)	0.357
≤ 4	19 (95)	1 (5)	
4-6	134 (83.2)	27 (16.8)	
6-8	3 (60)	2 (40)	
≥ 8	4 (80)	1 (20)	

Data shown as frequencies. P value using Student's t-test or chi-square test.

Both scores showed an evident association between age and coronary risk. The increase in both variables was proportional, which indicates the need to establish earlier and more frequent health promotion and prevention actions for cardiovascular diseases for the at-risk population, considering the trend towards increased

life expectancy and the resulting greater possibility of exposure to RF for CVD.¹⁸

The GRS and the FRS allowed a better visualization of variables related to the risk of developing coronary diseases in 10 years, making it essential to identify

individuals exposed to cardiovascular risk as a target group for preventive cardiovascular actions at the individual and population levels.¹⁹

Increased levels of physical activity and specific dietary changes should be encouraged.²⁰ Nutritional interventions

are effective in helping to reduce cardiovascular events in high-risk individuals. Protective diets are based on foods of plant origin in abundance (fruits, vegetables, whole grains, legumes, nuts, and others), olive oil and other vegetable oils as the main source of fat.²¹

Table 4 – Lifestyle and food variables, according to the Global Risk Score

Variable	Global Risk Score			p value
	Low risk (n = 23)	Intermediate risk (n = 56)	High risk (n = 47)	
Physical activity, n (%)				
Yes	13 (19.7)	31 (47.0)	22 (33.3)	0.436
No	10 (16.9)	25 (42.4)	24 (40.7)	
Smoking status, n (%)				
Never smoked	18 (25.7)	33 (47.2)	19 (27.1)	0.001*
Ex-smoker	5 (9.8)	22 (43.1)	24 (47.1)	
Smoker	–	1 (20)	4 (80)	
Alcohol consumption. n (%)				
Never drinks alcohol	21.7 (13)	41.7 (25)	36.7 (22)	0.360
Drinks sporadically	16.9 (10)	45.8 (27)	37.3 (22)	
Drinks everyday	–	1 (25)	3 (75)	
Other	–	1 (100)	–	
Salt consumption. n (%)				
Normal	9 (16.4)	25 (45.4)	21 (38.2)	0.932
Little	10 (20)	24 (48)	16 (32)	
A lot	4 (22.2)	5 (27.8)	9 (50)	
Not reported	–	1 (100)	–	
Use of oils / fats. n (%)				
Lard	100 (1)	–	–	0.195
Vegetable oil	19 (17.4)	51 (46.8)	39 (35.8)	
All options	3 (21.4)	3 (21.4)	8(57.2)	
Hours of sleep. n (%)				
Not reported	–	1 (50)	1 (50)	0.915
≤ 4	1 (8.3)	6 (50)	5 (41.7)	
4-6	22 (21.4)	43 (41.7)	38 (36.9)	
6-8	–	2 (50)	2 (50)	
≥ 8	–	1 (50)	1 (50)	

Data shown as frequencies. P value using chi-square test. * p <0.05.

Table 5 – Nutritional status according to cardiovascular risk scores

Variables	Framingham Risk Score			p value
	Low risk (n = 165)	Intermediate/high risk (n = 32)		
BMI (kg/m ²)	28.8 ± 5.8	31.0 ± 5.2		0.048*
Body fat (%)	30.7 ± 7.9	31.5 ± 7.1		< 0.001*
Waist circumference (cm)	95.6 ± 14.5	107.7 ± 13.0		0.621
Variables	Global Risk Score			p value
	Low risk (n=23)	Intermediate risk (n=56)	High risk (n=47)	
BMI (kg/m ²)	30.3 ± 5.9	29.4 ± 4.4	31.4 ± 5.8	0.182
Body fat (%)	32.6 ± 7.3	30.6 ± 8.0	32.7 ± 7.8	0.436
Waist circumference (cm)	99.9 ± 15.2 ^a	99.3 ± 11.6 ^b	106.1 ± 13.4 ^c	0.025*

*Data are shown as mean (standard deviation). P value using Student's t-test and Analysis of Variance (ANOVA). Median / mean followed by the same letter, in the same line, do not differ from each other at Tukey's test at the 5% probability level. * p < 0.05. BMI: body mass index.*

Moreover, higher values of BMI, %BF and WC were found in subjects with intermediate / high risk in both scores. According to Barbosa et al., the increase in morbidity and mortality due to chronic-degenerative diseases is associated with excess weight and fat deposits (mainly abdominal fat), favoring the occurrence of cardiovascular events - particularly coronary events.²² A study by Casanueva et al.²³ showed that CVD frequency increased in parallel with increased adiposity measured by BMI or WC. Moreover, abdominal obesity has been strongly associated with dyslipidemia and SAH.²⁴

Ademais et al.²⁵ found that the occurrence of obesity due to BMI and %BF was significantly higher in those individuals with a hypertriglyceridemic waist phenotype. Hermsdorff et al.²⁶ found that individuals with higher WC and waist-to-hip ratio had higher concentrations of C-reactive protein (CRP), complement C3, interleukin 6 (IL6) and retinol-binding protein (p < 0.05).

In another study,²⁷ the individuals with the highest tertiles of trunk fat and WC had the highest concentrations of CRP and IL6, in addition to higher values of blood pressure, Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) and LDL/HDL-c ratio (p < 0.05) – factors that, when associated, increase the chances for CVD.

In both scores, the presence of high values of fasting glycemia and SAH showed an increase that was proportional to the risk. The so-called “visceral

obesity” is associated with a higher mortality rate than peripheral obesity. This difference is due to the fact that visceral adipose tissue is metabolically more active than subcutaneous adipose tissue, causing, for instance, a high production of glucose and, consequently, type 2 DM and hyperinsulinemia. This higher secretion of insulin causes sodium retention, resulting in SAH.²⁸

Interestingly, we found that in both the FRS and GRS, UA values were increased, as they developed from the RS. The acute increase in UA levels seems to be a protective factor to oxidative stress, and its chronic increase is associated with the risk of chronic noncommunicable diseases.²⁹ Hyperuricemia has been associated with the occurrence of metabolic syndrome, which is recognized as an important cardiovascular RF. However, the use of UA has been commonly ignored in clinical practice and in the context of RF; its inclusion as a variable for cardiovascular risk stratification may be interesting, since it is an easy-to-perform and low-cost exam that is useful in clinical practice.^{8,30}

In the GRS, slightly more than half of the individuals with SAH were classified as high risk, which may be justified by its important association with the development of coronary diseases, mainly due to social and physical factors (educational level, elevated TC levels, and DM), which are frequently associated with SAH. Because there is a strong relationship with lifestyle, this disease can be prevented, reduced, or treated by adopting healthy life habits.³¹

Despite the low rate of smoking in the present study, smoking was significantly associated with coronary risk in both scores. It is known that smoking is a significant modifiable cardiovascular RF in the world's population.²⁹ According to Weiner et al.³², approximately one in five CVD deaths are caused by smoking, which, alone, doubles the possibility of the disease and, when associated with TC or HAS, this risk is multiplied by four (it becomes eight-fold higher when all three factors are combined).

The present study has limitations. As a cross-sectional study, it is not possible to infer a cause-effect association for the results. Furthermore, to calculate the scores, a group of variables was necessary, which were not always available in the medical records of all users. However, in the literature, few Brazilian studies perform the calculation of these scores to identify risk in patients with cardiometabolic risk.

Conclusion

The scores showed a difference in the risk distribution. Excess body weight and uric acid values were shown to be important markers of cardiovascular risk in addition to those present in the score. The need for further research on the subject and the development of more specific risk scores for each population was evident.

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Author contributions

Conception and design of the research: Hermsdorff HHM. Acquisition of data: Rodrigues JS, Almeida AP, Hermsdorff HHM. Analysis and interpretation of the data: Rodrigues JS, Almeida AP, Hermsdorff HHM. Statistical analysis: Rodrigues JS, Almeida AP, Hermsdorff HHM. Writing of the manuscript: Rodrigues JS, Almeida AP. Critical revision of the manuscript for intellectual content: Almeida AP, Rosa COB, Hermsdorff HHM.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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