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Characterization of metabolically healthy obese Brazilians and cardiovascular risk prediction

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ABSTRACT

Objective: The aim of this study was to identify metabolically healthy obese individuals (MHOs) and their characteristics, as well as to estimate cardiovascular risk using the Framingham score.
Method: In all, 258 adult individuals, with body mass index ≥30 kg/m^2, and no report of diabetes mellitus or cardiovascular disease, were classified according to their metabolic state considering two criteria: rhe National Cholesterol Education Program–Adult Treatment Panel III (NCEP-ATP III) and the homeostasis model assessment (HOMA). Biochemical, anthropometric, and body composition characteristics were compared between MHOs and metabolically unhealthy obese (MUO) individuals according to each criterion. Cardiovascular risk was estimated using the Framingham score.
Results: MHOs exhibited smaller waist circumference and lower body fat percentage, as well as lower blood glucose, triacylglycerols, and insulin levels, in addition to higher high-density lipoprotein cholesterol concentration, when HOMA criterion ($P < 0.05$) and associated criteria were adopted. The estimated cardiovascular risk was similar between the two groups according to the HOMA index; however, the risk was significantly lower according to the ATP III guidelines. Obese individuals at intermediate and high risk showed higher body fat percentage compared with those individuals at low risk.
Conclusions: MHOs had biochemical and anthropometric characteristics, such as lower body mass index, waist circumference, percent fat mass, glucose, triacylglycerols, and increased high-density lipoprotein, that made them different from those individuals classified as MUO. The latter exhibited increased risk for cardiovascular disease according to the Framingham score, when using the ATP III criterion alone or in conjunction with the HOMA index.

Introduction

The prevalence of obesity has been increasing sharply in recent decades, including in developing countries, and it is considered a public health problem. It is estimated that approximately 1 billion adults worldwide are overweight and at least 475 million are considered obese [1]. In Brazil, the percentage of obese adults has increased more than four times among men (2.8%–12.4%) and more than twice among women (8%–16.9%) from 1975 to 1985 and 2008 to 2009 [2].

Obesity is recognized as an important risk factor for the development of several metabolic complications, which may increase the risk for cardiovascular diseases (CVD) [1]. However, studies have shown a subgroup of obese individuals that seems to be protected or more resistant to the development of metabolic abnormalities associated with obesity [3–5]. These individuals are known as metabolically healthy obese (MHO) individuals, because despite having excess body fat, they have a favorable metabolic profile characterized by high insulin sensitivity, as well as normal blood pressure and lipid profile [4,6].

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No proper and standardized method exists to identify MHO individuals. Studies have used methods based on insulin sensitivity, such as the index derived from the oral glucose tolerance test and the homeostasis model assessment (HOMA), as criteria for the diagnosis of metabolic syndrome (MetS; Adult Treatment Panel [ATP III]), or the combination of the two methods [7,8].

The long-term consequences of obesity for MHO individuals' health, to our knowledge, are not known yet. Few prospective studies have been conducted [9–13], but some showed a lower risk for CVD associated with this phenotype when compared with eutrophic and metabolically unhealthy individuals [12,13].

Differentiating MHO from metabolically unhealthy obese (MUO) individuals becomes especially relevant if we consider that MUO individuals would be at greater risk for CVD and require primary prevention measures [11]. Scores for risk prediction have been used as valuable tools to estimate cardiovascular risk and guide prevention strategies. The Framingham Risk score (FRS) is the best known and most commonly used [14]. It is based on traditional risk factors such as sex, age, systolic blood pressure (SBP), tobacco smoking, concentration of total cholesterol (TC) and high-density lipoprotein cholesterol (HDL-C) [15].

The goal of this study was to classify obese individuals as MHO or MUO according to the criteria most often used to assess metabolic disorders (HOMA and ATP III) and to estimate cardiovascular risk through the FRS.

Participants and method

Population studied

The sample comprised 258 adults recruited through posters displayed at a health center in the municipality of São Gonçalo, State of Rio de Janeiro, Brazil. The study was approved by the Research Ethics Committee of the Clementino Fraga Filho University Hospital (Federal University of Rio de Janeiro, Brazil), under certificate no. 062/10. The participants of the study signed an informed consent form.

Adults of both sexes with body mass index (BMI) $\geq$30 kg/m^2 were included in the study. For the exclusion criteria we considered smokers; pregnant women; breast-feeding mothers; patients with pacemakers or metal prostheses; individuals who were following diets or making use of drugs to lose weight, or supplements of any kind; and individuals with CVD or diabetes mellitus. We considered the diagnosis of CVD or diabetes mellitus based on volunteers' reports or when they were taking medicines.

Anthropometric assessment, body composition, and blood pressure determination

Body mass was obtained using an electronic scale (Welmy, São Paulo, Brazil), with 200-kg capacity and accurate to 5 g. Stature was measured using a 2 m stadiometer coupled to the scale. BMI was calculated according to the World Health Organization (WHO) [16]. Waist circumference (WC) was measured using an inelastic metric tape, at the midpoint between the last rib and the iliac crest [16]. Neck circumference (NC) was measured with the patient standing, the head positioned in the horizontal plane, circling the neck with the inelastic tape measure below the laryngeal prominence [17]. Body composition was assessed by means of tetra polar bioimpedance analysis (Biodynamics 450, Australia) [18].

Blood pressure was measured by the auscultation method using a sphygmomanometer aneroide (Missouri, São Paulo, Brazil) and a stethoscope duoscopic (Missouri, São Paulo, Brazil) after the individual had remained sitting for $\geq$5 min [19].

Biochemical analyses

Blood samples were collected after a 12-h fast in vacuum blood collection tubes with gel and centrifuged for 15 min at 4000*g* to obtain the serum. Serum concentrations of TC, HDL-C, triacylglycerols (TGs), glucose, and uric acid were determined by the colorimetric enzymatic method in a LABMAX 240 automated biochemical analyzer (Labtest Diagnóstica S.A., Minas Gerais, Brazil). Concentrations of low-density lipoprotein cholesterol (LDL-C) were calculated using Friedewald

Table 1
General characteristics according to metabolic classification criteria

	HOMA		*P*-value	ATP III		*P*-value
	MHO ($\leq$2.78)	MUO		MHO	MUO	
N (%)	186 (72.1)	72 (27.9)		183 (70.9)	75 (29.1)	
Age (y)	43.8 ± 10.9	42.0 ± 11.6	0.222	41.6 ± 11.3	47.5 ± 9.4	<0.001
Sex, % (n)						
Female	91.4 (170)	87.5 (63)	0.342	90.7 (166)	89.3 (67)	0.734
Skin color, % (n)						
Whites	28.5 (53)	43.1 (31)	0.062	29 (53)	41.3 (31)	0.056
Non-whites	71.5 (133)	56.8 (41)		71 (130)	58.7 (44)	
Education, % (n)						
Illiterate	1.6 (3)	–		1.1 (2)	1.3 (1)	
<12 y	33.8 (63)	33.3 (24)	0.969	33.3 (61)	34.7 (26)	0.929
$\geq$12 y	64.5 (120)	66.7 (48)		65.6 (120)	64 (48)	
Marital status, % (n)						
Married	63.4 (118)	66.7 (48)		66.1 (121)	60 (45)	
Not married	36.6 (68)	33.3 (24)	0.930	33.9 (62)	40 (30)	0.342
Per capita income	672.8 ± 533.0	655.0 ± 533.4	0.809	688.3 ± 583.2	617.9 ± 378.5	0.335
Hypertension, % (n)	37.1 (69)	56.9 (41)	0.004	28.9 (53)	76 (57)	<0.001
Hyperthyroidism, % (n)	4.8 (9)	4.2 (3)	0.818	6.1 (11)	1.3 (1)	0.105
Physical activity, %	18.8 (35)	20.8 (15)	0.713	19.7 (36)	18.7 (14)	0.853

ATP, Adult Treatment Panel; HOMA, homeostasis model assessment; MHO, metabolically healthy obese; MUO, metabolically unhealthy obese
Mean and SD for the continuous variables and *t* test for comparing the groups or % for categorical variables of the χ^2 test