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Preliminary evaluation of the prevalence of sarcopenia in obese patients from Southern Italy

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ABSTRACT

Objectives: Sarcopenic obesity has not yet been widely defined. The aim of this study was to evaluate the prevalence of sarcopenia in a group of severely obese adults from southern Italy by using two different indexes: percentage of skeletal muscle mass (SMP) and skeletal muscle mass normalized for height (SMI); and to determine SMP and SMI cutoff points in a southern Italy reference population.

Methods: Skeletal muscle mass of 131 consecutive obese adult outpatients (51 men and 80 women; ages 45–67 y; body mass index 44.6 ± 7.7 kg/m^2), was assessed by bioimpedance analysis. SMP and SMI cutoff points to identify moderate and severe sarcopenia were calculated in a reference group of 500 young southern Italy adults (100 men and 400 women; ages 18–40 y; body mass index 25.2 ± 5.6 kg/m^2) and applied to assess the prevalence of sarcopenia in the study population.

Results: SMP cutoff points to identify moderate and severe sarcopenia were, 28.8% to 35.6% and ≤28.7% in men and 23.1% to 28.4% and ≤23% in women, respectively. The corresponding values for SMI were 8.44 to 9.53 kg/m^2 and ≤8.43 kg/m^2 in men, 6.49 to 7.32 kg/m^2 and ≤6.48 kg/m^2 in women. According to SMP, 23 of 51 (45.1%) men and 19 of 80 (23.8%) women were moderately sarcopenic; 28 of 51 (54.9%) men and 61 of 80 (76.3%) women met the definition of severe sarcopenia. Based on SMI, only 2 of 51 (3.9%) men were moderately sarcopenic.

Conclusions: This study confirms that sarcopenia rates vary widely in obese patients depending on the criteria used. SMP as a screening tool to identify a sarcopenia at-risk population.

Introduction

Sarcopenia describes a progressive and generalized loss of skeletal muscle mass (SM) and strength below a critical threshold [1].

Sarcopenic obesity (SO) was defined for the first time in 1996 as the combination of reduced fat-free mass (FFM) and excess fat mass (FM), evaluated by bioimpedance analysis (BIA) and expressed as body weight percentage [2–4]. Excessive caloric intake, physical inactivity, low-grade inflammation, insulin-resistance, and hormonal changes have been described to contribute to SO [4,5].

Sarcopenia and SO are associated with increased morbidity and mortality, reduced quality of life, increased rehospitalization, hospital length of stay, and health care costs [6–11]. SO is widespread and is constantly increasing in Western societies. The occurrence of SO strongly affects personal and social costs, and there is not yet a clear and widely accepted definition. To the best of our knowledge, there are no reliable criteria to evaluate its real prevalence [1,3,4,10]. In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) developed a clinical definition and consensus diagnostic criteria for sarcopenia: Assessment of both low muscle mass and low muscle function (strength or physical performance) was recommended [1]. The early identification and treatment of SO could affect patients' quality of life and health costs by influencing daily

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activities, level of disability, loss of independence, and increased risk for death [3,4,10].

In Italy and in southern Europe, a high prevalence of overweight and obesity in all age groups has been observed [12–16].

The present study aims to evaluate the prevalence of sarcopenia in a group of obese adults from southern Italy using two different criteria: percentage of skeletal muscle mass (SMP) and skeletal muscle mass normalized for height (SMI); and to determine SMP and SMI cutoff points in a southern Italy reference population.

Methods

Study population

In all, 131 consecutive obese individuals (51 men and 80 women; ages 45–67 y; body mass index [BMI] 45.7 ± 7.8 kg/m^2 in men and 47.3 ± 7.7 kg/m^2 in women) were recruited at the Obesity Outpatient Clinic of Clinical Medicine and Surgery Department of Federico II University Hospital in Naples, Italy. All participants were white and had been living in southern Italy for at least three generations. Exclusion criteria were presence of known diabetes, cardiovascular disease, organ failure, chronic inflammatory disease, malignancy, endocrine disease, and pregnancy. Case history was collected for each participant. A complete clinical examination was performed and blood samples for were collected to check the presence or absence of associated metabolic abnormalities.

Data from 500 young adults (ages 18–40 y; 100 men and 400 women) seen at the same hospital were used as reference data (control group) to define cutoff values for normal skeletal muscle mass and sarcopenia. This reference sample had a BMI distribution that reflected the BMI distribution in a southern Italian population [17]. Members of this population are healthy, are health care personnel or healthy relatives of obese patients whose demographic and anthropometric data have been collected as reference control groups for scientific aims (Table 1).

All participants provided informed consent before inclusion in the study. The study was approved by the local Ethics Committee and was therefore performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments (1998).

Anthropometry

Height was measured to the nearest 0.1 cm with a stadiometer; body weight was measured to the nearest 0.1 kg on a balance beam scale with participants wearing light clothes, without shoes. BMI was calculated as weight (kg) divided per squared height (meters). Body composition was evaluated by BIA (Human IM Plus II–DS Medica, Milano, Italy). Impedance for the whole body was measured at 50 kHz in the postabsorptive state, at an ambient temperature of 22°C to 24°C, after voiding and after being in the supine position for 20 min. No patients had clinical detectable edema, which could affect resistance and reactance [18,19]. Neither patients nor the control population had strongly represented skeletal muscle masses that could affect BMI reliability. Bioimpedance Index was calculated as the ratio squared height (m^2)/resistance (ohm). Total body water, FM, and FFM were calculated by Kushner's formula [20]. Anthropometry and body composition assessments were performed after overnight fast.

Table 1
Anthropometric characteristics of the Southern Italy young adult reference population

	Men (n = 100) Mean ± SD	Women (n = 400) Mean ± SD
Age (y)	27 ± 7	25 ± 6
Height (m)	1.75 ± 0.06	1.62 ± 0.06
Weight (kg)	79.1 ± 18.9	66 ± 16.4
BMI (kg/m^2)	25.8 ± 5.7	25.2 ± 5.7
Fat mass (kg)	20.9 ± 14.9	23.4 ± 11.5
Fat-free mass (kg)	58.9 ± 8.5	42.6 ± 7
SM (kg)	32.5 ± 3,7	21.4 ± 2.8
SMP (%)	42.5 ± 6.9	33.4 ± 5.2
SMI (kg/m^2)	10.6 ± 1.1	8.2 ± 0.8

BMI, body mass index; SM, skeletal muscle mass; SMI, SM index; SMP, percentage of SM

Skeletal muscle mass was calculated using the BIA equation as previously described [21]:

$$\text{SM (kg)} = \left[\left(\text{h}^2 / \text{BIA resistance} \times 0.401\right) + (\text{sex} \times 3.825) + (\text{age} \times 0.071)\right] + 5.102$$

where height (h) is in cm, BIA resistance is in ohms; as concerning sex, male = 1 and female = 0; age is in y. This BIA equation has been developed and cross-validated against magnetic resonance measures of whole-body skeletal muscle mass in a sample of 269 individuals with a wide age (18–86 y) and BMI (16–48 kg/m^2) range [21,22].

Definition of sarcopenia

Sarcopenia was evaluated using two different muscle mass indexes: 1) SMP, calculated as SM (kg)/body mass (kg) × 100 [22]; and 2) skeletal muscle mass normalized for squared height (h) or SMI, calculated as SM (kg)/h (m)^2 [6].

The sex-specific SMP and SMI cutoff points to identify moderate and severe sarcopenia were respectively calculated as −1 SD and −2 SD of the sex-specific mean of the young southern Italian reference population.

Participants were considered to have normal SM, if SMP and SMI were > −1 SD of the sex-specific mean for control group. Participants whose SMP and SMI were within −1 to −2 SD of the sex-specific mean for the reference population were considered moderately sarcopenic, and those whose SMP and SMI were <−2 SD of the sex-specific mean for the reference group were severely sarcopenic. This approach was adopted by in 2002 to detect sarcopenia in older Americans and is comparable with the evaluation of normal bone density, osteopenia, and osteoporosis on the basis of bone mineral density in a young reference population [22,23].

Successively, the prevalence of SO obtained by applying SMP and SMI NHANES (National Health and Nutrition Examination Survey) III cutoff points [6,22,24] was compared with the prevalence rates obtained by applying SMP and SMI cutoff points of the reference population. The SMP sex-specific cutoff points reported previously to identify the presence of moderate and severe sarcopenia were respectively, 31.6% to 37% and ≤31.5% in men; the corresponding values in women were 22.2% to 27.6% and ≤22.1% [22]. The SMI sex-specific cutoff points reported in a 2004 study were 8.51 to 10.75 kg/m^2 in men and 5.76 to 6.75 kg/m^2 in women for moderate sarcopenia and ≤8.50 kg/m^2 in men and ≤5.75 kg/m^2 in women for severe sarcopenia [1,6].

Statistical analysis

All data were digitized and analyzed with a dedicated software (SPSS-WIN version 14; SPSS, Chicago, IL, USA). All results are expressed as mean and SD. Student's *t* test for unpaired data was used to evaluate the differences between groups. Chi-square test was used for evaluation of prevalence in different groups. Two-way statistical analysis was performed to compare data between different groups (analysis of variance test). Differences were considered statistically significant for *P*-values < 0.05.

The sex-specific SMP and SMI cutoff points to identify moderate and severe sarcopenia were respectively calculated as −1 SD and −2 SD of the sex-specific mean of the reference population. Participants were considered to have normal SM when SMP and SMI were > −1 SD of the sex-specific mean for the reference population. Those whose SMP and SMI were within −1 to −2 SD of the sex-specific mean for the reference population were considered moderately sarcopenic, and those whose SMP and SMI were < −2 SD of the sex-specific mean for the reference group were classified as severely sarcopenic.

Results

The main characteristics of the 131 obese patients are described in Table 2. FFM, SM, SMP, and SMI were significantly higher in men than in women, whereas FM was significantly higher in women than in men. SM was 37.8 ± 6.2 kg in men and 25.5 ± 3.9 kg in women ($P < 0.001$). Mean SMP was 28.5% ± 3.5% in men and 21.6% ± 2.3% in women ($P < 0.001$). Mean SMI was 12.9 ± 1.7 kg/m^2 in men and 10.1 ± 1.5 kg/m^2 in women ($P < 0.001$). The sex-specific SMP and SMI cutoff points calculated in reference population to identify the presence of moderate and severe sarcopenia are reported in Table 3.