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# Body composition, physical performance and muscle quality of active elderly women

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ABSTRACT

Fat gain is one of the major factors aggravating physical disability in the elderly population, which presents an increase in fat mass and a decrease in lean mass compared to the young population. For this reason it is important to assess body composition and the effects of these alterations in obese elderly women. The purpose of this study was to assess body composition, physical performance and muscle quality in active elderly women. Cross-sectional study included 75 elderly women (29 eutrophic and 46 obese) 65–80 years old. Body composition was evaluated by dual energy X-ray absorptiometry (DXA) and the physical performance was determined by 6-minute walk test (6MWT), handgrip strength (HS) and knee extension strength (KES). Muscle quality was calculated as the ratio between muscle strength and lean mass. Fat free mass, lean mass, fat mass and percent body fat were significantly higher in the obese group ($p < 0.05$). Furthermore, the obese group showed a poorer performance than the eutrophic group in the 6MWT ($432.31 \pm 66.13$ m and $472.07 \pm 74.03$ m, respectively, $p = 0.01$). HS and KES did not differ between groups, however, regarding muscle quality, the obese group exhibited a impaired in comparison to the eutrophic group in the upper ($11.45 \pm 2.57$ kg and $13.31 \pm 2.03$ kg, respectively, $p < 0.01$) and lower limb ($2.91 \pm 1.16$ kg and $3.44 \pm 0.97$ kg, respectively, $p = 0.05$). The increase in muscle mass detected in the obese elderly was not sufficient to maintain adequate muscle quality and physical function, showing a negative influence of the excess of body fat.



## 1. Introduction

Approximately 1.0 billion adults are currently overweight, and a further 475 million are obese (IOTF, 2010). The accumulation of adipose tissue in the organism is directly or indirectly related to pathological situations that contribute to morbidity–mortality, such as arterial hypertension, dyslipidemia, ischemic coronary disease and osteoarticular and neoplastic diseases. Nowadays, the prevalence of obesity is higher among women (Bouchard, Soucy, Sénéchal, Dionne, & Brochu, 2010) and also among the elderly (Sulander, Rahkonem, Helakorpi, Nissinen, & Vutela, 2004).

Obesity is one of the major factors aggravating physical disability in the elderly population, being that women report more limitations at all ages than men (Bouchard et al., 2010). This fact is possibly due to the large amount of fat mass (FM) accumulating in this population associated with a sedentary life style, factors frequently associated with functional disability (Rolland et al., 2004; Villareal, Banks, Siener, Sinacore, & Klein, 2004).

The percentage of fat free mass (FFM) and bone mass of adult obese individuals tends to be higher than in eutrophic individuals and this modification of body composition is believed to be an adaptation to the increased body weight imposed on the physical structure of an individual (Baumgartner et al., 2004). According to Newman et al. (2003) this adaptation may be beneficial since obese elderly with increased FFM may have less difficulty in performing their daily activities than obese subjects with a reduction of FFM quantity, known as sarcopenia.

However, it cannot be stated whether this increase in FFM among obese elderly subjects will reflect on muscle quality (MQ), which is defined as muscle strength divided by the lean mass of an individual. What needs to be clarified is whether this increase in lean mass will provide improved muscle strength and quality

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(Barbat-Artigas, Rolland, Zamboni, & Aubertin-Leheudre, 2012; Rolland et al., 2004).

Obesity may have important functional implications in elderly persons because it worsens the age-related decline in physical function, which can lead to frailty and dependence (Villareal et al., 2004). However, the mechanisms responsible for the physical disability of obese elderly have not been fully identified (Rolland et al., 2004). Furthermore, until recently, obesity was thought to protect skeleton from osteoporosis and that adipose tissue accumulation insulate bone. However, recent data showed a high rate of bone fracture in obese postmenopausal women. Thus, it is important to conduct studies that will estimate body composition, physical performance and muscle strength in obese elderly, to support in the development of therapeutic strategies aimed at this population.

On this basis, the purpose of this study was to assess and to compare body composition, fat mass distribution, physical performance and muscle quality of active elderly women.

## 2. Materials and methods

### 2.1. Study design, recruitment and participants

A cross-sectional observational study was conducted at the University Hospital, Faculty of Medicine of Ribeirão Preto, University of São Paulo (HCFMRP-USP). The study was approved by the Research Ethics Committee of the Institution (protocol HCRP no. 12152/2007), according to the requirements of resolution no. 196/96 of the National Health Council. All volunteers were informed about the objectives and operational procedures of the study and about guaranteed preservation of anonymity and gave written consent to participate.

The study sample consisted of active female volunteers community-dwelling, aged 65–80 years selected by convenience. The elderly were recruited at the Acquaintance Center of the Community of Ribeirão Preto at São Paulo, which provides a regular physical activity program (three times a week).

Exclusion criteria were: bedridden or dependent subjects, amputees using ortheses or prostheses, subjects with cognitive impairment that would prevent the understanding of the tests (as evaluated on the occasion of the initial interview), subjects with musculoskeletal or articular impairment, with localized loss of strength, with severe sequelae of cerebrovascular accidents, subjects with inadequate clinical correction of visual disorders (use of corrective lenses on the occasion of the test) and patients with non-compensated vestibular deficits.

Female volunteers older than 65 years were selected to participate in the study and were divided into two groups based on the percent body fat (%BF) assessed by DXA. Elderly women with %BF of 38 or more were considered obese (Baumgartner et al., 2004).

### 2.2. Measurements

The initial clinical evaluation consisted of anamnesis including self-reported presence or absence of diseases such arterial hypertension, diabetes mellitus, cancer, rheumatic disease, chronic pulmonary disease, and depression. The subjects were questioned about personal and family history, associated diseases, medications, daily life activities, chemical dependence, and physical activity.

The level of physical activity was assessed by applying the International Physical Activity Questionnaire (IPAQ) version 8 during an interview, with questions about the frequency and duration of moderate, vigorous and walking physical activities, using the last week as reference (Craig et al., 2003).

Body weight was measured with a Filizola ID 500 scale with 0.1 kg graduations. Each woman was instructed to position herself in the center of the scale, wearing light clothing and barefoot. Height was measured with an inextensible vertical bar with 0.5 cm graduations. The data obtained were used to calculate the body mass index (BMI).

The body composition of the volunteers was assessed by dual energy X-ray absorptiometry (DXA, Hologic, QDR 4500W®, Bedford, MA, USA), the FFM was defined as the sum of bone mineral content (BMC) and fat-free soft parts and skeletal lean mass or muscle mass was defined as fat-free soft parts without the BMC.

The coefficient of variation of DXA was 0.49% for body weight, 1.48% for BMC, 1.99% for FFM, and 4.71% for FM in elderly, evaluated in the previous study (Vilaça et al., 2011).

The aerobic capacity of the volunteers was assessed on the basis of the distance covered in the 6 minute walk test (6MWT), which was performed according to the directives established by the American Thoracic Society Statement (2002). The following instruments were used for the test: a professional quartz timer (Kadio, model KD1069), a measuring tape, a heart rate monitor (Polar FS1, China), a sphygmomanometer and a double stethoscope (BIC, São Paulo, Brazil).

The tests were performed in a 40-m corridor of the University Hospital, Faculty of Medicine of Ribeirão Preto. The test area was marked on the floor with colored adhesive tape, with the distance determined with an inextensible measuring tape every 5 m. The final distance reached was recorded in meters, with a final precision of 1 m.

Handgrip strength (HS) was measured with a portable hydraulic dynamometer (Saehan Corporation, Masan Free Trade Zone, Korea) with a graduation scale of 0–100 kilograms of force (kgf). The test was performed according to the recommendations of the American Society of Hand Therapists (Fess, 1992). Three measurements were made with an interval of at least one minute between them, alternating between the dominant and non-dominant side and the highest value was recorded.

To determine lower limb maximum load was used the adapted protocol (Kraemer & Fry, 1995) in order to measure knee extension strength (KES) by the one-repetition maximum test 1-RM. The 1-RM testing protocol closely adhered to the recommendations of the National Strength and Conditioning Association (2008). The equipment used was a movement extension chair, the loads applied obeyed the overload of the instrument itself in the form of plates and the equipment was regulated according to the size of the segment evaluated.

The exercise chosen was bilateral knee extension on the chair in the sitting position, with the arms along the body holding the support of the instrument, with a 70° inclination the trunk, the knee in 90° flexion and the head positioned perpendicular to the floor. The test started from the position of knee flexion, followed by full extension of the legs and then a return of the leg to the initial position.

Muscle quality was calculated as the ratio between muscle strength and lean mass of the limb evaluated. Specifically for the upper limb, HS in kgf was evaluated with a portable hydraulic dynamometer, divided by the lean mass of the dominant upper limb and the muscle quality of the lower limb was evaluated by the bilateral KES in kg divided by the lean mass of the lower limb in kg (Newman et al., 2003).

### 2.3. Statistical analysis

Descriptive statistics were performed using means and standard deviations. To determine if *data* were *normally distributed*, the Shapiro–Wilk test was used and a non-normal distribution was