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Feature Article

# Body mass index as discriminator of the lean mass deficit and excess body fat in institutionalized elderly people

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ABSTRACT

The objective of this study was to identify the discriminating criterion for body mass index (BMI) in the prediction of low fat free mass and high body fat percentage according to sex among older people. Observational analytical study with cross-sectional design was used for this study. All institutionalized older people from the city of Uberaba (Minas Gerais, Brazil) who fit within the inclusion and exclusion criteria were approached. Sixty-five institutionalized older people were evaluated after signing a Free and Informed Consent Form. Descriptive and inferential statistical procedures were employed for the analysis, using Student's t-test and multiple linear regression. Receiver Operating Characteristic (ROC) curves were constructed to determine the BMI (kg/m$^2$) cut-off points. The study complied with all the ethical norms for research involving human beings. In comparing the anthropometric measurements obtained via bioimpedance, elder male had higher mean height and body water volume than females. However, women had higher mean triceps skinfold and fat free mass than men. The BMI cut-off points, as discriminators of low fat free mass percentage and high body fat percentage in women, were $\leq$22.4 kg/m$^2$ and $>$26.6 kg/m$^2$, respectively; while for men they were $\leq$19.2 kg/m$^2$ and $>$23.8 kg/m$^2$. The results of this study indicate the need for multicenter studies aimed at suggesting BMI cut-off points for institutionalized older people, taking into account specific sex characteristics.



## Introduction

In recent decades, Brazil has been undergoing the phenomenon of population aging. At the same time, the profile of the population has been influenced by new dietary behaviors, characterized by the excessive consumption of high kilocalorie foods and reduced physical activity, resulting in an energy balance that tends toward fat storage.[1]

Increased body weight resulting from fat is related to a higher prevalence of diabetes mellitus, cardiovascular disease, kidney failure and mortality.[2] Therefore, the nutritional status of the population should be periodically monitored, based on reliable indicators.[3]

Nutritional status can be defined as the balance between energy intake, nutrients and the body's use of these. One of the most widely used measurements to assess nutritional status is body mass index (BMI).[4] The widespread use of this method is due to the ease with which BMI (kg/m$^2$) can be calculated through anthropometric weight and height measurements, combined with evidence denoting an interrelationship with morbidity and mortality indicators.[4] However, it may be inappropriate to use the same BMI (kg/m$^2$) criteria for the older population as those applied to young adults, due to changes in body composition that take place during the aging process.[5]

These changes include reduced water volume and fat free mass and increased adipose tissue.[5,6] In addition to changes in body composition, height loss also occurs during aging, due to vertebral compression, changes in the intervertebral discs, loss of muscle tone and postural changes.[7,8]

Nevertheless, although BMI (kg/m$^2$) is a predictor of chronic diseases and mortality, the BMI (kg/m$^2$) cut-off points are not clear for classifying the nutritional status of older people,[9] and this limitation is greater in the case of older people who are bedridden or use wheelchairs.[4]

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Nutritional classification based on BMI (kg/m$^2$) for the general population is defined by the World Health Organization (WHO), according to cut-off points that classify underweight as BMI (kg/m$^2$) less than 18.5 kg/m$^2$; normal weight from 18.5 to 25 kg/m$^2$; overweight from 25 to 30 kg/m$^2$ and obesity as exceeding 30 kg/m$^2$.[10] Specifically in regard to the older people, some nutrition experts have suggested arbitrary cut-off points for classifying nutritional status for this indicator, with BMI (kg/m$^2$) for underweight equal to or less than 22 kg/m$^2$; normal weight from 22 to 27 kg/m$^2$; and overweight equal to or greater than 27 kg/m$^2$.[3] However, the criteria proposed for the general[10] and older[3] population do not take into account specific sex characteristics.

A Brazilian survey with older individuals showed that the BMI (kg/m$^2$) cut-off points suggested by WHO (1998) and Lipschitz (1994) have low sensitivity for diagnosis of overweight/obesity for both sex, i.e., these criteria are not good indicators for assessing the nutritional status of older people.[11] Given this situation and based on the assumption that the aging process causes changes in body composition that differ between sexs,[11] our aims were to identify the discriminating criterion for BMI (kg/m$^2$) in the prediction of low fat free mass and high body fat percentage according to sex.

Establishing the relationship between BMI (kg/m$^2$) and fat free mass and fat mass indicators, according to sex, could contribute to the development of more accurate BMI cut-points for institutionalized older adults. These cut-points would impact the speed of decision making by health professionals in screening older adults in a state of malnutrition and/or excess body weight in places with limited equipment for measuring body composition.

## Methods

An observational analytical study with cross-sectional design carried out in nursing homes in the city of Uberaba, located 494 km from Belo Horizonte, the capital of Minas Gerais, in southeastern Brazil.

### *Sample and setting*

There are nine nursing homes registered with the Municipal Social Assistance Council (CMAS) of the city, sheltering on average 295 individuals and 65 older adults were recruited via convenience sampling techniques. The inclusion criteria were institutionalized older people men and women living in the city's nine nursing homes, who were 60 years of age or over, able to communicate, and capable of doing the anthropometric tests. In total, 230 (77.9%) residents were excluded from the research because they did not attend to the inclusion criteria: 102 (44.3%) due to limitations to understand the questions and inability to express the answers, 64 (27.9%) were not capable of doing the anthropometric tests, 48 (20.8%) had not completed 60 years of age, eight (3.5%) declined to participate in the research and eight (3.5%) were not present at the moment of the interview due to an excursion or hospitalization, as indicated in Fig. 1.

### *Data collection*

From February to July 2010 the data collection was conducted in the nursing homes, where interviews and assessments of the older people by the researchers were scheduled with the coordinators of the institutions. The interviews were conducted by interviewers who had been trained and prepared beforehand.

### *Measurements*

The anthropometric measurements (body mass and height) were done using a calibrated digital scale (Detecto Digital Physician Scale 6127, made in United States of America) and tape measure (Wiso R88 in centimeter, made in Brazil). Weight was measured in the morning, in the fasted state, after voiding, without shoes and with light clothes. Body mass index was calculated by dividing body mass in kilos (kg) by height in meters (m) squared. To measure body composition (fat free mass, body fat and water), the bioimpedance technique was used.

The Maltron Body Fat Analyser (BF 906 – made in England) was used to determine bioelectrical impedance. The older person was instructed to remove any adornments or accessories that could interfere with the assessment. In a supine position, with the limbs apart and hands open, two surface electrodes (emitter and detector) were placed on the dorsum of the right hand and on the side of the right foot. After recording data such as age, sex, height, weight and nationality, the body composition was read and estimated, through applying an electric current of 50 kHz, which was harmless

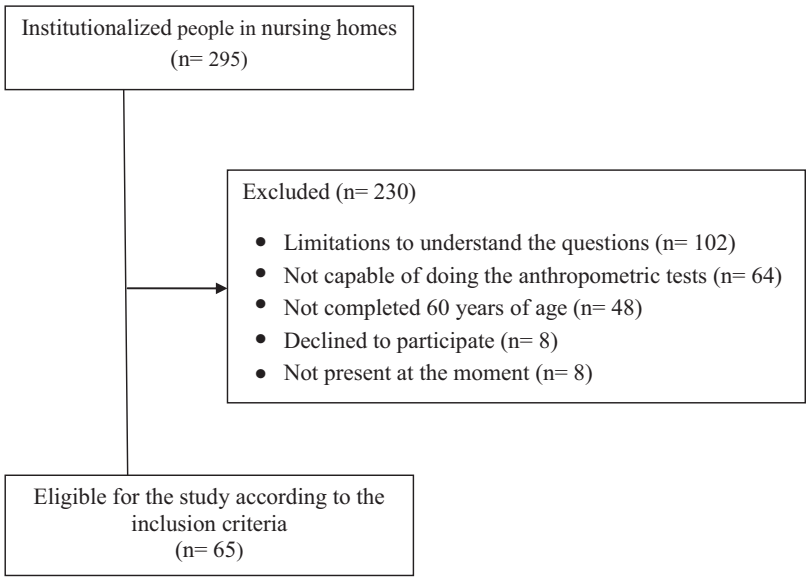


**Fig. 1.** Diagram of the population and eligible study sample.