

## BODY COMPOSITION AND FUNCTIONAL CAPACITY EVALUATIONS IN LONG-LIVED SUBJECTS

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### ABSTRACT

**Introduction:** The number of subjects with 80 years old or over are increasing, In wide world .  
**Objectives:** To evaluate body composition and functional capacity of elderly people living São Paulo.,  
**Method:** This was a cross-sectional study, that recruited 65 subjects older than 74.6 years, in São Paulo. All participants underwent bioimpedance and six-minute walk tests.  
**Results:** The mean age was  $78.8 \pm 4.4$ , BMI was  $27.4 \pm 5.6$ . Overall, 61.6% were women. No loss of lean mass in the studied population, but women had a lower percentage of lean mass when compared to the men. We also observed that the longevity with better functional capacity was achieved in elderly with higher values LM.  
**Conclusion:** The body composition of healthy long-lived subjects present significant percentage of lean mass. The functional capacity assessed by the 6MWT was considered adequate given the distance walked achieved and the improvement in physiological variables.

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### INTRODUCTION

The rapid incidence increase in the elderly population is due to the decline in mortality (related to advances in health-related technologies raising life expectancy) as well as birth rates. According to this, a reverse pyramid population status is yet to be seen in developed and more rapidly in developing countries (MIRANDA *et al.*, 2016). Among the elderly population group there are a particular subgroup named long-lived subjects. Globally, it is difficult to define from at what age point a subject is considered to be a long-lived. Currently, this definition depends on the region or country's socioeconomic situation he/she lives in. In Brazil, subjects considered to be long-lived are those who reach or exceed the age of 74.6 years (BRITO *et al.*, 2014).

In 1980, there were 591 thousand elderly people living in Brazil., projections indicate that in 2050 there will be 13.8 million people, corresponding to an increase of 2.22%, in addition, a prevalence in female long-lived is to been seen either (LOURENÇO *et al.*, 2012 and CHAIMOWICZ, 2013). One condition elderly present n are increasing changes in body composition chronological age progresses, in particular, the decrease in fat free mass and bone density and the increase of body fat (SACON, 2011). The gain in body weight and the gathering of localized body fat that affect the elderly population seem to be a result from a genetically programmed pattern, diet changes and reduced physical activity level. All can be related to age or to an interaction between each factors. However, o documented reason related to the body composition alteration in elderly is the fat free mass (FFM) change composition (TODYS, 2015). The presence of chronic non-transmissible diseases (CNTD) is associated, in most cases, with the excessive accumulation of body fat (mainly in the abdominal region) and the reduction of lean mass (LM). In

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addition, the presence of these two conditions are related to the reduction of functional capacity and the diseases aggravation (SANTOS *et al.*, 2013). Functional capacity represents the individual's ability to perform physical and motor activities of daily life without difficulties. For older people this concept is important since it resembles physical independence to carry out daily activities (SANTOS *et al.*, 2013). In face with an on growing population with potential and special care needs, it is necessary to know if the body composition and the functional capacity of elderly is adequate for their age range. Although health researches, policies and governmental strategies try to embrace this population, there are few information regarding body composition and functional capacity of long-lived subjects in Brazil.

## MATERIALS AND METHODS

This descriptive study, quantitative and transversal. Data collection was initiated after our university research council approval (UNASP / SP CEP, nº 871.829). Ethic's analysis was set in accordance with National Health Council resolution 466/12. Data collection took place from March to June, 2015, and was conducted in churches, community centers, parks, rest homes and located residences in the region of Capão Redondo (located at the Technical Health Supervision of Campo Limpo, located at southern São Paulo, Brazil). To be included in this study subjects had the following criteria: 74.6 years or older and resident at the Capão Redondo region of São Paulo. We excluded from this study hospitalized subjects with decompensated cardiovascular and respiratory diseases, with previous diagnosis of end-stage cancer, severe neurological conditions, orthopedic or rheumatologic lesions or diseases that made them impossible to walk, walking inability, surgery within two months and acute myocardial infarction six months prior to the study. The 65 long-lived subjects included were visited at the above mentioned institutions and, after being informed about the protocol and signing the informed consent, performed bioimpedance and the six-minute walk tests (6MWT). Bioimpedance was used to evaluate body composition and it is a simple, non-invasive, painless test that measures fat, lean mass and hydration percentages, allowing to calculate the ideal weight range for each individual according to gender and age (Nahas *et al.*, 2000). At dorsal decubitus positioning, an electric current passes through the subject's body through two pairs of adhesive electrodes placed on both hands and on the right foot. Subject remained at least five minutes of absolute rest in the dorsal decubitus before the examination. All subjects performed the six-minute walk test (6MWT) to assess physical capacity. The test was performed in a free obstacles 30 meters length corridor.

Patients were given prior instructions to come on the day of the test with comfortable clothing and footwear, as well as maintaining usual medication. Prior to the test, patients had a resting period of at least 10 minutes. During this period blood pressure, pulse oximetry, heart and respiratory rates and dyspnea level were evaluated. Data are presented as mean and standard deviation. The Chi-Square test was used to analyze proportions differences (qualitative variables) between discrete dichotomous variables. For comparisons between means (quantitative variables), when necessary, we used the Analysis of Variance (ANOVA) or the Student's T Test in case of variables with normal distribution. In cases where previous assumptions were not observed, non-parametric Kruskal-Wallis or Mann-Whitney tests were used as appropriate. The

coefficient of confidence was 95% and the significance of  $\alpha = 0.05$ . All statistical analyzes were performed using statistical software EPI 6.0 and Graph Prisma 5.0

## RESULTS

A total of 65 subjects older than 74.6 years old, living in Capão Redondo, São Paulo, participated in the study. The mean age of participants in the sample was  $78.8 \pm 4.4$ , mean weight of  $68.1 \pm 16.3$  and mean BMI of  $27.4 \pm 5.6$ . Overall, 61.6% were women. As for health conditions, seven were former smokers, three were smokers, and one used alcohol at least three times a week. Forty six subjects were physically active. Regarding the presence of chronic non-communicable diseases, 43 died from any type of these diseases (Table 1).

Table 1. Characterization of the studied sample

Variable	Dates n=65
Age (years)	78.8±4.4
Weight (kg)	68.1±16.3
BMI (kg/m <sup>2</sup> )	27.4±5.6
Gender (M/W)	37/63
Ex-smoker (%)	11
Smoker (%)	5
Use alcoholic drink (%)	2
Physically active (%)	71
Non-communicable diseases (%)	66

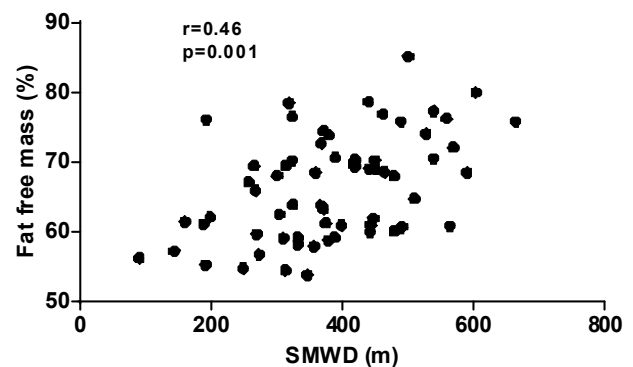


Figure 1. Correlation between lean mass (%) and distance walked in the six-minute walk test

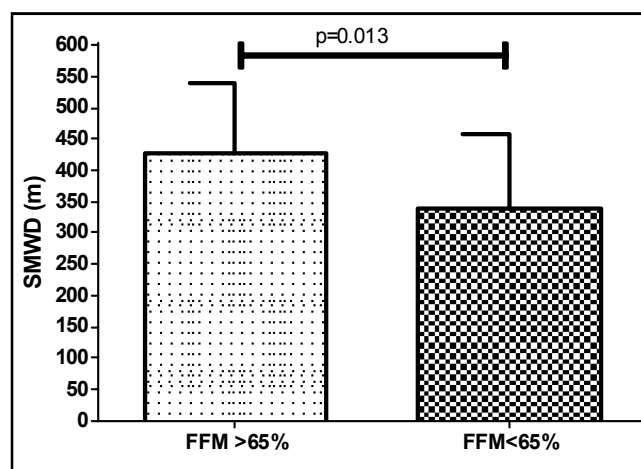
Table 2. Characteristics of the sample studied according to the lean mass index

Variáveis	GroupFFM <65% n= 31	GroupFFM >65% n= 34	P
Age (years)	78.77±4.19	79	0.41
Gender (M/W)	0/31	24/10	
BMI (kg/m <sup>2</sup> )	29.82±8.89	29.30±10.4	0.9
IMG (%)	40.00±3.23	36.2	0.6
FFM (%)	59.6±8.6	72.5±7.6	0.0001
Smoker (%)	3	6	Ns
Alcohol (%)	3	0	Ns
Non-communicable diseases (%)	77.4	56	Ns

Up to forty eight percent (47.6%) of the individuals had a lean mass index (MMI) of less than 65%. It was seen that groups were similar for age, BMI and IMG. However, all men had preserved IMM, whereas the majority of women had IMM below 65% (Table 2). A correlation between physical capacity by means of the six-minute walk test with lean muscle mass showed that the higher the lean mass, the greater the distance walked in the six-minute walk test.

**Table 3. Prevalence of individuals with FFM less than 65% according to health-related behaviors**

Variables	N° (65)	NCD<350m (n=25)	Prevalence (%)	OR	CI 95%	p
Gender						
Man	24	3	12.5	1	-	-
Woman	41	22	53.7	4.2	1.4-12.8	0.0013
Non-communicable diseases (-)						
Non-communicable Diseases (+)	43	19	44.2	1.6	0.75-3.4	0.28
hours of sleep > 6/24	11	1	9.1	0.2	0.03-1.3	0.04
hours of sleep <6/24	54	24	44.4	1	-	-
No smoker	62	23	37.1	1	-	-
Smoker	3	2	66.7	1.7	0.75-4.2	0.55
Non-alcoholic	64	24	37.5	1	-	-
Alcoholic	1	1	100.0	1.3	0.32-5.5	0.99
Physically active	46	15	32.6	1	-	-
Sedentary	19	10	52.6	0.61	0.34-1.1	0.16
Health status compared to last year	3	1	33.3	1	-	-
Much better (%)	13	4	30.8	0.92	0.15-5.5	0.99
Best (%)	35	13	37.1	1.1	0.21-5.8	0.99
Equal (%)	14	7	50.0	1.5	0.27-8.0	0.99
Worse (%)	0	0		-	-	-

**Figure 2. In six minutes Walking distance by long-lived individuals according to the lean mass index**

Those participants who had a lean mass percentage greater than the sample median value (66%), most walked more than 384 m (median six minutes walking distance covered (Figure 1). Evaluating the distance walked on the 6MWT "as a function of the lean mass index, it was seen that there was a significant difference between subjects with MMI values under and over 65%. Mean MMI of subjects under 65% was  $340.2 \pm 116.5$ , (95% CI, 297 to 382) meters., and subjects over 65% was  $428.38 \pm 115.7$ , (95% CI, 385 to 470) meters (Figure 2). According to health-related behaviors, the prevalence rate among women and smokers with a MMI of less than 65% was significantly higher than that of men and non-smokers (0% and 75%) (33.3% and 48.4%, respectively) (Table 3).

## DISCUSSION

The present study evaluated the body composition of 65 long-lived individuals. The results of this research showed that there was no loss of lean mass in the studied population, however, women presented a lower percentage of lean mass when compared to men. Perhaps, lean mass maintenance of the evaluated elderly is a determinant factor for the longevity, since the corporal composition is related to the increase of the life expectancy and the reduction of the mortality. During aging, body composition is modified by reducing water content, increasing fat and decreasing skeletal muscle mass. In addition, to the decline of more than 15% of basal metabolic expenditure, due to the reduction of lean tissue, mainly metabolically active muscle cells, i.e., reduction of muscle mass and increase of body fat.

This increase in body fat compromises functional capacity and lean mass is one of the variables most used for the indicative of fragility in the elderly (SACON *et al.*, 2011). Changes in body composition are directly related to the reduction of the functional capacity of older subjects, however, it is not well established in the literature which components of body composition (LM, FM) is the most determinant in the elderly (TODYS, 2015). In addition, to increase the risk of coronary heart disease, studies indicate that excess of body fat in the elderly also limits mobility. This is because of the greater amount of fat mass or the greater proportion of body fat, which can increase body overload, limiting movements and increasing stress on joints and muscles, accentuating the risk of disability in the elderly with excess fat (TODYS *et al.*, 2015., SANTOS *et al.*, 2013., Conselho Nacional de Saúde. Resolução, 2012., Nahas *et al.*, 2000 and CÔMODO *et al.*, 2009). The largest fat mass and the lowest lean mass in middle age and late adulthood are responsible for disabilities, and more importantly, not only people who have better health habits live longer but subjects with lower fat mass and greater lean mass, the disability is delayed and limited a few years up to the end of life (SOUZA *et al.*, 2016 and CANHHESTRO and BASTO, 2016). The association between the percentage of body fat and the maximum walking speed was more significant for subjects aged 60 to 79 years, while for the elderly over 80 years this association was not very evident. These results may give an indication that, the amount of body fat may not exert as much influence on the mobility of older people (BERLEZI *et al.*, 2016). The increase and maintenance

of lean mass in the third age helps to generate the necessary conditions for the maintenance of a more active role in society and concomitantly promotes the acquisition of new social roles, reducing the chances of depressive conditions, after all socially active people tend to be happier (TODYS *et al.*, 2015). Strengthening of the musculature together with the increase in fat-free mass avoidance is one of the main causes of disability and falls, decreasing falls, reduce the risk of functional capacity components losses, thus avoiding the reduction of daily life activities (SOUZA and SANTOS, 2012., ALMEIDA and SILVA, 2016 ). Studies have found that women and men who had less lean mass had respectively 3.6 and 4.1 higher chances of disability when compared to those with higher muscle mass (7-8). Other studies have shown the association between muscle mass and the prevention of numerous problems such as maintenance of functional independence, osteoporosis, thermoregulation dysfunction and glucose intolerance (SOUZA and SANTOS, 2012., ALMEIDA and SILVA, 2016). The greater amount of lean mass has a potential to protect against the causes of death in the elderly (SACON, 2011). From the economic point of view, previous reports provide evidence that control of lean mass loss would result in a significant decrease in health care costs (SOUZA and SANTOS, 2012). The complications caused by the lack of maintenance of lean mass cause high healthcare costs and also end up being responsible for expenses with early institutionalization, and associated with fragility., this loss generates even greater economic and social costs. Thus, the increase in lean mass would represent considerable savings to the national health system (WHO, 2009). Thus, positive changes in body composition are related to the increase in life expectancy and the reduction of mortality in both men and women (SACON, 2011). This control of lean and fat mass is also associated with disease prevention, autonomy preservation and greater independence.

After all, the lower values of fat percentage are related to lower occurrences of chronic diseases and their disabilities, as well as to alleviate psychological disorders related to self-esteem (TODYS, 2015). Regarding the functional capacity of the longevity subjects, evaluated through the six-minute walk test (6MWT), the results showed that the longevity subject's functional capacity is preserved. It was observed that the majority of the longevity subjects presented good functional capacity, which means a high index of independence in this long-lived population. Functional capacity of patients with chronic obstructive pulmonary disease (COPD) and heart failure are well evaluated through the 6MWT, however, this is the first study to evaluate healthy elderly subject's functional capacity through the six-minute walk test. Considering the methodological differences, the results of this study are similar to those observed in studies conducted in developed countries, such as Portugal and China. In the first case, 62% of the elderly with 75 years of age or older presented better functional capacity (RIBEIRO *et al.*, 2016). In China, a longitudinal study identified a prevalence of ADL capacity of 83% among subjects aged 80-89 years and 63% among subjects aged 90 to 99 (SINGH *et al.*, 2013). We also observed in our results that there is a strong association between the female gender and the functional capacity. The greater risk of disability among long-lived can be attributed to greater survival and also to the slight disability presented in their adult life, which would, therefore, lead to a higher risk of developing some degree of functional disability. This result is in line with what has been observed by other studies (LOURENÇO *et al.*, 2012., SINGH *et al.*, 2013). Numerous

studies have demonstrated an association between increased age and a greater chance of functional dependence, as well as the high prevalence of functional disability or limited functional capacity in the elderly population (DAUDT, 2013., AZEVEDO *et al.*, 2014 and GUIMARÃES and OLIVEIRA, 2014). These surveys highlight that the most acquired years should be accompanied by quality of life and free from a high cost of dependence (GUIMARÃES and OLIVEIRA, 2014). An investigation carried out aiming to know the functional capacity of the elderly and their determinants, observed that subjects at the age group between 70 and 79 years is 7.3 times more likely to have functional impairment when compared to subjects at the age group of 60 to 69 years. Also, the authors indicate that the elderly with 80 or older present 3.4 times more chances of impairment than the elderly from 70 to 79 years (LOURENÇO *et al.*, 2012). A study that analyzed the association between functional capacity, body composition and health conditions in 135 elderly subjects showed that men with higher functional capacity had higher percentage values of lean mass compared to those with lower capacity., also those with higher capacity had higher values of femoral bone mineral content compared to those with lower capacity., as well, women with higher capacity presented higher values of bone mineral density compared to those with lower capacity (SOUZA *et al.*, 2016). Chronic diseases are a risk factor for functional disability in the elderly. Independently of the other variables, diabetes mellitus, stroke and heart disease were associated with dependence on basic activities of daily living (BADL), and the latter pathology was also associated with dependence on instrumental activities of daily living (IADL) (DAUDT, 2013).

## Conclusion

At the end of the study, we can conclude that most of the 65 individuals living in the Capão Redondo district of São Paulo have healthy body composition, with a significant percentage of lean mass, thus presenting a positive impact on quality of life, since body composition is directly related to physical, functional and nutritional changes. Although the sample was composed of older and female elderly, the functional capacity is good, indicating a high index of independence in this population. However, it was observed that female individuals and smokers had a worse body composition. We observe the importance of continuity of studies of this nature, as well as that other studies may be added to this, contributing for the population to grow even older and with better quality of health and life.

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