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Relation between Age and Body Composition of Institutionalized Fragiles Elderly Women

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***Abstract*—** *In the last decades, due to the reduction of mortality rates and the fall of birth rates, there has been a transformation in Brazil's demographic profile, which has increased longevity, and consequently, in the expressive number of elderly people. With the life expectancy's increase, functional alterations arise that can compromise the functional independence and quality of life of this population. Among the most relevant aging-related alterations is the Frailty Syndrome of the Elderly (FFS). This syndrome is considered highly prevalent, resulting in dramatic consequences to the health of the elderly. North American data show a prevalence of 7 to 12%, and in Latin America and some Caribbean countries, the prevalence has increased considerably, being 30 to 48% in women and 21 to 35% in men. These rates far exceed not only North American data but also data from European countries. OBJECTIVE: To analyze the relation between age and body composition of institutionalized fragiles elderly women. METHODOLOGY: Forty elderly women, aged ≥70 years, diagnosed with SFI without dementia and/or depressive features were selected. After body mass index (BMI) determination, classification into three groups was performed (n=6 underweight <22 kg/m2, n=13 eutrophic 22 to 27 kg/m2, and n=21 overweight >27 kg/m2), total muscle mass index (TMSI) by predictive equation, and handgrip strength (HGS) by dynamometry were also evaluated. RESULTS: Significant differences were found in the means of BMI (underweight 20.1; eutrophic 25.2 and overweight 30.5; p<0.000) and IMMT (underweight 4.9; eutrophic 6.3 and overweight 7.8; p<0.000). Both indices decreased with advancing age. The mean IMMT was lower than normative values (5.9 to 9.5 kg.m-2) only in the low weight group. Although no significant differences were found*

between the groups in the FPM measurements (underweight 17.2; eutrophic 16.2, and overweight 18.6), the overweight group performed better. CONCLUSION: The results show that as age advances there is a reduction in BMI and IMMT. Although the group with the best muscle strength measurements was the overweight group, this was the youngest group. However, it is worth remembering that these findings may corroborate the Obesity-Mortality Paradox, where body weight, although above the reference values for the elderly (between 22 and 27 kg/m2) could manifest itself as a protective factor for the elderly, thus representing an energy reserve that could be used when facing pathological conditions such as malnutrition or infections. The importance of a thorough evaluation of body composition, nutritional status, and muscle strength in the elderly is emphasized, and it is also suggested that bodyweight should be maintained at least at levels close to normal.

I. INTRODUCTION

According to Meneguci, Santos, and Damião (2014), the demographic transition is a reality in both developed and developing countries, such as Brazil, being represented by the significant increase in the elderly population accompanied by higher life expectancy each year. Estimates suggest that, currently, approximately 10% (705 million) of the world population is represented by the elderly, and that in 2050, this prevalence will reach 32% (2 billion) (FREITAS et al., 2015).

According to Falsarella (2015), aging is a continuous and gradual process, as well as heterogeneous among populations, since it is influenced by the environment, culture, genetics, and presence or absence of pathological conditions. From the biological point of view, aging is characterized by the decreased ability of body systems to maintain homeostatic balance under conditions of functional overload, leading to greater vulnerability. In this sense, changes in the physical, cognitive, and social dimensions in the elderly population contribute to the increased risk of adverse health manifestations.

In the elderly, global functionality, i.e., the individual's ability to manage their own life or take care of themselves, is an important predictor of health, since it considers the dynamic and integrated functioning between the environment, cognition, and motor skills. From this perspective, investigations of the variables associated with aging, such as body composition, are relevant in geriatrics and gerontology today, since changes in body composition, with advancing age, have an important impact on health status, functional capacity, and quality of life (FALSARELLA, 2015).

The changes in body composition are inherent to the physiology ofaging and are due to the reduction of lean mass, especially muscle mass and bone mineral density, the decrease in height, weight changes, the redistribution of adipose tissue, with greater accumulation in the trunk and viscera and less in the limbs, and changes in tissue compressibility and elasticity. In women, for example, the increase in body mass reaches its plateau at age 75, when it begins to decline associated with the reduction of body water and muscle mass (TAVARES et al., 2015; SILVA; PEDRAZA; MENEZES, 2015).

However, such changes in body composition can contribute to unfavorable outcomes for mobility, such as falls, fractures, limitation in self-care tasks, and independent living, as well as representing a predictor for Elderly Frailty Syndrome (EFS), comorbidities, and mortality (FALSARELLA, 2015).

Likely, changes in the lifestyle of the world population that has occurred in recent decades, such as the change in dietary profile, physical inactivity, and smoking have determined the phenomenon of epidemiological transition, characterized by a reduction in mortality from infectious diseases, however, with an increase in chronic non-communicable diseases (NCDs) that are based on overweight (CARLOS; GAZZOLA; GOMES, 2016; MENEGUCI; SANTOS; DAMIÃO, 2014).

According to Costa and Neri (2011), in addition to the progressive functional impairment resulting from the clinical manifestations of NCDs inherent to aging, we should also consider the increased prevalence of IFC, resulting in dramatic consequences to the health of the elderly. North American data point to a prevalence of 7 to 12%, while in Latin America and some Caribbean countries the prevalence has increased considerably, being 30 to 48% in women and 21 to 35% in men. These rates far exceed, not only North American data but also European countries (XUE, 2011).

According to Pereira, Spyrides, and Andrade (2016) and Soares et al. (2016) this context of aging and prevalence of NCDs and IFC in this age group require

from the authorities and researchers in the area special attention regarding the epidemiological and clinical aspects of this group of people.

Based on this reasoning, this study aimed to analyze the relationship between age and body composition of institutionalized frail elderly women.

II. METHODOLOGY

This is a descriptive study developed in the long-stay institutions (ILPs) Bethesda and Betânia, in Joinville, Santa Catarina, Brazil. The research project was approved by the Ethics Committee for Research in Human Beings of the Instituto Superior e CentroEducacionalLuteranoBom Jesus/IELUSC under number 393.274. To participate in the study, the elderly women signed a Free and Informed Consent Form (FICF).

Study Participants

From a total of 140 elderly residents in the two largest ILPs in the city of Joinville-SC (Bethesda and Betânia), 45 intentionally selected elderly women aged ≥70 years were evaluated. This process occurred after an initial screening by the health teams of the institutions. Five participants were not part of the study according to exclusion criteria (two with dementia traits, two with impairments secondary to stroke, and one parkinsonian). Thus, 40 women diagnosed with IFC, presenting frailty characteristics according to the criteria already established (FRIED et al, 2001), participated in the study. They did not present cognitive deficit or depressive traits, evaluated by the Mini Mental State Examination and the Geriatric Depression Scale, respectively. All hadlived in the institutions for at least three years, received the same nutritional orientation and general health care, such as regular use of medication and monitoring of vital signs, and were independent in their activities of daily living.

Measurement Instruments and Evaluation Procedures

The evaluations were initiated through a registration form containing personal identification data, a brief anamnesis, and a list of twelve pathologies and/or associated dysfunctions (systemic arterial hypertension, diabetes mellitus, stroke, parkinsonism, cardiopathy, pneumopathy, nephropathy, obesity, rheumatic disease, visual, auditory and/or vestibular deficits), medications in use and associated treatments. As initial screening instruments, the Mini Mental State Examination was used, considering cut-off scores according to the level of education (WAJMAN *et al*, 2014; BRUCKI *et al*, 2003) and the Geriatric Depression Scale to screen the elderly with a depressive profile (VALIM-ROGATTO *et al*, 2011).

To classify the level of physical activity (low, moderate, and high) the International Physical Activity Questionnaire - Short Form was used (VALIM-ROGATTO *et al*, 2011).

Muscle strength was evaluated through dynamometry. A TAKEI® handgrip dynamometer was used to assess handgrip strength. The evaluation of handgrip strength was measured according to the recommendations of the American Association of Hand Therapists (SOARES *et al*, 2012). The equipment was calibrated before data collection. After performing two measurements of maximum isometric contraction (3 to 5 seconds) the best measurement was recorded.

For muscle mass evaluation a predictive equation was used (LEE *et al*, 2000) establishing the Total Muscle Mass Index (IMMT) ranging from 5.9 to 9.5 kg.m-2, calculated by the formula below**.** Where the Total Muscle Mass Index is expressed by IMMT (kg.m-2) = MMT / E2.

$$MassaMuscularTotal\ (MMT) = 0{,}244.PC + 7{,}80.E1 - 0{,}098.I + 6{,}6.S + Et - 3{,}3$$

Where BW = body weight, in kg; E1 = height, in meters; I = age, in years; S = gender (female = 0 and male = 1; Et = ethnicity (Caucasian = 0, Asian = -1.2; Afro-descendant = 1.4).

A digital scale with a 50g resolution was also used to measure body mass (Model 2096PP, Toledo®, BR), a stadiometer with a 1mm resolution to measure the height (Model ES2020, Manufacturer *American Medical* do BrasilLtda, Sanny®, BR).

After determining the Body Mass Index (BMI), the elderly women were classified into three groups: Low weight <22 kg/m2; [Eutrophic] 22 to 27 kg/m2; [and] Overweight >27 kg/m2. This classification of nutritional status based on BMI was proposed by the *Nutrition Screening Initiative*, considering the changes in body composition inherent to aging. These cut-points were adopted for the elderly in Brazil according to recommendations of the Food and Nutritional Surveillance System (SISVAN). This classification seems to be more appropriate for the elderly population than the classic general classification recommended by the WHO (PEREIRA et al, 2016).

III. DATA ANALYSIS

The tabulation and analysis of data were performed in GraphPad Prism 6® software. Descriptive statistical data were obtained as means and standard deviations. To verify the differences between the groups classified by BMI the *Student*'s *t* test was applied with a significance level of 95% ($p<0.05$). To verify the

relationship between age and the other study variables the Pearson Correlation Test was used, with a 95% significance level ($p<0.05$).

Table 1. Summary of the results of the three groups classified according to BMI

	BMI <22 n=6	***p-value***	**BMI 22 to 27** n=13	***p-value***	**BMI >27** n=21
Age	87,5 (4,8)	0,476	85,4 (7,7)	0,213	82,2 (5,5)
MEEM	27,3 (3,7)	0,164	24,5 (4,0)	0,899	24,7 (3,6)
BMI	20,1 (0,8)	0,000*	25,2 (1,7)	0,000*	30,5 (2,5)
IMMT	4,9 (0,4)	0,000*	6,3 (0,6)	0,000*	7,8 (0,9)
FPM	17,2 (4,9)	0,684	16,2 (5,0)	0,194	18,6 (5,5)

BMI, Body Mass Index (kg/m2); **Age**, in years; MMSE, Mini Mental State Examination (0-30); TMSI, Total Muscle Mass Index (5.9 to 9.5 kg.m-2); **FPM**, handgrip strength (kgf, women >16). All variables present mean **M** and standard deviation (**SD)**. significant difference ($p<0.05$).

The first interesting aspect to be observed in Table 1 is that the BMI decreases as age advances, although the age difference between the groups was not significant, this fact draws attention. However, it can be seen that the groups have a significant difference in mean BMI and MFI. Of the 40 women participating in the study, most are overweight (52.5%), and as for the MFI, only the underweight group (MFI 4.9 kg.m-2) had rates below the normative values (5.9 to 9.5 kg.m-2). The best FPM averages are from the overweight group, being 8.1% higher than the underweight group and 14.8% higher than the eutrophic group.

In this study, besides the classification of the elderly women into groups based on BMI, a correlation analysis between age and the other controlled variables was also performed. This analysis is of the group as a whole, since there is a lot of discrepancy between the number of participants in each group, and this hinders the individual correlation analysis of the groups. The data obtained are shown in Table 2.

Table 2. Correlation analysis of Age versus other variables

	MEEM	**BMI**	**IMMT**	**FPM**
Value r	-0,08	-0,40	-0,52	-0,14
p-value	0,626	0,010*	0,001*	0,376

MMSE, Mini-Mental State Examination (0-30); **BMI**, Body Mass Index (kg/m2); TMSI, Total Muscle Mass Index (5.9 to 9.5 kg.m-2); **FPM**, handgrip strength (kgf). * Significant correlation coefficients ($p<0.05$).

Table 2 shows that there was a moderate negative correlation of age with BMI and IMMT, that is, as age advances there is a reduction of both indexes. There was also a very strong positive correlation between BMI and IMMT (r 0.89 $p<0.000$), showing that the higher the BMI, the higher the IMMT. At least in part, this can be explained because the IMMT obtained by the predictive equation adopted in this study uses the BMI value among the calculation variables.

As for the cognitive aspect assessed by the MMSE and the muscle strength assessed by the FPM, no significant correlations of age with these variables were observed.

IV. DISCUSSION

It is known that aging can alter body composition. What causes controversy is to unveil which changes may bring damages to the health of the elderly. The progressive loss of muscle mass and strength, and the redistribution of body fat with greater accumulation in the abdominal region are some of these changes that can compromise mobility, the performance of daily activities, increase the risk of falls, and generate progressive functional disability (FALSARELLA, 2015).

Following Carneiro et al. (2017) the BMI reduction related to advancing age, demonstrated earlier in our results, predominates in the longevous elderly and has a high relationship with frailty. Volpini and Frangella (2013) emphasize that women have a greater predisposition to the development of frailty when compared to men, since they have a longer life expectancy, and thus become more susceptible over time to the cumulative deleterious effects of chronic-degenerative diseases.

It is noteworthy that BMI is an important routine measure to detect the degree of malnutrition and assess body composition. Our findings showed a predominance of overweight elderly women. The deposition of fat mass in women occurs later, after menopause, mainly due to the drop in estrogen levels causing an accumulation of fat that ends up reflecting in BMI values (PEREIRA; SPYRIDES; ANDRADE, 2016).

Although the mean age was high, i.e., of older women (over 75 years old), the results of the present study showed that those with overweight had the lowest mean age. Such finding is corroborated by the study of Oliveira, Duarte, and Reis (2016) who showed that as age advances BMI values tend to reduce. According to Pereira, Spyrides, and Andrade (2016), there is a significant reduction in BMI with advancing age and this is explained by physiological changes resulting from aging. Essentially, reduced sense of smell and vision, diminished taste buds, chewing difficulties, use of ill-fitting dental prostheses, are factors that contribute to malnutrition in the elderly. Morphological changes of the stomach and difficulties in absorbing nutrients, as well as the slowing of gastric emptying with a consequent increase in satiety time, are additional factors to develop malnutrition (VIEIRA et al., 2015).

Another relevant aspect that characterizes frailty as a multidimensional phenomenon is the significant reduction in the level of physical activity, a common characteristic in the elderly, especially the institutionalized ones, accelerating the development of sarcopenia and dinapenia (VOLPINI; FRANGELLA, 2013). The loss of muscle mass is more pronounced in sedentary individuals, with a reduction of up to 50%. Usually, this change is accompanied by the transformation in body composition, where muscle mass is replaced by fat mass (TELMA, 2017).

Advancing age also dramatically affects muscle strength levels. There is a relationship between the loss of muscle mass and reduced muscle strength (SOARES et al., 2017). Such negative effects on muscle mass and strength are, at least in part, explained by the drop in hormonal levels, and also by neural factors such as the degeneration of motor units (VIEIRA et al., 2015). To assess this physical valence, muscle strength, handgrip dynamometry is commonly used. This measure reflects the patient's overall strength because it has a good correlation with large body muscle groups (SOARES et al, 2017). As found in our study, the elderly women with higher BMI measures performed better in the strength tests assessed by dynamometry. Such findings are corroborated by other studies that found in underweight/undernourished elderly women a worse performance in muscle strength tests (SILVA et al, 2015).

V. CONCLUDING REMARKS

It seems quite evident that marked changes occur in body composition as a result of advancing age. Such changes are related especially to nutritional conditions and the reduced level of physical activity of the elderly. Thus, it should be remembered that a thorough assessment of body composition and muscle strength should be performed in clinical practice.

We can suggest that the maintenance of body weight at levels close to normal, as well as the maintenance of muscle strength, can be achieved with the control of chronic degenerative diseases, a good diet, and regular physical activity. Such recommendations should guide the management of the elderly, both in the prevention and in the possible reversal of signs and symptoms of the frailty syndrome.

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