OPEN ACCESS
Freely Available Online

INTERNATIONAL JOURNAL OF NUTRITION
ISSN NO: 2379-7835

Research

DOI: 10.14302/issn.2379-7835.ijn-19-2645

Relationship Between Body Composition and Nutritional Status in Brazilian Nonagenarians

Claudia Aline Oliveira Safian[1], Ângelo José Gonçalves Bós[1,*]

[1]Professor of School of Medicine at Pontifical Catholic University of Rio Grande do Sul. Porto Alegre, Brazil

Abstract

Introduction: Brazil has undergone considerable changes in age distribution, particularly in nonagenarians. Allied to this reality, there is a series of nutritional disorders in this population segment. An important factor related to quality of life and healthy aging is good nutrition throughout life.

Objective: To observe the possible relationship between nutritional status and body composition in nonagenarians.

Methodology: This is a descriptive, cross-sectional and analytical study, with participants aged 90 years or older, evaluated using the Mini Nutritional Assessment (MNA), anthropometric parameters, and Bioimpedance.

Results: The sample consisted of 72 nonagenarians, averaging in age 93.7 years, most female (72%), white (82%) and widowed (64%), 19.4% were in nutritional risk, based on the MNA criteria. All anthropometric parameters presented lower averages among nonagenarians in nutritional risk. Regarding the bioimpedance parameters, in general the risk-free nonagenarians presented higher averages of weight, maximum ideal weight, minimum ideal weight, BMI, lean-mass, fat-mass, percentage of fat-mass and minimum percentage of fat-mass. **Conclusions:** Most nonagenarians were in good nutritional status. Both anthropometric and bioimpedance parameters were effective to discriminate between normal and at nutritional risk nonagenarians. We also concluded that nutritional risk assessment in nonagenarians patients requires a joint analysis of the several existing methods for the nutritional evaluation, in order to obtain global diagnosis and accurate analysis of the nutritional status of the nonagenarians.

Correspondig author: Angelo Jose Goncalves Bos, Professor of School of Medicine at Pontifical Catholic University of Rio Grande do Sul. Porto Alegre, Brazil, Email: angelo.bos@pucrs.br

Keywords: Anthropometry, bioimpedance, body composition, 80+ years old, public health.

Received: Feb 08, 2019 **Accepted:** Apr 11, 2019 **Published:** Apr 15, 2019

Editor: Fei He, University of Illinois Urbana Champaign, United States.

Introduction

Population aging is a worldwide phenomenon which occurs when there is a progressive increase in the number of people with greater age and a greater life expectancy. In accordance with the projection of the Brazilian Institute of Geography and Statistics [1], at present Brazil has nearly 26 million old adult people (age above 60 years). Besides, the proportion of nonagenarians is increasing in a more considerable way [2].

The increase in life expectancy has been one of the greatest triumphs of humanity in the twentieth century, with significant repercussions in the present century. If on the one hand this can mean a gain, on the other it poses great challenges for society. Such an environment leads to the discussion of a theme that will focus more and more attention on public health, medical, nutrition, and community policies: the need to guarantee quality of life, and nutritional well-being to this contingent of citizens who generally coexist with the more or less severe reduction of their functional abilities, and therefore, also require special care [3].

The nonagenarians group has, often, limiting characteristics and disabling events, so health is also related to the nutritional status and eating habits. A balanced nutritional status favors physical and emotional health, preventing or delaying the appearance of the most frequent illnesses during the aging process [4]. Schirmer [5] observed a worrying frequency of nonagenarians with low nutritional levels, in addition to a significant number of chronic diseases.

Food habits are influenced by several interdependent and complementary factors: economic, nutritional, social, and cultural factors that directly influence the ingestion of certain essential nutrients and consequently affect the nutritional status of the nonagenarians [6].

Thus, we observed increasing prevalence of nutritional disorders in the older-adult, and also the increase in morbimortality associated with them, the lack of specific parameters or classification criteria for this population, and the need for a greater domain of the health professional on how to evaluate the nutritional status and body composition. As a result, the nonagenarians is frequent excluded from a nutritional assessment in routine clinical calls, therefore, this study aims to identify whether there is a relationship between nutritional status and body composition in the nonagenarians. This observation may bring new horizons for an effective intervention with improvements to the quality of life of the nonagenarians.

Particular interest in this topic arose after the finding of a progressive increase in the nonagenarians population, changes in the demographic and epidemiological profile of the Brazilian population, where it was possible to verify the need for adequate social and health reorganization to meet these new emerging demands. Active and healthy aging is the major goal in this process. If we consider health in an expanded way, it is necessary to change in the current context towards the production of a social and cultural environment more favorable to the long-lived population. In this sense, the academic environment has a challenging mission to foster not only health practices aimed at the demand of this growing part of the population - the nonagenarians - with its characteristics and peculiarities, as well as research addressing the relationship between eating habits and nutritional status. Such demands require greater attention from health professionals and health systems in the country, seeking promotion and prevention, generating health and quality of life through a healthy diet. In this context, some questions about the nutritional state of nonagenarians arise, how is their body composition, and if there is a relation between body composition and their nutritional status.

These questions cannot be answered in an irresponsible way, making it essential to carry out a concise study on the body composition and nutritional status of the nonagenarians, in order to consider all variables.

Methodology

This study is in accordance with the Guidelines and Norms Regulating Research Involving Human Beings (Resolution No. 466 of the National Health Council of December 12th, 2012). This study was evaluated and approved by the Scientific Committee of the Institute of Geriatrics and Gerontology and by the Research Ethics Committee of PUCRS (CEP) with the number: 1772706.

All the participants were informed clearly about the objectives and methods of the research, being guaranteed the confidentiality of information collected and that it will not offer risks or damage to participants. All participants agreed to participate voluntarily in the study after reading and signing the informed consent form.

This study is a descriptive cross-sectional analytical study. The studied population consisted of long-lived 90-year-olds living in Porto Alegre (Brazil) and the sample of those assisted by the Multiprofessional Care of Oldest-Old Project (AMPAL) of the Geriatrics and Gerontology Service of the São Lucas Hospital (HSL) of the Pontifical Catholic University of Rio Grande do Sul (PUCRS). The participants were identified at first stage of AMPAL in the city of Porto Alegre. The city administration shares local demand budgets into 17 regions. We randomly selected a census sector from each Budget Region and performed a feld search for nonagenarians and centenarians on them, aiming to get a random sample of this population age. Through the Project, 237 participants were evaluated and monitored. In this study, we included participants aged 90 or over, living in the city of Porto Alegre, accompanied by the AMPAL, who expressed, personally or through the caregiver, the interest in participating in this research. We excluded the nonagenarians who could not perform the Bioimpedance assessment: with lower limb amputation at a level greater than the fingers or toes, pacemaker carriers, those who presented difficulty to stay at supine for at least 10 minutes, with obvious edema independent of cause (heart failure, lymphedema or other), with difficulty in oral rehydration and those with acute diarrhea in the last 7 days. The total sample was 72 participants, most exclusion criteria was not be able to stand supine for at least 10 minutes.

Data collection followed AMPAL's routine, held up weekly, every morning from 9 am to 12 pm. On the nutritional data collection, anthropometric data verification was carried out, as well as questionnaires and a bioimpedance test. Anthropometry is a method of scientific research, a non-invasive assessment of body composition, which provides indirect information about the muscle or fat tissues, in addition to presenting safety in operation, simplicity and low cost. The measures adopted in this evaluation were: body weight in kilograms, height, body mass index (BMI), knee height, arm circumference and calf circumference in centimeters. A calibrated digital anthropometric set of scales of the EatSmart brand, Model RMBD117, with a maximum capacity of 180 kg was used to verify the weight. For the evaluation, the nonagenarians stood in the center of the scales, barefoot and in light clothes. The height was measured using a Sanny brand portable stadiometer, with the individual barefoot on a smooth, level surface, in an upright position, with heels together, straight back and arms extended at the side of the body. The BMI, expressed in kg/m2, is a simple and good indicator of the nutritional status of the older-adult, calculated from the weight (kg) divided by the height (m) squared. For the classification of the nutritional status of the nonagenarians from the BMI, the cut-off points of Lipschitz [7] used for the older-adult were: underweight (≤ 22.0 kg/m^2), eutrophic (22.0 to 27.0 kg/m^2) overweight (≥ 27.0 kg/m^2). The MNA® questionnaire was developed and validated to perform a simple and rapid assessment of the nutritional status of older-adult patients in clinics, hospitals and asylum institutions, allowing the detection of risk of malnutrition and nutritional intervention when necessary [8]. The questionnaire was carried out through a standardized interview, using the version translated into Portuguese by Nestlé Services of the Mini Nutritional Assessment, which is the version of the "Short-form Mini Nutritional Assessment" method adapted for home patients [7].

The arm circumference measure represents the sum of the areas constituted by the bony, muscular and greasy tissues of the arm. To obtain it, the arm to be evaluated must be flexed towards the thorax, forming an angle of 90º. The evaluator should mark the midpoint of the arm, that is, the distance between the acromion and the olecranon of the elbow. The measurement is performed on the patient with the arm extended along the body with the palm facing the thigh. The values found were compared to MNA reference values [7]. Calf circumference is the parameter that provides the most sensitive measure of muscle mass in the older-adult. For correct measurement of calf circumference, the inextensible measuring tape was positioned horizontally in the area of greatest calf diameter, in the space between the ankle and the knee.

It was measured with the older-adult person sitting relaxed or standing with the weight evenly distributed between both feet. The largest calf diameter measurement was recorded. Bioimpedance was included during the nutritional evaluation of the nonagenarians for the analysis of body composition data. The test was carried out using the instrument called Biometrical Tympanololimeter Maltron BF900. This instrument contains eight contact electrodes that allow the analysis of the entire body in a segmented manner. In the equipment manual, it exhibited normality patterns for ages up to 99 years. The accuracy of a test involving analysis of body composition depends on the conditions of the patient and the environment where the test is conducted.

From the evaluations carried out, the nonagenarians were classified according to MNA®: in adequate nutritional status, at risk of malnutrition or malnutrition. Averages of the different body components calculated by bioimpedance (muscle mass, bone mass and fat mass), fat percentage and BMI were calculated for each level of nutritional status. The possible differences observed were tested by Variance Analysis. Significance levels lower than 5% ($p<0.05$) were considered significant. Levels of significance between 5 and 10% will be considered indicative of significance [9]. For the proper analysis of the calf, abdominal and waist circumferences, which showed significant differences in the variances, it was necessary to use the Kruskal-Wallis test that evaluates the difference in the distribution of the results, being a non-parametric test. The odds of having nutricional risk were calculated by logistic regression for both anthropometric and bioimpedance parameters.

Results

The study included 72 nonagenarians, 20 men and 52 women, with an average age of 93.7 years.

Table 1 compares the frequency of sociodemographic characteristics among the oldest old with and without nutritional risk. 72 nonagenarians participated, of which 19.4% were classified as being in nutritional risk based on the Mini Nutritional Assessment. The sample was represented mainly by women (72%), white (82%) and widowers (64%). The percentage of women was higher among the oldest old with nutritional risk (86%), as well as the percentage of whites (86%) and widowed (93%). The average age was higher among nonagenarians at nutritional risk, although this difference was also not significant ($p=0.202$). There was a significant relationship between marital status and nutritional risk ($p=0.028$), being beyond the highest frequency of widows among nonagenarians at nutritional

Table 1. Sociodemographic characteristics among the oldest old with and without nutritional risk, based on the Mini Nutritional Assessment

Characteristics	With Risk	Without Risk	Total	P
Sex				0.322
Male	2 (14.3%)	18 (31.0%)	20 (27.8%)	
Female	12 (85.7%)	40 (69.0%)	52 (72.2%)	
Age	93.7 ± 4.12	92.4 ± 3.16	92.7 ± 3.37	0.202
Color (race)				0.683
White	12 (85.7%)	47 (81.0%)	59 (81.9%)	
Another	2 (14.3%)	11 (19.0%)	13 (18.1%)	
Marital status				0.028
Married	0 (0.00%)	20 (34.5%)	20 (27.8%)	
Single / separate	1 (7.1%)	5 (8.6%)	6 (8.3%)	
Widower	13 (92.9%)	33 (56.9%)	46 (63.9%)	
Total	14 (19.4%)	58 (80.6%)	72 (100.0%)	

risk mentioned above. It was noted that all who were married were in the level without nutritional risk.

On table 2, the average anthropometric parameters between nonagenarians with and without nutritional risk were compared. All parameters had lower averages among participants with nutritional risk. In relation to weight and BMI measures which are easily measured in the population, it is observed that at risk individuals showed significantly lower ($p<0.001$). Between the circumferences were significantly lower the arm ($p=0.001$) and calf ($p<0.001$) showed a statistical difference among the groups. The calf, abdominal and waist circumferences had a significantly greater standard deviation in the nutritional risk group, indicating a greater sample dispersion in this group or maybe the smaller number of participants in that group. The two parameters (abdominal and waist circumference) showed very low levels of significance, which is considered indicative of significance for the former. Concerning skin folds, the folds that presented statistical significance were: triceps ($p=0.04$), abdominal ($p=0.03$), thigh ($p=0.03$) and calf ($p=0.02$).

In Table 3, a comparison of bioelectrical impedance parameters between nonagenarians with and without risk of malnutrition was performed. In general, subjects without risk had greater average weight, ideal maximum weight, ideal minimum weight, BMI (very close to the value measured by the weight and height recorded separately), lean mass in kg, fat mass in kg, body fat percentage, Body water in liters, ideal maximum percentage of water, ideal minimum percentage of water and basal metabolism rate. Interestingly, the comparison of the percentage of lean mass was greater in individuals at risk, with a statistically significant difference ($p=0.001$). Although the body water measured in liters was not significantly different between groups, the percentage of body water was significant, indicating that the distribution of fluids

Table 2. Comparison of the averages of anthropometric parameters evaluated by anthropometry among the oldest old with and without nutritional risk.

Characteristics	With risk Average ± SD	Without risk Average ± SD	p
Weight Kg	51.17 ± 10.49	65.78 ± 10.97	<0.001
BMI (by anthropometry, kg/m²)	21.41 ± 3.75	26.21 ± 2.67	<0.001
Circumferences (cm)			
Arm	24.96 ± 3.84	28.07 ± 2.92	0.001
Calf	28.57 ± 7.34	33.93 ± 4.04	<0.001 *
Abdominal	93.00 ± 14.9	98.98 ± 8.05	0.094 *
Waist	87.21 ± 13.92	92.29 ± 8.85	0.107 *
Skin-folds (mm)			
Breastplate	9.71 ± 5.09	11.77 ± 5.90	0.233
Subscapularis	14.50 ± 7.57	17.08 ± 6.26	0.187
Tríceps	11.64 ± 6.25	14.79 ± 4.75	0:04 0
Axillary	14.14 ± 8.13	17.37 ± 6.26	0.106
Supra Iliac	15.35 ± 9.17	18.60 ± 7.52	0.169
Abdominal	14.35 ± 10.35	19.63 ± 7.27	0.028
Thigh	19.21 ± 10.74	24.70 ± 7.96	0.034
Calf	14.57 ± 7.21	19.63 ± 7.37	0.023

BMI= Body Mass Index; SD=Standard Deviation; * Kruskal-wallis.

Table 3. Comparison of the averages of bioimpedance parameters among the oldest old with and without risk of malnutrition.

Characteristics	With risk Average ± SD	Without risk Average ± SD	P
Weight (kg)	51.17 ± 10.49	65.78 ± 10.97	<0.001
Maximum Ideal Weight (kg)	51.71 ± 8.25	58.87 ± 10.50	0,020
Minimum Ideal Weight (kg)	43.50 ± 7.39	49.05 ± 8.99	0.035
BMI (kg/m²)	21.31 ± 3.76	25.93 ± 2.76	<0.001
Lean Mass (kg)	37.94 ± 7.40	43.91 ± 9.85	0.037
Lean Mass (%)	75.12 ± 10.47	66.02 ± 6.39	0.001*
Fat mass (kg)	13.17 ± 7.68	21.69 ± 5.75	<0.001
Fat mass (%)	24.84 ± 10.47	33.67 ± 6.44	0.001*
Maximum Ideal Fat Mass (%)	36.07 ± 7.25	32.82 ± 4.01	0.067*
Maximum Ideal Mass Min (%)	29.42 ± 7.44	26.68 ± 3.93	0.211*
Body Water (l)	29.79 ± 7.41	31.90 ± 6.70	0.303
Body Water (%)	52.92 ± 1.81	48.52 ± 2.25	0,008*
Maximum Ideal Water (%)	52.71 ± 11.93	53.37 ± 4.71	0.309
Maximum Ideal Water (%)	45.71 ± 1.81	46.37 ± 2.25	0.309
Basal Metabolic Rate	1084.42 ± 121.5	1183.05 ± 165.7	0.040

SD=Standard Deviation; * Kruskal-wallis.

relative to the other body components was higher in nonagenarians at risk.

The odds of having nutricional risk associated to anthropometric and bioimpedance parameters are shown in Table 4. Nutricional risk were significantly associated to BMI assessed by anthropometry and by bioimpedance. Other significant factors associated to the nutricional risk were arm and calf circumference, abdominal, tight calf and tricipes skin-folds; and most bioimpedance parameters, except minimum fat mass, body water, and basal metabolic rate.

The dispersion graph shows that the group at risk of malnutrition presented a greater percentage variation of fat calculated by the SIRI, with values more frequently below 25%. The risk-free subjects were concentrated in a standard value between 25 and 35%, that is, values greater than% fat. The regression line between the percentage of fat calculated by the SIRI (anthropometric) and the percentage of fat measured by the bioimpedance presents a higher angle (0.46) in the group with risk of malnutrition (green line in the figure) than the group without risk (0.34, p> 0.05). There is also a greater dispersion of fat percentage results around the regression line among participants at risk of malnutrition. (Figure 1).

Discussion

Maintaining longevity with quality of life is associated with the preservation of an adequate nutritional status. This is measured by body composition with its parameters within criteria established in the literature. However, we observed the absence of criteria to identify the adequacy of body composition parameters in nonagenarians. Therefore, the present dissertation sought to analyze the body composition through anthropometry and bioimpedance in older-adults with 90 years or more.

The majority of the analyzed population is composed of female older-adults. The Census conducted by the IBGE in 2010 [1] also observed the highest frequency of females in nonagenarians above 90 years (68%). In the State of Rio Grande do Sul, the percentage of nonagenarian women is higher than that

Table 4. Odds of having nutritional risk for anthropometric and bioimpedance parameters.

Caracteristic	OR (95%CI)	p
Age (years)	1.11(0.95-1.30)	0.2021
Sex (M/F)	0.37(0.08-1.83)	0.2229
BMI (by anthropometry, kg/m²)	0.56(0.40-0.76)	0.0003
Circumferences (cm)		
Abdominal	0.94(0.88-1.00)	0.0501
Waist	0.95(0.89-1.01)	0.0973
Arm	0.73(0.59-0.90)	0.0036
Calf	0.82(0.71-0.95)	0.0094
Skin-fold (mm)		
Abdominal	0.92(0.86-0.99)	0.0345
Axillary	0.92(0.83-1.02)	0.1098
Tight	0.93(0.87-1.00)	0.0405
Calf	0.91(0.83-0.99)	0.0289
Breastplate	0.94(0.84-1.04)	0.2340
Subscapularis	0.94(0.86-1.03)	0.1885
Supra Iliac	0.94(0.86-1.03)	0.1715
Triceps	0.88(0.78-1.00)	0.0461
Bioimpedance parameters		
Weight (Kg)	0.85(0.78-0.94)	0.0008
Maximum Ideal Weight (kg)	0.92(0.85-0.99)	0.0276
Minimum Ideal Weight (kg)	0.91(0.84-1.00)	0.0444
BMI (kg/m²)	0.57(0.42-0.78)	0.0004
Lean Mass (kg)	0.91(0.83-1.00)	0.0471
Lean Mass (%)	1.15(1.06-1.26)	0.0010
Fat mass (kg)	0.80(0.71-0.90)	0.0004
Fat mass (%)	0.87(0.80-0.95)	0.0013
Maximum Ideal Fat Mass (%)	1.12(1.00-1.25)	0.0457
Minimum Ideal Fat Mass (%)	1.10(0.99-1.23)	0.0772
Body Water (l)	0.95(0.86-1.05)	0.3048
Body Water (%)	1.11(1.01-1.23)	0.0318
Maximum Ideal Water (%)	0.44(0.09-2.18)	0.3124
Minimum Ideal Water (%)	0.45(0.10-2.17)	0.3241
Basal Metabolic Rate	0.99(0.99-1.00)	0.0538

OR (95%CI)= Odds-ratio (95% confidence interval); BMI= Body Mass Index

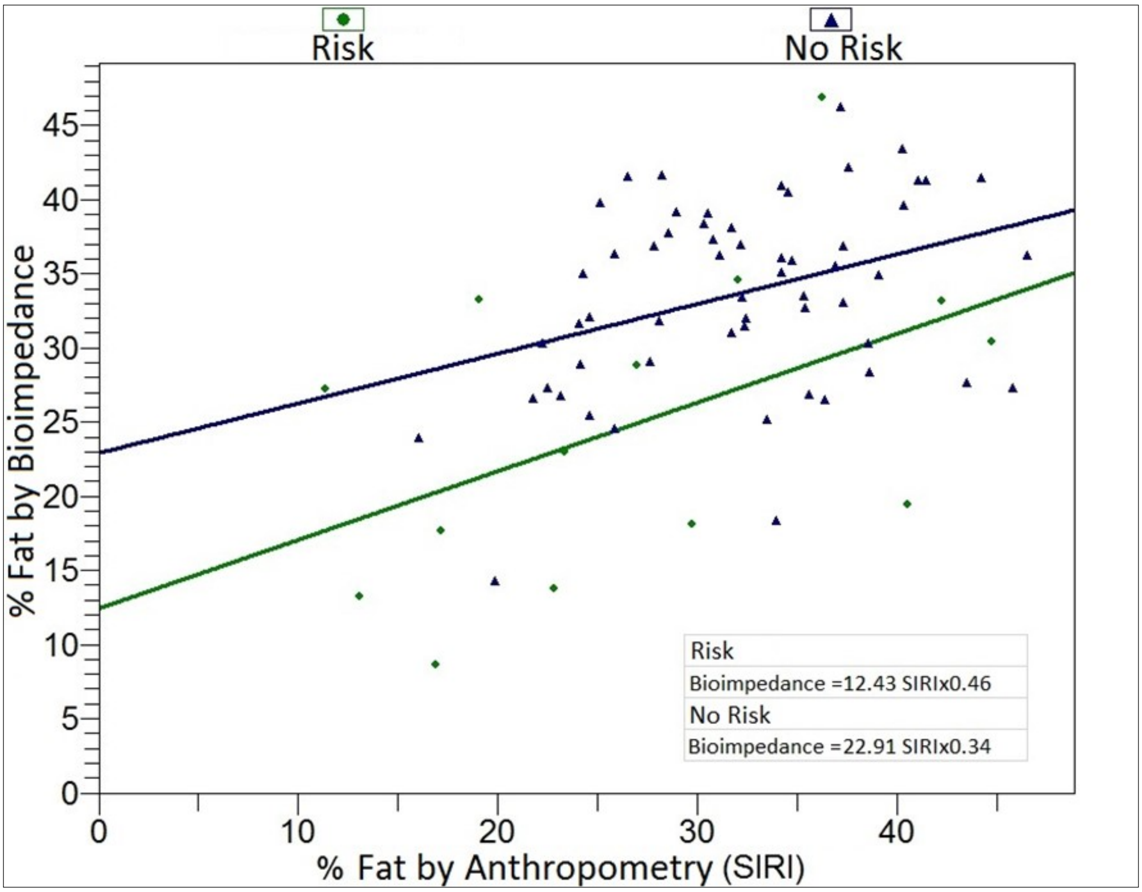

Figure 1. Dispersion of body fat percentage calculated by bioimpedance and anthropometry for nonagenarians with or without nutritional risk (r^2=0.32, $p<0.01$).

of Brazil (73%) [10]. We observed that the distribution by gender in the present study was similar to that of the population census, thus being representative of the population in this question. As for the distribution by marital status, the 2010 Census showed that widowers, as well as the present survey, represented the majority of the population over 90 years old [10].

Regarding age, we observed that the nonagenarians without nutritional risk were younger than the others. On the contrary, the nonagenarians at nutritional risk showed a higher average age. Campos et al., [11] and Schirmer [5] also observed that older-adults with more advanced age are more likely to develop nutritional risk.

The sample had little representation of individuals of brown and black color. This phenomenon was also found in the profile survey of the older-adults in Rio Grande do Sul, where most interviewees were white, probably due to colonization in the State. Even though they number in the majority, the percentage of nonagenarians at nutritional risk was higher in white individuals. Studies have shown that brown nonagenarians individuals show greater family support (US), this support may be a reason for them to present a better-quality diet, and as a consequence, better nutritional status.

As for the marital status, the majority of the widowed individuals presented nutritional risk and all the married ones were without risk. Research shows that older people who live independently and eat alone, inadequately ingest food and have greater nutritional risk. On the other hand, the opposite occurs with married couples who have a companion who remains present, sharing moments like food [12].

The average weight of nonagenarians was lower in the group at risk of malnutrition, justifying their inclusion in this group, besides reflecting, according to Paz et al. [13], the difficulty of accessing natural and healthy food, the high cost of this type of diet, and the lack of concern about eating a balanced diet. These factors are characteristic, according to the authors, to the life of a retired older-adult, often abandoned by his or her family, aggravated by the nutritional deficiencies, peculiar to the aging process itself.

In the present study, the use of MNA as a method of assessing nutritional status showed that the nonagenarians evaluated had an average BMI of 25.04 ± 3.49 kg / m², with a 25% percentile of 22.5, median of 25.0 and 75% percentile of 27.55 kg / m². This shows that the nonagenarians population also undergoes a nutritional transition, as well as the other Brazilian age groups [14]. Santos & Sichieri found an average BMI of 24.5 kg / m² in the older-adults in Rio de Janeiro, while Sampaio & Figueiredo [15] obtained 24.4 kg / m² in older-adult patients attended at the Hospital das Clínicas da Bahia. These values are similar to those found in this work. It is interesting to observe that more than 25% of the nonagenarians evaluated were overweight according to the Lipschitz criteria

Arm circumference had a lower average among patients at nutritional risk, with statistical difference between groups. This finding is consistent with the literature that mentions arm circumference as an indicator of both subcutaneous fat and lean mass. Studies have suggested that arm circumference has a high correlation with BMI and may be a good indicator to replace BMI or another measurer to evaluate the nutritional status of the older-adult population [16]. The present study allows us to conclude that arm circumference can also be an indicator of malnutrition in nonagenarians.

Both the abdominal circumference and the abdominal skin fold obtained the lowest average in the nonagenarians at risk of malnutrition. These results have also been frequently described in the scientific literature, where the relationship between abdominal fat and morbidities is already well established. The literature also cites the need for studies that develop simple and accessible methods for assessing body composition, especially of the older-adults, and especially for the diagnosis of visceral fat, since it has a close relationship with metabolic diseases, especially cardiovascular diseases [17]. In older-adult individuals there is a greater accumulation of abdominal fat when compared to adults, and this occurs for both sexes, especially in men. In women, fat accumulation occurs mainly in the gluteofemoral region and subcutaneous abdominal tissue [17]. This parameter also seems to be suitable for nonagenarians.

The nonagenarians without nutritional risk presented higher average values for each of the anthropometric parameters. MNA calculates its score using parameters related to malnutrition, not considering overweight or obesity as a nutritional problem. Despite susceptibility to developing malnutrition, the older-adults have 20% to 30% increase in total body fat and a change in their distribution, leading to a more central location. There is a decrease of the fat tissue in the upper limbs and a decrease of the lean mass in the legs. Because of these changes, the nonagenarians may present alterations in some anthropometric variables, such as increased waist circumference and decrease of arm cirmcunference and triceps skinfold, observed in younger adults [18]. These findings corroborate those found in this work in nonagenarians.

Lean mass was the largest component of the nonagenarians's body composition at all levels investigated. There are no studies that associate body composition and nutritional risk or quality of diet in nonagenarians. However, Dos Santos [19] used the Dual Energy X-Ray Absortiometry (DEXA) to analyze the body composition of 123 individuals with an average age of 83.2 years and observed a lean mass of 46.7kg for men and 31.5 kg for women and a fat mass of 23.4 kg for women and 20.7 kg for men, values similar to those found in this study using bioimpedance even with an older sample.

Water intake is a component evaluated by MNA and by the level of classification of diet quality. The average difference between the risk and risk-free older-adult in body water was 0.4 liters. As a metabolic and functional component, body composition undergoes significant changes in old age [20], which are mainly expressed by negative variation in fat-free mass and positive variation in fat mass [21]. Physiological changes refer to muscle mass reduction; however, there is still a decrease in bone mass as well as body water [22] in accord with the results found in this study.

Conclusions

Evaluating the health conditions of the nonagenarians makes it possible to develop strategies for the implementation of targeted interventions in order to meet the demands of this population and, consequently, to improve their quality of life. In addition, nutritional intervention, adequate and timely to prevent the deterioration of the health status of the nonagenarians, can provide well-being and greater survival for nonagenarians. In this study, we observed that most of the nonagenarians individuals were not at nutritional risk. The anthropometric parameters evaluated showed that the waist circumference, arm circumference, calf circumference and skinfolds were high among those without nutritional risk. There was an association between marital status and nutritional risk, but the sex, age and color of the oldest old did not present a significant relation between the investigated parameters.

The literature does not specify which evaluation method is considered the gold standard for this age group. There are no specific nutritional classification parameters for this population. The measurement of nutritional risk in the older-adult requires the joint analysis of the various methods available for nutritional assessment in order to obtain a global diagnosis and an accurate analysis of the nutritional status of the nonagenarians. During this process, changes in senescence over the nutritional status of the nonagenarians should be considered.

We conclude, with the present research, that there was a significant relationship between nutritional status and body composition of nonagenarians. Most of the nonagenarians evaluated presented nutritional status without risk. Older-adult patients with nutritional risk presented significant differences in body composition parameters measured by both Bioimpedance and anthropometry. Anthropometry, due to its low cost, is an effective tool in the evaluation of the nutritional status of nonagenarians individuals, even though it requires a specific training. Bioimpedance, despite having a higher cost, is easier to apply even by non-nutritionists, except for its interpretation. Home care is one of the main focus areas of AMPAL, the umbrella project of this work. In this context of the AMPAL, the proposal of multiprofessional teams for home evaluation with pairs of professionals with subsequent discussion in a meeting with all professionals would benefit from bioimpedance as one of the instruments that can be used in the evaluation.

Studies have sought to characterize dietary patterns potentially associated with longevity. However, achieving healthy longevity with quality of life and a certain level of autonomy becomes a major challenge.

Therefore, proper nutrition can contribute to a physical and mental improvement and reduce mortality and comorbidities.

Other Brazilian studies on the nutritional assessment of nonagenarians need to be carried out; so that effective measures of nutritional intervention can be effectively structured for this population in Brazil.

The longitudinal character of AMPAL will allow the monitoring of the nonagenarians analyzed, providing the identification of factors (among them nutritional) associated to a better life expectancy with quality in this age group. It will also be possible to compare results with other longitudinal studies conducted in developed countries with Italy, the United States and the United Kingdom.

References

1. IBGE. Instituto Brasileiro de Geografia e Estatística. Censo 2010 – Primeiros resultados [Brazilian Census – First results]. Available at www.ibge.gov.br/censo
2. CAMACHO, N. C. A.; MORCHE, K. R.; MULLER, A. L. W.; BÓS, ÂNGELO JG Por que nonagenários não se tornam centenários no Brasil? [Why nonagenarians does not turn to centenarians in Brazil]. REVISTA AMRIGS. , v.62, p.55 - 59, 2018.
3. WORLD POPULATION PROJECTIONS: the 2000 revision. Population Division Department of Economic and Social Affairs, United Nations. Disponível em: http://www.un.org/spanish/esa/population/wpp2000h.pdf
4. BERGER, L., MAILLOUX, D., POIRRIER, M. Pessoas idosas: uma abordagem global.[Older people: a global approach]. Lisboa; p. 215-57, 1995.
5. SCHIRMER, C. Relação entre hábitos alimentares e composição corporal de longevos [Relationship between eating habits and body composition of

long-lived]. Master's Thesis of Pontifical Catholic University of Rio Grande do Sul, Brazil; 2014.

6. OLIVEIRA, T., SILVANA, P. DE. Estudo do consumo alimentar: em busca de uma abordagem multidisciplinar [Food consumption study: searching for a multidisciplinary approach]. Rev. Saúde Pública.;v. 31, n. 2, p. 201-8, 1997.
7. LIPSCHITZ, D. A. Screening for nutritional status in the older-adult. Primary Care; p. 55-67, 2004.
8. GUIGOZ, Y., VELLAS, B., GARRY, P. J. Mini Nutritional Assessment (MNA): Research and Practice in the older-adult. Nestle nutrition workshop series. Clinical &programme; v. 1, 1999.
9. BÓS, A. J. G. Epi info sem misterio: Um manual prático.Edipucrs,2013.
10. BÓS, A. J. G. Ângelo José Gonçalves Bós. Introdução aos resultados e características gerais dos idosos pesquisados [Introduction to results and general caracteristics of older-adults] in Perfil dos Idosos do Rio Grande do Sul [Older-adults profile in Rio Grande do Sul, Brazil]. ESP, 2015. Available in http://www.escoladesaudepublica.rs.gov.br/download/20180813110229perfil_dos_idosos_do_rio_grande_do_sul.pdf
11. CAMPOS, M. T. F. S., et al. Estado nutricional e fatores associados em idosos [Nutritional status and associated factors in the older-adult]. Rev. Assoc. Med. Bras.; v.52, n.4, 2006.
12. BROWNIE, S. Why are older-adult individuals at risk of nutritional deficiency? Int. J.Nurs.Pract. v. 12, n. 2, p.110-8, 2006.
13. PAZ, R. C.; FAZZIO, D. M. G.; SANTOS, A. L. B. Avaliação nutricional em idosos institucionalizados [Nutritional Assessement in older adult institucionalized]. Revisa. [cited 2015 Oct 21]; 1 (1): 9-18, 2012.
14. SOUZA, R., FRAGA, J. S., GOTTSCHALL, C. B. A., BUSNELLO, F. M., RABITO, E. I. Avaliação antropométrica em idosos: estimativas de peso e altura e concordância entre classificação de IMC. [Anthropometric evaluation in the older-adult: estimates of weight and height and agreement between classification of BMI] Rev. Bras. Geriatr. Gerontol.; v. 16, n. 1, p. 81-90, 2013.
15. SAMPAIO LR, VC FIGUEIREDO. Correlação entre o índice de massa corporal e os indicadores antropométricos de distribuição de gordura corporal em adultos e idosos -Rev. Nutr., Campinas, 18(1): 53-61, jan./fev., 2005.
16. ARAÚJO, C. R., FARIA, H. M. R., PEREIRA, O. A. V. Análise do perfil nutricional de idosos do movimento da terceira idade praticantes de hidroginástica. [Nutritional profile analysis of older-adults from third-age movements participating in water-gymnastics]. Rev.Nutrir.Gerais, 2007.
17. EICKEMBERG, M., OLIVEIRA, C. C. D., RORIZ, A. K. C., FONTES, G. A. V., MELLO, A. L., & SAMPAIO, L. R.. Bioelectrical impedance and visceral fat: a comparison with computed tomography in adults and elderly. *Arquivos Brasileiros de Endocrinologia & Metabologia*, *57*(1), 27-32, 2013.
18. DOS SANTOS, A. C. OLIVEIRA; DE OLIVEIRA MACHADO, M. MARIA; LEITE, E. MACHADO. Envelhecimento e alterações do estado nutricional. GERIATRIA & GERONTOLOGIA, p. 168, 2010
19. WOODROW, G. Body composition analysis techniques in the aged adult: indications and limitations. Current Opinion in Clinical Nutrition and Metabolic Care; v. 12, n. 1, p. 8-14, 2009.
20. ALEMÁN-MATEO, HELIODORO, et al. Elderly Mexicans have less muscle and greater total and truncal fat compared to African-Americans and Caucasians with the same BMI. *The journal of nutrition, health & aging*, 2009, 13.10: 919-923.
21. FIELDING, R. A., VELLAS, B., EVANS, W. J., BHASIN, S., MORLEY, J. E., NEWMAN, A. B. et al. Sarcopenia: An undiagnosed condition in older adults. current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. Journal AmericanMedicine Dir Assoc; v. 12, n. 4, p. 249-256, 2011.
22. FALSARELLA, G., GASPAROTTO, L., BARCELOS, C., COIMBRA, I., MORETTO, M., PASCOA, M., COIMBRA, A. Body composition as a frailty marker for the older-adult community. Clinical Interventions in Aging; v. 10, p. 1661-1667, 2015.