Nutritional aspects of elderly practitioners of physical activity

Guilherme da Silva Dórea[1]
Marina Garcia Manochio-Pina[1]
Daniel dos Santos[2]

[1] Universidade de Franca, Departamento de Nutrição, Curso de Nutrição. Franca-SP, Brasil.

[2] Universidade de Franca, Curso de Educação Física. Franca-SP, Brasil.

Correspondence
Guilherme da Silva Dórea
E-mail: guilherme.dorea@gmail.com

Abstract

This study aimed to assess nutritional status by collecting data on anthropometrics and dietary patterns of physically active elderly in a countryside town in São Paulo state. Thirty-one elderly people participated: 22 women and nine men. The variables related to body composition were: BMI, current and ideal weight, adequacy of mid-arm muscle circumference (MAMC), fat percentage, waist circumference and calf circumference. Dietary pattern was analyzed for intake of water, energy, calcium and fiber, as well as adequacy of macronutrients. The mean values for BMI, current weight, MAMC and calf circumference showed no statistical difference from the standard deemed appropriate by the literature for both sexes. The mean value for women's fat percentage (38.76% ± 4.07%) and the amount corresponding to women's waist circumference (87.36 ± 9.84) were higher than the value considered as adequate. Mean energy intake for both sexes was lower than recommended, with statistical significance (p < 0.0001). Despite the deficient calorie intake, the adequacy of macronutrients was shown to be within the standard. The intake of water, calcium and fibers for both sexes was lower than that in the literature with appropriate statistical significance (p = 0.0001). The results suggest that the correction of eating habits and the prescription of physical activity in appropriate intensity for this population are of paramount importance to improve the nutritional status and thus avoid the incidence of future problems.

Key words: Nutritional Status. Anthropometry. Quality of Life. Food Intake. Health of the Elderly.

Introduction

According to the World Health Organization (WHO), the term 'the elderly', in developing countries, defines people who are 60 years old or older. The number of people in this age range has grown. It is expected that Brazil will have the sixth largest elderly population in the world by 2025. The development of this population can be explained by advances in medicine, with treatments of various diseases and their complications, as well as improved quality of life.[1,2]

However, with increasing life expectancy, illnesses such as Alzheimer's disease, influenza, pneumonia, kidney disease and hypertension are increasingly present in the lives of the elderly. There is knowledge of these facts because of numerous studies in the literature on the health status of the elderly. Such studies reported limitations to daily physical activity, quality of life and use of health promotion services.[3-5]

The elderly population is one of the groups most prone to malnutrition caused by life events, disease, genetics and economics. Factors such as regular sleep, frequency of intake of balanced meals, regular physical activity, smoking, increased alcohol consumption and body weight are features that appear to influence nutritional status and physiological age. Awareness of nutritional changes resulting from aging is crucial, particularly in developing countries, where the elderly have premature functional aging due to lifestyle factors.[3]

Biological changes that are typical of this cycle are continuing loss of lean body mass (approximately 2-3% per decade) and body fluids, increased body fat, decreased organs like kidneys, liver and lungs and mainly a great loss of skeletal muscles. Given these aspects, it is essential to pursue nutritional behavior and diagnostics that improve the quality of life of this population.[3]

The habit of exercising regularly improves several functions that decline during the aging process, such as cardiovascular, metabolic, musculoskeletal and mental functions. The increase in body mass and strength improve bone density, prevents loss of functional capacity and reduces the risk of falls. Moreover, the increased energy needs of exercise practitioners result in increased appetite, food intake and weight gain. Current recommendations for promoting population health include the practice of moderate exercise on a regular basis at least 30 minutes a day. The practice of endurance and strength exercises has been recommended for the elderly for health promotion, and prevention and rehabilitation of several chronic diseases.[1,6,7]

In addition to encouraging the elderly to practice physical activity, nutritional follow-up is necessary in order to meet the energy needs for macro and micronutrients. It is known that total energy expenditure (TEE) declines with increasing age, which contributes to reduced energy needs. Nutritional adequacy is important to practice physical activity and prevent deficiencies that may hinder athletic performance.[1]

Dehydration should be carefully considered because it is the most common water-electrolyte disorder in the elderly, evidenced by decreased sensitivity to thirst. Lower water intake, combined with the use of diuretic medications and exercise, can lead to dehydration. It is recommended that active men should intake 3.7 liters and women, 2.7 liters per day in order to maintain hydration levels[1,8]

The elderly need a varied and balanced diet suited to organic functions. Some studies have shown that this population has nutritional deficiencies, especially of vitamins and minerals, which can cause a number of complications. Meals should be easy to digest and pleasant to eat, be affordable and suit individual taste in order to provide a good feeding experience and follow the nutritional recommendations for the elderly.[1,9]

Nutritional assessment of the elderly is a sensitive tool for detection of risk factors associated with malnutrition. Thus, one should develop methods that use simple and quick questions that highlight warning signs of nutritional status and focus on interventions. Two problems resulting from poor nutrition that affect the elderly are malnutrition and obesity; malnutrition is particularly serious because it is closely associated with mortality. Individuals over 65 years of age undergo changes that increase the likelihood of developing malnutrition.[6]

Thus, the present study aimed to investigate nutritional status and intake of energy, water, macronutrients and calcium of participants of a physical activity program in a countryside town in the state of São Paulo.

Methods

This cross-sectional study included 31 elderly men and women out of a group of 80 physical activity practitioners; they were invited during their training activities. Inclusion criteria were: age equal to or greater than 60, no illness on the day of data collection and no interruption of physical activity for more than six months. The study excluded patients under 60 years of age.

The participants practiced regular exercise five times a week: adaptive volleyball, water aerobics and aerobics. They signed an Informed Consent Form. After that, the anthropometric data protocol was applied to practitioners to measure triceps, biceps, suprailiac and subscapular skinfold; arm, waist, hip and calf circumference, and also weight and height. These assessments were used to calculate mid-arm muscle circumference (MAMC), triceps skinfold thickness and fat percentage, by collecting four skinfolds in the equation proposed by Durnin & Womersley: D=1,1339-0,0645 Log$^{10}\Sigma$ (biceps, triceps, subscapular and supra-iliac).[10]

BMI (body mass index) was used to measure weight, calculated with the following formula: BMI = weight (Kg) / (height x height) (m^2). Criteria proposed by Lipschitz were used for classification of the elderly based on the BMI results. They recommend that BMI for people over 65 years of age should range from 22 to 27 Kg/m^2.[11]

In addition to collection of demographics, a 24-hour Food Recall was applied for a regular weekday to check the dietary pattern of the participants, their intake of energy and macronutrients (carbohydrates, proteins and lipids), as well as their intake of calcium and water. Data were analyzed by the software *Diet Pro*®*5i* and compared with the specific Dietary Reference Intakes (DRIs) for this age range.[12,13] Estimated daily calorie was measured and compared with the standards established by calculating the Estimated energy requeriments (EER) equation using the current weight for normal and ideal individuals (maximum BMI) on overweight individuals, as well as height, age and activity factor. Both protocols were collected at an aerobics training facility on a regular day. Each assessment lasted for 15 minutes.

The data collected for the research were organized and analyzed statistically through the GraphPad Prism 5.0® software to check the approximation of values of anthropometric variables in the experimental group and compare them with the literature.[14,15] The group was divided into males and females because of the specific characteristics of each sex. The statistical test for this comparison was Student's t-test for significance of the difference between the sample mean and the population mean.

This project was approved by the Research Ethics Committee because it is a study involving human subjects. It was registered under protocol number 23518513.4.0000.5495.

Results

The sample consisted of 31 elderly people between 60 and 80 years, mean age of 68.48 (± 5.71) years. Most practitioners were females (n = 22), which corresponds to 70.9% of the total participants, and (n = 9) males corresponded to 29.1% of the sample.

The mean current weight (69,78Kg ± 13.12) is not significantly higher (p = 0.2226) than the mean found for the ideal weight (66,33Kg ± 8.43), as shown in Table 1, suggesting that the overall sample has proper weight. Thirteen women (59.1%) were overweight, and there were two women (9.1%) whose weight was below standard. Four men (44.4%) were overweight and one (11.2%) had less than optimal weight.

Data on mean BMI (27,31Kg / m 2 ± 4.76) were not significant (p = 0.6955), compared with the criteria proposed by Lipschitz, cited in recent studies, which recommended that the BMI of individuals over 65 years of age should range between 24 and 27 kg/m^2.[9] Normal weight was observed for BMI in the overall sample. The analysis showed that males had a mean BMI of 25.58 ± 3.065, and females, 28.02 ± 5.198, with no significant differences between sexes (p = 0.2000). In the overall sample, three individuals had low weight (9.7%) and 18 were overweight (58%). Fourteen out of the 22 women in the study were overweight (63.6%) and two, underweight (9%). Five out of the nine men were overweight (55.5%) and one was underweight (11.1%).

Mean waist circumference for males (84,22cm ± 16,14) did not make a difference (p = 0.1066) for the maximum reference value for increased risk of 94 cm, according to the WHO, 1998.[12] Three (33.3%) out of the nine male participants had increased risk of cardiovascular disease, and two of them had very increased risk (22.2%).

The mean waist circumference of females (87.36cm ± 9.84) showed significant difference (p = 0.0021) compared with the allowed maximum value (80 cm) according to the WHO (10). There were eight out of all female participants (n = 22) whose circumference indicated increased risk of cardiovascular disease (36.3%), and 12 had very increased risk (54.5%).

There was no significant association (p = 0.0922) between MAMC of the overall sample (85.73% ± 13.68) and nutritional status, according to the adequacy of MAMC, whereby normal individuals are considered to have values ≥90%[10]. The analysis of females alone showed that two of them (9.1%) had severe malnutrition, five (22.7%), moderate malnutrition, and eight (36.4%), mild malnutrition. In the male group, one (11.1%) out of all nine participants had severe malnutrition, three (33.3%), moderate malnutrition; and two (22.2%), mild malnutrition.

Mean fat percentage of males (25% ± 5.26%) was not significant (p = 0.9902), relative to maximum allowable body fat percentage of 25%.[11] Individual analysis showed that three participants (33.3%) had very high percentage (> 30) and one (11.1%), high percentage (between 28% and 30%).

Mean female fat percentage (38.76% ± 4.07%) was significant (p = 0.0001) compared with the maximum allowable percentage of 32%.[12] Individual analysis showed that 15 participants (68.1%) had very high percentage (> 38) and five (22.7%), moderately high percentage (between 33% and 35%).

The values found for calf circumference (CC) (32.74cm ± 3.85cm), (p = 0.0172) are significant compared with the marker of (31 cm), suggesting normal weight; the appropriate standard results are > 31 cm for men and women.[6]

Table 1. Anthrpometric data collected from physical activity practitioners in a countryside town in the state of São Paulo. 2014.

Data/Variables	Mean	Standard deviation*	Reference standards
Current weight	69.78	13.12	66.33 ± 8.43[†]
General BMI	27.31	4.76	27 Kg/m^2
CC	32.74	3.85	>31
WC for Males	84.22	16.14	94 cm
WC for Females	87.36	9.84	80 cm
MAMC	85.73	13.68	≥ 90%
%G for Males	25.02	5.26	25%
%G for Females	38.76	4.07	32%

* Amounts expressed as mean ± standard deviation; † Mean relative to the total ideal weight of the sample; C.C: calf circumference; W.C: waist circumference.

Mean for the calorie intake of 24-hour Food Recall (R24h) (1276 ± 424.6) is considerably lower than the estimated energy requirement (1943 ± 277), with statistical significance (p < 0.0001). The mean energy intake of males (1059 ± 154.1) and females (1365 ± 81.95) was lower than the mean recommended energy intake (2272 ± 69.80) for men and (± 1808 35.27) for women, with statistical significance (p < 0.0001).

The findings for macronutrients showed assertive results, according to the references consulted. Carbohydrates were appropriate for minimum percentage 45% (53.03% ± 7.9%) (p = 0.0001). Similarly, protein values (19.42 ± 5.76%) were within the adequacy standard, compared with the minimum adequacy percentage of 10%, with positive significance. (p < 0.0001). The proportion of lipids in the diet (27.54% ± 6.60%) was within the normal range established by specific literature, and it showed statistical significance (p = 0.0001).

The mean grams of protein per kilogram of body weight (0.92 ± 0.5), showed no statistical significance (p < 0.1836) compared with the minimum value 0.8 g.[1]

As for the average calcium intake of the general sample (460 ± 270.8 mg / d), there is significantly less statistical difference (p < 0.0001) than the standard intake of 1,200 mg.[12] This occurred when intake was analyzed separately by sex: (510.9 ± 282.8) for women and (335.5 ± 201.4) for men.

The mean intake of water by males (2.32 ± 1.25) and females (2.032 ± 0.55) has lower statistical values than those recommended by the literature[1] for both sexes: (p = 0.0112) and (p = 0.0001), respectively.

Mean fiber intake (16,77g ± 5,68g) for males showed inadequate intake pattern (p = 0.0001) compared with the recommended one for this age group:[12] 30 grams[12] per day. Mean fiber intake by females (15.81 ± 6.65) was also significantly lower (p = 0.0001) than recommended: 21 grams per day.[12]

Table 2. Mean and standard deviation of the data on feeding/ regular diet collected from physical activity practitioners in a countryside town in the state of São Paulo. 2014. (n = 31)

Data/Variables	Mean	SD	Reference standards†
Water intake/females	2.03	0.55	2.7 Liters
Water intake/males	2.33	1.25	3.7 Liters
Calcium intake	460	270.8	1200 mg
Water intake/females	15.81	6.65	21 grams
Fiber intake/males	16.77	5.68	30g
Carbohydrate adequacy	53.03	7.9	45%
Protein adequacy	19.42	5.76	10%
Lipid adequacy	27.54	6.60	20%
Grams of protein / kilogram	0.92	0.50	0.8 grams
Calories diet / regular diet	1276	424.6	1943 kcal
Estimated energy requirements	1943	277	1276 kcal ± 424.6*

Note: Amounts in ± standard deviation; † Reference patterns according to DRIs (10,12); * Data refers to the mean calculated for the group.

Discussion

This study involved collecting data on anthropometry and eating habits of participants in an activity program in a countryside town in the state of São Paulo. Twenty-two out of the 31 elderly subjects analyzed for nutritional status and dietary patterns were women (70.9%). These data corroborate the studies of Cheik et al.,[16] in which there was prevalence of females in the research sample.

There was no difference between the mean value for current weight and mean ideal weight, indicating normal weight in the group in general. However, it should be noted that 19 participants in the sample (58%) were overweight according to BMI (14 of whom were females) and three individuals had low weight (9.6%). Ribeiro et al.[17] highlighted the scarcity of scientific studies produced in the Portuguese language that have assessed the nutritional status of institutionalized and/or home-dwelling elderly. Most of these studies have pointed to nutritional risk.

According to statistical analysis, women had different values from the standard considered healthy by the literature; this did not happen for men in the results of waist circumference and body fat percentage. A study in Cuiabá-MT analyzed fat percentage equations in elderly women, compared with bioimpedance analysis. It showed that the equation proposed by Durnin & Womersley[10] had some of the most consistent results.[18]

According to Felix & Souza,[19] in a study that analyzed the nutritional status of 37 institutionalized elderly, the risk of cardiovascular disease associated with waist circumference (WC) was present in 86.4% of women and 57.1% of men. Generally, body fat is distributed at the hip and thigh areas in women; it is the so-called gynoid distribution. In men, fat is distributed at the abdomen. It is known as android distribution, which is directly linked to cardiovascular disease and changes in lipid profile. Studies indicate that, at menopause, increased fat deposition in the abdominal area is larger, whereas the gluteofemoral area does not show this increase.[20,21]

The average values of MAMC adequacy showed no difference between the pattern of normal weight (90%) for men and women. Individual assessment is important because 69.2% of women and 66.6% of men had a pattern related to malnutrition. Menezes & Marucci,[22] in a study with 305 elderly, showed the increased tendency of muscle mass loss in both men and women, although it was more evident in women. The finding is expected, since women have more body fat distribution and less skeletal muscle mass.[21-23]

Sarcopenia, seen as a slow and almost inevitable loss of lean muscle mass and muscular power, is a common characteristic with aging and it is associated with a decrease of 20-40% in muscle strength. Strength training programs for the elderly can be beneficial, avoiding dependence and inability to carry out daily tasks.[24]

The results of the sample comprised of females were average compared with the fat percentage above the recommended values. This did not occur to the sample of males. Moreira et al.[23] showed, in a study that analyzed the fat percentage of 37 elderly, the statistically higher difference for females compared to males. National studies to determine the fat percentage of the elderly are scarce; thus, further research is required on the nutritional profile of this population in order to encourage early diagnosis and intervention.[23]

Calf circumference (CC) showed positive results in the present research, and pointed to normal weight in the overall sample. Studies indicate that muscular strength reduction in the elderly is much greater than the loss of lean body mass, suggesting a decrease in muscle quality. Also, there are no significant associations between muscle function and CC measurements, suggesting a dissociation between muscle mass and strength. Thus, assessments of CC can be difficult to interpret.[24,25]

Albino et al., in a study with 22 elderly women, claimed that strength training can minimize or delay the loss of lean mass (sarcopenia) in the elderly, help increase muscular strength, decrease risk of falls and provide physical independence.[26]

Thus, research on eating habits is very important; in the present study, the amounts were collected through a food survey by using the 24-hour Food Recall. Barazzetti et al.[27] Menezes et al.[28] used this survey in their studies because of its ease of application. They mentioned that there are the limitations reported in the literature for using it with the elderly. However, nutrition is essential part of their lives; therefore, they can remember what they have eaten.

It was shown that energy intake was inappropriate in the sample in general, compared with daily average energy requirements. Despite the inadequacy for calories, the proportions of carbohydrates (45-65%), proteins (10-35%) and lipids (20-35%) showed adequate results, according to the DRIs. The same result was found with regard to grams of protein per kilogram of body weight, which was indicative of adequate average intake by the general sample. This result is corroborated by a study carried out in Fortaleza with 458 elderly, in which Menezes et al.[28] found that the proportion of elderly people with balanced amount of macronutrients in their diet was positive; however, as far as energy intake was concerned, the amounts were below the recommendation for men and women.

Although the values found for the standard for macronutrients are in line with the adequacy standard and with studies that have stressed the importance of quality feeding, it should be noted that, if references are compared with calories, they are below the normal range. This fact is alarming, because a low-energy diet is associated with deficiency of several nutrients such as calcium.

It was found that the mean calcium intake by both male and female elderly participants was much lower than the recommended amounts. These data are supported by a study conducted in the city of Florianópolis, SC, with 178 elderly, which pointed to insufficient intake of calcium and other micronutrients. Another study with 208 Irish elderly showed that most of the surveyed individuals, especially men, did not consume adequate amounts of calcium and other micronutrients.[5,29] The analysis of these data has shown that consumption deficit for this micronutrient is common by the elderly, although it is important for their health.

The elderly need to consume adequate amounts of calcium, because active absorption in this age group is lower. This decline may be caused by insufficient consumption and reduction in endogenous production of vitamin D. Consumption by women is of great importance because postmenopausal hormonal decrease (estrogen) reduces vitamin D production, and high normal bone turnover in this early stage can inhibit intestinal absorption of calcium.[30]

Regarding water, there was insufficient intake by both males and females. Studies with elderly practitioners and non-practitioners of physical activity, in Curitiba-PR, 2011[31] and Caxias do Sul – RS, 2012,[32] have also shown the inadequacy of water intake, averaging 990 ml, and the appropriate standard of 1,600 ml in Curitiba and 1,805 ml in Caxias do Sul, as a reference to 2700 ml of DRIs. These data strengthen the hypothesis that older adults have a deficit in water intake.

Fiber intake was unsatisfactory as regards the standard of comparison for both sexes. None of the males has achieved the recommended amount of 30 g per day, and among females, only four (18.2%) out of the 22 participants of the sample reached the standard recommendation of 22g a day. The data are similar to those of a study with women practitioners of physical activity in São Paulo,[33] where 91.7% of respondents had inadequate intake of dietary fiber, averaging 12.7g (± 5.8), while standard recommendation is 20g. Another study carried out in the town of Bambuí, with 84 seniors, showed that 100% of them consumed an amount of fiber below the recommended values.[34]

Fiber intake must be associated with an adequate standard of water intake, because the aging process itself, linked to factors such as intake of diuretics and reduced sensitivity to thirst, can lead to constipation.[32]

Thus, proper nutrition of older adults leads to optimal health, vigor to perform general activities, wellness, and benefits to their immune system.[33-36]

The study showed, in general, that most elderly participants have inadequate nutritional status and deficiencies in their dietary patterns. Body composition of most of the sample falls short of the standard shown by statistical analysis, mainly in accumulation and distribution of body fat, which were higher in females.

Despite the positive results in the average statistical sample on items such as current weight, BMI, MAMC, male fat percentage and calf circumference, individualized assessment is crucial, because taken individually, several participants had inadequate standards for the same items. As regards dietary patterns, intake of energy, water, fibers and calcium is deficient, which contributes to the development of nutritional risks such as loss of lean mass, dehydration, constipation and osteoporosis. Proper nutrition, combined with regular exercise, is not only beneficial to nutritional status but also provides well-being and pleasure, and therefore should be encouraged.

Thus, the development of strategies for proper nutrition of the elderly is very important to correct and prevent possible problems. It is suggested that further research should measure a larger sample in a longer period of study and focus on other variables in order to collect more relevant data from the sample.

References

1. Ferreira MT. Aspectos nutricionais do idoso no esporte. In: Hirschbruch MD, Carvalho JR. Nutrição esportiva: uma visão prática. 2ª ed. Barueri, SP: Manole; 2008. p. 229-41.

2. World Health Organization. Ageing and health [Internet]. [acesso em 10 mai 2014]. Disponível em: www.who.int/hpr/ageing/menageingandhealth.pdf.

3. Mahan LK, Stump SE. Krause: Alimentos, nutrição e dietoterapia. 11ª ed. New York: Roca; 2004.

4. Ferreira M, Matsudo S, Matsudo V, Braggion G. Efeitos de um programa de orientação de atividade física e nutricional sobre o nível de atividade física de mulheres fisicamente ativas de 50 a 72 anos de idade. Rev. Bras. Med. Esporte 2005; 11(3):172-176.

5. Berkenbrock EP, Navarro AC. Consumo alimentar de idosos praticantes de atividade física do município de Florianópolis-SC: uma abordagem em micronutrientes. Revista Brasileira de Nutrição Esportiva 2011; 5(26):145-152.

6. Najas M, Yamatto TH. Avaliação do estado nutricional de idosos. Nestlé nutrition. 7p. Disponível em: http://www.nestle-nutricaodomiciliar.com.br/Files/documentos/AVALIACAO%20EST%20 NUT.pdf

7. Sampaio LR. Avaliação nutricional e envelhecimento. Rev. Nutr. 2004; 17(4):507-514.

8. Fonseca ACE. Estado nutricional: relação com a actividade física e doenças crônicas em idosos institucionalizados [Dissertação]. Covilhã: Universidade da Beira Interior; 2009.

9. Fiore EG, Vieira Vl, Cervato AM, Tucilo DL, Cordeiro AA. Perfil nutricional de idosos frequentadores de Unidade Básica de Saúde. Rev. Ciênc. Méd. 2006; 15(5):369-377.

10. Durnin JVGA, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. Br. J. Nutr.1974; 32(1):77-97.

11. Lipschitza DA. Screening for nutritional status in the elderly. Primary Care 1994; 21(1):55-67.

12. Institute of medicine. Dietary reference intakes for energy, carbohydrate. fiber, fat, fatty acids, cholesterol, protein, and amino acids. Washington, D.C.: National Academies Press; 2005

13. Institute of medicine. Dietary reference intakes for calcium, phosphorous, magnesium, vitamin d, and fluoride. Washington, D.C.: National Academies Press; 1997.

14. Cervi A, Franceschini SCC, Priore SE. Análise crítica do uso do índice de massa corporal para idosos. Rev. Nutr. 2005; 18(6):765-775.

15. Pontifícia Universidade Católica de Goiás. Apostila de avaliação nutricional [Internet]. [acesso em: 10 mar. 2014]. Disponível em: http://professor.ucg.br/SiteDocente/admin/arquivosUpload/14052/material/Apostila%20Avalia%C3%A7%C3%A3o%20Nutricional.pdf.

16. Cheik NC, Reis IT, Heredia RAG, Ventura ML, Tufik S, Antunes HKM, et al. Efeitos do exercício físico e da atividade física na depressão e ansiedade em indivíduos idosos. R. Bras. Ci. Mov. 2003; 11(3):45-52.

17. Ribeiro RL, Tonini KAD, Presta FMP, Souza MVM, Picanço EA. Avaliação nutricional de idosos residentes e não residentes em instituições geriátricas no município de Duque de Caxias/ RJ. Revista Eletrônica Novo Enfoque 2011; 12(12):39-46.

18. Reis Filho AD, Santini E, Coelho-Ravagnani CF, Fett WCR, Fett CA. Análise de diferentes equações para a estimativa de gordura em idosas. EFDeportes.com. Revista Digital [Internet] 2012; 15(166).

19. Félix LB, Souza EMT. Avaliação nutricional de idosos em uma instituição por diferentes instrumentos. Rev. Nutr. 2009; 22(4):571-580.

20. Rebuffe Scrive M, Lönnroth P, Marin P, Wesslau C, Björntorp P, Smith U. Regional adipose tissue metabolism in men and post menopausal women. Int. J. Obes. 1987; 11(4):347-55.

21. Reis CMRF, Melo NR, Vezzozo DP, Meirelles ES, Halpern A. Composição corpórea, distribuição de gordura e metabolismo de repouso em mulheres histerectomizadas no climatério há diferenças de acordo com a forma da administração do estrogênio? Arq. Bras. Endocrinol. Metab. 2000; 44(1):38-44.

22. Menezes TN, Marucci MFN. Antropometria de idosos residentes em instituições geriátricas, Fortaleza, CE. Rev. Saúde Pública 2005; 39(2):169-75.

23. Moreira Aj, Nicastro H, Cordeiro RC, Coimbra P, Frangella VS. Composição corporal de idosos segundo a antropometria. Rev. Bras. Geriatr. Gerontol. 2009; 12(2):201-213.

24. García PA, Dias JMD, Dias RC, Santos P, Zampa CC. Estudo da relação entre função muscular, mobilidade funcional e nível de atividade física em idosos comunitários. Rev. Bras. Fisioter. 2011; 15(1):15-22.

25. Goodpaster BH, Park SW , Harris TB, Kritchevsky SB, Nevitt M, Schwartz AV, et al. The loss of skeletal muscle strength, mass, and quality in older adults: the health, aging and body composition study. J. Gerontol. A. Biol. Sci. Med. Sci. 2006; 61(10):1059-64.

26. Albino ILR, Freitas CR, Teixeira AR, Gonçalves AK, Santos AMPV, Bós AJG. Influência do treinamento de força muscular e de flexibilidade articular sobre o equilíbrio corporal em idosas. Rev. Bras. Geriatr. Gerontol. 2012; 15(1):17-25.

27. Barazzetti R, Siviero J, Bonatto S. Estado nutricional, consumo de calorias e macronutrientes de mulheres participantes de uma universidade da terceira idade no sul do país. Estud. Interdiscipl. Envelhec. 2013; 18(2):331-347.

28. Menezes TN, Souza JMP, Marucci MFN. Necessidade energética estimada, valor energético e adequação de macronutrientes da alimentação dos idosos de Fortaleza, CE. Nutrire: Rev. Soc. Bras. Alim. 2009; 34(3):17-30.

29. Power SE, Jeffery IB, Ross RP, Stanton C, O'Toole PW, O'Connor EM, et al. Food and nutrient intake of irish community-dwelling elderly subjects: who is at nutritional risk? J. Nutr. Health Aging 2014;18(6):561-72.

30. Buzinaro EF, Almeida RNA, Mazeto GMFS. Biodisponibilidade do cálcio dietético. Arq. Bras. Endocrinol. Metab. 2006; 50(5):852-861.

31. Barbosa D, Ravazzani EDA. Avaliação do estado nutricional de idosos praticantes de atividade física. [Internet]. [acesso em: 25 jun. 2014]. Disponível em: http://www.unibrasil.com.br/pdf/nutricao/2011-1/6_tcc.pdf.

32. Sandri R, Bernardi JR, Siviero J. Consumo de fibras e líquidos em mulheres participantes de uma universidade da terceira idade no Sul do Brasil. RBCEH 2012; 9(2):213-225.

33. Mainard Gm, Yamaguchii MR,Sardinha RC, Nacif Avaliação do consumo de fibras por mulheres idosas praticantes de atividade física de um parque da zona oeste de São Paulo. EFDeportes.com, Revista Digital [Internet]. 2012; 17(175). [acesso em: 26 jun. 2014]. Disponível em: http://www.efdeportes.com/efd175/consumo-de-fibras-por-mulheres-idosas.htm

34. Lopes ACS, Caiaffa WT, Sichieri R, Mingoti SA, Costa MFL. Consumo de nutrientes em adultos e idosos em estudo de base populacional: Projeto Bambuí. Cad. Saúde Pública 2005; 21(4):1201-1209.

35. Foster S, Gariballa S. Age as a determinant of nutritional status: a cross sectional study. Nutr. J. 2005; 4:28-32.

36. De Groot CPGM, Staveren WA, Graaf C. Determinants of macronutrients intake in elderly people. Eur. J. Clin. Nutr. 2000; 54(3):70-76.