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Association between adductor pollicis muscle thickness and nutritional parameters in hospitalized elderly patients

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ABSTRACT

Introduction: the measurement of the adductor pollicis muscle thickness (APMT) has been investigated as an anthropometric parameter; however, there are few studies related to hospitalized elderly patients.

Objective: to analyze the association between APMT and nutritional parameters in hospitalized elderly patients.

Method: cross-sectional study made in 331 hospitalized elderly patients. The following variables have been assessed: APMT, Mini Nutritional Assessment® (MNA®), body mass index (BMI), arm circumference (AC), calf circumference (CC) and handgrip strength (HGS).

Results: the mean age was 78.4 ± 9.7 years and 56.8% were women. The women had showed APMT mean values significantly lower than the men (12.67 ± 4.13 mm *vs* 15.26 ± 4.01 mm), as well as the elderly patients ≥ 80 years old showed APMT values lower than the younger patients (12.62 ± 4.38 mm *vs* 14.83 ± 3.90 mm). In relation to the APMT classification, the women were more frequently below P5 than the men (89.9% *vs* 37.1%). In the univariate analysis, the mean values of APMT were significantly lower in the malnourished elderly patients (MNA®), thinness (BMI), AC < 21 cm, CC <31 and HGS < P5, regardless of gender. In the multivariate analysis, APMT remained as a factor independently associated with all nutritional indicators, even when adjusted to age and gender.

Conclusion: APMT has associated with all the nutritional parameters investigated, regardless of gender and age, reinforcing its applicability in the nutritional assessment of elderly people.

Key words: Aged. Hospitalization. Anthropometry. Malnutrition. Nutrition assessment.

RESUMEN

Introducción: la medida del espesor del músculo aductor del pulgar (EMAP) ha sido investigada como parámetro antropométrico, pero son escasos los estudios en ancianos hospitalizados.

Objetivo: analizar la asociación entre EMAP y parámetros nutricionales en ancianos hospitalizados.

Método: estudio transversal con 331 ancianos hospitalizados. Se evaluaron las siguientes variables: EMAP, Mini Nutritional Assessment® (MNA®), índice de masa corporal (IMC), circunferencia del brazo (CB), circunferencia de la pantorrilla (CP) y fuerza de prensión palmar (FPP).

Resultados: el promedio de edad fue de 78,4 ± 9,7 años y el 56,8% eran mujeres. Las mujeres tenían valores medios de EMAP significativamente menores que los hombres (12,67 ± 4,13 mm frente a 15,26 ± 4,01 mm), así como los ancianos ≥ 80 años tenían valores de EMAP inferiores a los más jóvenes (12,62 ± 4,38 mm frente a 14,83 ± 3,90 mm). En cuanto a la clasificación de la EMAP, las mujeres se encontraban con más frecuencia por debajo del P5 que los hombres (89,9% frente al 37,1%). En el análisis univariado, los niveles medios de la EMAP se mostraron mucho más pequeños en los ancianos con desnutrición (MNA®), delgadez (IMC), CB < 21 cm, CP < 31 cm y FPP < P5, independientemente del sexo. En el análisis multivariado, la EMAP permaneció como factor independiente asociado a todos los parámetros nutricionales, incluso cuando se ajustó para edad y sexo.

Conclusiones: la EMAP se asoció con todos los parámetros nutricionales investigados, independientemente del sexo y de la edad, reforzando su aplicabilidad en la evaluación nutricional de ancianos.

Palabras clave: Ancianos. Hospitalización. Antropometría. Desnutrición. Evaluación nutricional.

INTRODUCTION

The prevalence of malnutrition in hospitalized elderly is high when compared to community elderly (1). Therefore, the investigation of adequate techniques for nutritional assessment in this population is paramount for nutritional care, in order to support diagnosis and nutritional management (2). In this context, the Mini Nutritional Assessment® (MNA®) applied in its integral form (3) has been widely used for the evaluation of nutritional status of hospitalized elderly (1,3). However, some difficulties are associated with its application, e.g., when the elderly presents physical and mental limitations (1,3), in the absence of a companion to provide information for the application of the instrument or when the elderly receives enteral nutrition therapy (3). As such, with the aim of searching nutritional assessment instruments that are independent of the patient collaboration (4) in conjunction with rapid application and low cost, the adductor pollicis muscle thickness (APMT) measurement emerges as an anthropometric parameter (5). The adductor pollicis muscle is the only muscle that allows its direct thickness measurement in function of its anatomic characteristic (6). Many studies have been using this measurement in different populations and scenarios, such as community individuals (6-9), institutionalized elderly (10); different clinical conditions as in oncologic patients (11-13), chronic kidney disease and hemodialysis (14-16); and hospitalized clinical (17), surgical (17-21) and intensive unit care patients (22-24).

Nonetheless, specific studies regarding hospitalized elderly are scarce (5), with only two available studies (25,26). None of the aforementioned studies analyzed the association between APMT and the MNA®, which is a specific nutritional assessment instrument for the elderly. Therefore, the aim of the present study was to analyze the association between the APMT and nutritional parameters in the hospitalized elderly.

METHODS

Study design, population and sample

This is a transversal study. Three hundred and thirty-one elderly patients (≥ 60 years old) hospitalized at the Hospital São Lucas from the Pontifical Catholic University of Rio Grande do Sul (HSL/PUCRS) were evaluated from May 2014 to December 2015. Successful obtainment of the APMT and further assessed nutritional parameters were used as inclusion criterions.

Regarding the sample size for the APMT evaluation, with an error margin of 5 mm (17), power of 80% and significance level of 5%, and considering the frequency risk of malnutrition and malnutrition in the studied population, a minimal sample size of 130 elderly was required.

Investigated variables

The variables investigated were sex, age, nutritional state (MNA® and BMI), anthropometric variables (arm circumference [AC], calf circumference [CC] and APMT) and handgrip strength (HGS).

Data collection logistics

Data was collected at the elderly admission through trained evaluators.

The MNA® was applied with the patient alone or with the aid of a companion, when there was lack of cognitive conditions to answer the questions independently (27).

Body weight was measured through the digital portable scale (Urâno, UPC 150 model, Brazil), and height was obtained with a portable stadiometer (Sanny®, Personal Caprice model, Brazil). When it was not possible to perform body and/or weight measurements, the information was collected with the patient or companion. The BMI was obtained as the body mass (kg)/squared estimated height (m^2) (28).

The elderly patients were classified according to the established cut-off values described by Lipschitz (29): < 22 kg/m² (underweight), between 22 and 27 kg/m² (eutrophic) and > 27 kg/m² (overweight).

The AC was measured with an inelastic tape, positioned in the arm midpoint, between the acromion and olecranon. CC was assessed with the leg of the elderly flexed in a 90° angle, with an inelastic tape positioned in the maximum perimeter of the muscle, with an uncovered calf (30). AC ≤ 22 cm and CC < 31 cm values were considered as decreased, for both genders, following the cut-off values described at the MNA® (27).

The APMT was obtained in the dominant hand, and in case of obtainment impossibility, in the non-dominant hand. Details regarding APMT measurement method were previously published by El Kik and Schwanke (25). APMT was classified as decreased according to the percentile 5 values (18 mm for men and 14 mm for women) (8).

HGS was measured with the patient sitting, on the dominant hand, or in case of obtainment impossibility, on the non-dominant hand. The elbow was flexed at 90°, the forearm was in a neutral position, the grip was adjusted in the second position, and the patient held the maximum grip force during three seconds with 30 seconds to one-minute interval (31). Three measurements were performed and the average was considered for the HGS. HGS was classified according to the percentile 5 (18 kgf for men and 11 kgf for women) (9).

Statistical analysis

Data was computed on a Microsoft Excel database and further analyzed with SPSS 21.0 (SPSS Inc. Chicago, IL, USA). Normality distribution of continuous data was assessed by the Kolgomorov-Smirnov test, with all data variables presenting a normal distribution. Descriptive analysis was performed by frequency means, central tendency and dispersion. In order to compare mean average of APMT in relation to sex, the Student's t-test was applied. For the association between APMT classification with sex and age, the Pearson's Chi-square was used. Comparison between the APMT averages was conducted with the Student's t-test and analysis of variance (ANOVA), with a Bonferroni post-hoc correction. Multivariate analysis of Poisson regression was applied in order to assess the APMT effect over the investigated nutritional parameters due to the transversal study design and to correct for age and sex of the elderly. For this analysis, the polytomic variables were dichotomized.

Ethical aspects

The data presented in this article were obtained from the doctorate project entitled *"Handgrip strength and adductor pollicis muscle thickness as nutritional status, functional capacity and mortality assessment instruments in hospitalized elderly patients"*, approved by the PUCRS Research Ethics Committee (CAAE: 26825614.7.0000.5336, assessment 636.335 of 29/04/2014). Determinations from the National Heath Council resolution no. 466/2012

(32) were followed and all the participants were instructed regarding the procedures involved in this research and signed the free and informed consent form.

RESULTS

The sample majority was composed by women (56.8%). Mean age was 78.4 ± 9.7 years old, ranging from 60 to 105 years old. Women are more frequently in the age group ≥ 80 years. The most frequent causes of hospitalization were respiratory diseases (n = 60, 17.9%) and gastroenterological (n = 53, 15.8%) and cardiac (n = 43, 12.8%) conditions.

Regarding nutritional parameters, MNA® nutritional status was normal (45.7%); patients were considered as eutrophic as measured by the BMI (40.1%), AC > 22 cm (87.6%), CC > 31 cm (71.5%) and a HGS without depletion risk (64.8%) (Table I).

On table II, depicted average values of APMT were significantly lower in women as compared to men (12.67 ± 4.13 mm *vs* 15.26 ± 4.01 mm, $p < 0.001$). Elderly with over 80 years old had lower APMT values than younger elderly patients (12.62 ± 4.38 mm *vs* 14.83 ± 3.90 mm, $p < 0.001$), in men (14.36 ± 4.10 mm *vs* 15.76 ± 3.89 mm, $p = 0.044$) as well as in women (11.78 ± 4.28 mm *vs* 13.80 ± 3.66, $p = 0.001$).

As for the APMT classification, women were more frequently below the P5 when compared to men (89.9% *vs* 37.1%), regardless of age (Table II).

At the univariate analysis, APMT was associated with all investigated nutritional parameters, independent of age (Table III).

On table III, the comparison between the APMT according to the nutritional parameters classification is described. The APMT average value of elderly patients with normal nutritional status was higher than in elderly patients classified as malnourished or with risk of malnourishment ($p < 0.001$). No significant difference was observed between the APMT average values of malnourished elderly and at risk of malnourishment elderly patients. Elderly classified as underweight by the BMI presented a lower mean APMT as compared to eutrophic and overweight elderly patients.

Elderly patients with AC > 22 mm presented a higher APMT than elderly with AC < 22 cm, as well as patients with CC ≥ 31 cm presented higher APMT as compared to CC < 31 cm.

Men with HGS ≥ 18 kgf had superior APMT in contrast with elderly patients with HGS < 18 kgf ($p = 0.021$).

At the multivariate analysis (Table IV), APMT proved to be an independent measurement associated to all nutritional parameters, even when adjusted for age and sex ($p < 0.05$). Increased APMT was related to a 4% lower chance of malnutrition/risk of malnutrition as classified by the MNA®, 11% in the BMI, 21% in the AC < 21 cm, 12% in the CC < 31 cm and 6% in the HGS < P5.

DISCUSSION

The present study evaluated the association between the APMT and nutritional parameters in hospitalized elderly in Porto Alegre, a city located in the south of Brazil. It is one of the few studies performed only in hospitalized elderly patients (25,26). Another important characteristic is that this study is the first one to evaluate the association between the APMT and diagnosed malnutrition by the MNA®, whereas other studies analyzed the relationship between APMT and the Subjective Global Assessment, and other nutritional parameters (13,15,20-22,24,33). It was possible to observe that the APMT was associated to all investigated nutritional parameters such as the MNA®, BMI, AC, CC and HGS.

According to the different nutritional parameters, the investigated elderly patients presented a risk of malnutrition/malnutrition frequency of 54.3% in the MNA®, 26.1% in the BMI, 12.3% in the AC, 64.4% in the CC and 35.2% in HGS.

Recent literature has demonstrated that malnutrition in the hospitalized elderly is frequent (1). The present results were similar to those of a study conducted with 89 elderly patients in a medium complexity hospital of Rio Grande do Sul, where 58% of malnutrition/risk of malnutrition was observed according to the MNA® (34). A systematic review with meta-analysis included 66 studies that evaluated hospitalized elderly patients by the MNA® and demonstrated higher malnutrition/risk of malnutrition values (67.5%) in this population (35). Even higher values were identified in a study conducted in a high complexity hospital of Rio Grande do Sul including 131 elderly patients (36), observing malnutrition in 73.7% of women and 89.1% of men.

Other similar studies with hospitalized elderly demonstrated higher values as compared to the present study concerning the BMI underweight frequency, according to Lipschitz. We identified that 26.1% of the investigated elderly patients were underweight, whereas other studies observed values of 36.6% (36), 38% (37) and 41% (38).

The frequency of CC < 31 cm in the present study was 28.5%, whereas other studies identified even higher inadequacy values, such as 38.2% (36) and 59% (37).

Regarding AC, only 12.3% of the elderly patients were classified below the recommended values, while others verified higher values as 63% (39) and 67.2% (36).

The difference between the obtained values might be attributed to the epidemiological profile of the studied population. In the study performed by Zanchim et al. (36), the main cause of hospitalization was cancer. As for the study by Morais, Campos and Lessa (37), the most frequent cause of hospitalization was respiratory diseases.

Related to the anthropometric parameters, there was a perceived limitation regarding availability of data for comparative analysis. According to Fidelix, Santana and Gomes (39) in a narrative review, there are scarce number of studies providing updated data regarding hospitalized elderly population.

Besides being a functional capacity indicator and predictor of aggravated health status in the elderly, the HGS has been considered to be a nutritional state indicator (40). However, it was not possible to identify studies which used the same cut-off value as the one applied in the current study, which was based on a population research that determined the cut-off value for Brazilian elderly population (9).

Differences in the APMT related to sex (6-8,14,16) and age (6,16) have been previously described. According to a previous published study with a lower sample size (25), women and elderly had a reduced APMT. Still, in the present study, women had a higher frequency of APMT < P5, whereas men had APMT > P5 ($p < 0.001$), even when correcting for age < 80 or ≥ 80 years old. A study with hospitalized candidates to surgical procedure also found a higher frequency of malnutrition through the APMT in women. Such finding can be explained by the bodily composition differences among men and women (19), and also due to the fact than women are older than men in this sample. Although women live longer, they experience worse health and present a greater chance than men to experience the typical diseases of the last phase of life (41).

The present study demonstrated higher mean values of APMT in elderly classified with a normal nutritional status (MNA®); eutrophic by BMI, with a AC > 22 mm, CC ≥ 31 cm and HGS ≥ 18 kgf in men and FPP ≥ 11 kgf in women. Another study conducted in surgical patients observed a higher mean APMT value in patients classified as eutrophic by means of AC and BMI (19).

APMT demonstrated to be an independent factor associated to all parameters, even when corrected by age and sex, reinforcing its applicability in the clinical practice. Several studies have associated APMT to classic nutritional assessment parameters, such as anthropometric measures, highlighting its relation with malnutrition (6,14,15,18,18,21,24), as well as the HGS (15,40).

Karst, Vieira and Barbiero (24) assessed the correlation between APMT, BMI and CC in patients in a cardiologic intensive care unit. Oliveira et al. (14) observed a positive correlation between the APMT and BMI and also APMT and AC in hemodialysis patients.

In the study conducted by Pereira et al. (15) in hemodialysis patients, a positive correlation between the APMT and HGS was observed. This is in accordance with the study by Guerra et al. (40), conducted in hospitalized patients, where an association between APMT and HGS was also found.

Interestingly, one study conducted in hospitalized patients (17) and other in breast cancer patients (13) found a weak association between the APMT and anthropometrics parameters, and both studies related this finding to the fact that the studied population was predominantly overweight/obese.

Another study in hemodialysis patients (15) did not find a correlation among APMT and anthropometric parameters, relating this finding to possible hydric alterations in this population, as well as possible errors in the reproducibility of anthropometric measures related to the observer's variability.

Even though several studies pointed towards an association between APMT measurement and classic nutritional parameters, results are still insufficient to promote APMT as a unique indicator of lean mass reserve (7). The nutritional assessment is considered as a complex process and it is wise to associate different methods in the pursuit of a more trustworthy and precise diagnosis (2).

The present study has some limitations, especially regarding its design (cross-sectional) and the low malnutrition frequency. In this context, further research is required with matching nutritional status condition.

In conclusion, APMT was associated with all the investigated nutritional parameters, independent of sex and age, which reinforces its applicability in the nutritional assessment of elderly patients.

REFERENCES

1. Pereira DS, Oliveira ACS, Pereira MHQ, Pereira MLAS. Mini Avaliação Nutricional: utilização e panorama nos diferentes cenários de atenção ao idoso. Rev Saúde Com 2017;13(1):824-32. DOI: 10.22481/rsc.v13i1.426

2. Fidelix MSP. Manual orientativo: sistematização do cuidado de nutrição. São Paulo: Asbran; 2014. Available from: http://www.asbran.org.br/arquivos/PRONUTRI-SICNUT-VD.pdf

3. Najas M. Consenso Brasileiro de Nutrição e Disfagia em Idosos Hospitalizados. Barueri: Minha Editora; 2011.

4. Frangella VS. Avaliação do músculo adutor. In: Rossi L, Caruso L, Galante AP. Avaliação nutricional: novas perspectivas. 2nd ed. Rio de Janeiro: Guanabara Koogan; 2015. pp. 358-9.

5. Pereira CA, Moreno JG, El Kik RM. Utilização da espessura do músculo adutor do polegar na avaliação nutricional. Cienc Saude 2014;7(2):109-14. DOI: 10.15448/1983-652X.2014.2.16626

6. Lameu EB, Gerude MF, Campos AC, Luiz RR. The thickness of the adductor pollicis muscle reflects the muscle compartment and may be used as a new anthropometric parameter for nutritional assessment. Curr Opin Clin Nutr Metab Care 2004;7(3):293-301.

7. Bielemann RM, Horta BL, Orlandi SP, Barbosa-Silva TG, Gonzalez MC, Assunção MC, et al. Is adductor pollicis muscle thickness a good predictor of lean mass in adults? Clin Nutr 2015;XX(y):1-5. DOI: 10.1016/j.clnu.2015.07.022

8. Gonzalez MC, Duarte RRP, Budziareck MB. Adductor pollicis muscle: reference values of its thickness in a healthy population. Clin Nutr 2010;29(2):268-71. DOI: 10.1016/j.clnu.2009.08.012

9. Budziareck MB, Duarte RRP, Silva MCGB. References values and determinants for handgrip strength in healthy subjects. Clin Nutr 2008;27:357-62. DOI: 10.1016/j.clnu.2008.03.008

10. Volpini MM, Frangella VS. Avaliação nutricional de idosos institucionalizados. Einstein 2013;11(1):32-40. DOI: 10.1590/S1679-45082013000100007

11. Poziomyck AK, Weston AC, Lameu EB, Cassol OS, Coelho LJ, Moreira LF. Preoperative nutritional assessment and prognosis in patients with foregut tumors. Nutr Cancer 2012;64(8):1174-81. DOI: 10.1080/01635581.2012.721157.

12. Silva JB, Maurício SF, Bering T, Correia MITD. The relationship between nutritional status and the Glasgow prognostic score in patients with cancer of the esophagus and stomach. Nutr Cancer 2013;65(1):25-33. DOI: 10.1080/01635581.2013.741755

13. Bering T, Maurício SF, Braga da Silva J, Correia MITD. Nutritional and metabolic status of breast cancer women. Nutr Hosp 2015;31(2):751-8. DOI: 10.3305/nh.2015.31.2.8056

14. Oliveira CMC, Kubrusly M, Mota RS, Choukroun G, Neto JB, Silva CAB. Adductor pollicis muscle thickness: a promising anthropometric parameter for patients with chronic renal failure. J Ren Nutr 2012;22(3):307-16. DOI: 10.1053/j.jrn.2011.07.006

15. Pereira RA, Caetano AL, Cuppari L, Kamimura MA. Adductor pollicis muscle thickness as a predictor of handgrip strength in hemodialysis patients. J Bras Nefrol 2013;35(3):177-84. DOI: 10.5935/0101-2800.20130029

16. Machado AD, Rissotto CM, Martins CTB, Bazanelli AP. Associação entre o consumo energético e proteico e a espessura do músculo adutor do polegar em pacientes em hemodiálise. Cienc Saude 2017;10(1):3-9. DOI: 10.15448/1983-652X.2017.1.24111

17. Cobêro FE, Gomes MCB, Silva AP, Bernardi JLD, McLellan KCP. A medida do músculo adutor do polegar está associada com indicadores antropométricos de avaliação de massa magra e de massa gorda em pacientes hospitalizados. Nutrire: Rev Soc Bras Alim Nutr 2012;37(2):174-82. DOI: 10.4322/nutrire.2012.014

18. Bragagnolo R, Caporossi FS, Dock-Nascimento DB, Aguilar-Nascimento JE. Espessura do músculo adutor do polegar: um método rápido e confiável na avaliação nutricional de pacientes cirúrgicos. Rev Col Bras Cir 2009;36(5):371-6. DOI: 10.1590/S0100-69912009000500003

19. Melo CYSV, Silva SA. Músculo adutor do polegar como preditor de desnutrição em pacientes cirúrgicos. ABCD Arq Bras Cir Dig 2014;27(1):13-7. DOI: 10.1590/S0102-67202014000100004

20. Gonzalez CG, Duarte RRP, Orlandi SP, Bielemann RM, Barbosa-Silva TG. Adductor pollicis muscle: a study about its use as a nutritional parameter in surgical patients. Clin Nutr 2015;34(5):1025-9. DOI: 10.1016/j.clnu.2014.11.006

21. Valente KP, Silva NMF, Faioli AB, Barreto MA, Moraes RAG, Guandalini VR. Espessura do músculo adutor do polegar na avaliação nutricional de pacientes cirúrgicos. Einstein 2016;14(1):18-24. DOI: 10.1590/S1679-45082016AO3596

22. Caporossi FS, Caporossi C, Dock-Nascimento DB, Aguilar-Nascimento JE. Measurement of the thickness of the adductor pollicis muscle as a predictor of outcome in critically ill patients. Nutr Hosp 2012;27(2):490-5. DOI: 10.1590/S0212-16112012000200021

23. Ghorabi S, Ardehali H, Amiri Z, Shariatpanahi ZV. Association of the adductor pollicis muscle thickness with clinical outcomes in intensive care unit patients. Nutr Clin Pract 2016;31(4):523-6. DOI: 10.1177/0884533615621547

24. Karst FP, Vieira RM, Barbiero S. Relação da espessura do músculo adutor do polegar e avaliação subjetiva global em unidade de terapia intensiva cardiológica. Rev Bras Ter Intensiva 2015;27(4):369-75. DOI: 10.5935/0103-507X.20150062

25. El Kik RM, Raasch J, Rosa MC, Gomes I, Schwanke CHA. Espessura do músculo adutor do polegar em idosos hospitalizados: relação com sexo e idade. Cien Saude 2017.

26. Margutti KMM, Pereira LL, Schuch NJ, Blasi TC, Schwanke CHA. Espessura do músculo adutor do polegar e estado nutricional em idosos hospitalizados. Persp 2017;41(153):43-52.

27. Najas M. Consenso Brasileiro de Nutrição e Disfagia em Idosos Hospitalizados Barueri: Minha Editora; 2011.

28. Souza R, Fraga JS, Gottschall CBA, Busnello FM, Rabito EI. Avaliação antropométrica em idosos: estimativas de peso e altura e concordância entre classificações de IMC. Rev Bras Geriatr Gerontol 2013;16(1):81-90. DOI: 10.1590/S1809-98232013000100009.

29. Lipschitz DA. Screening for nutritional status in the elderly. Nutr In Old Age 1994;21:55-67.

30. Callaway CW, Chumlea WMC, Bouchard C, Himes JH, Lohman TG, Martin AD, et al. Circumferences. In: Lohman TG, Roche AF, Martorell R, eds. Anthropometric standardization reference manual. 15th ed. United States: Human Kinetics Books; 1988. pp. 39-54.

31. Innes E. Handgrip strength testing: a review of literature. Aust Occup Ther J 1999;46(3):120-40. DOI: 10.1046/j.1440-1630.1999.00182.x

32. Ministério da Saúde. Conselho Nacional de Saúde. Resolução n. 466, de 12 de dezembro de 2012. Dispõe sobre as diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos. Brazil; 2012. Accessed on Aug 10 2017. Available from: http://bvsms.saude.gov.br/bvs/saudelegis/cns/2013/res0466_12_12_2012.html

33. Hanusch FD, Da Silva MGB, Prado LVS, Costa MDS, Gadelha PCFP. Avaliação nutricional de pacientes submetidos à cirurgia do trato gastrointestinal: associação entre avaliação

subjetiva global, ferramentas de triagem nutricional e métodos objetivos. Nutr Clin Diet Hosp 2016;36(2):10-9. DOI: 10.12873/362daysa

34. Soares ALG, Mussoi TD. Mini-avaliação nutricional na determinação do risco nutricional e de desnutrição em idosos hospitalizados. Rev Bras Nutr Clin 2014;29(2):105-10. Available from: http://www.sbnpe.com.br/wp-content/uploads/2016/12/03-Mini-avaliacao-nutricional.pdf

35. Cereda E, Pedrolli C, Klersy C, Bonardi C, Quarleri L, Cappello S, et al. Nutritional status in older persons according to healthcare setting: a systematic review and meta-analysis of prevalence data using MNA®. Clin Nutr 2016;35(6):1282-90. DOI: 10.1016/j.clnu.2016.03.008

36. Zanchim MC, Liberali R, Coutinho V. Estado nutricional de idosos hospitalizados em um hospital geral de alta complexidade do Estado do Rio Grande do Sul. Rev Bras Nutr Clin 2013;28(4):292-9. Available from: http://www.sbnpe.com.br/wp-content/uploads/2016/12/07-Estado-nutricional-de-idosos.pdf

37. Morais FTD, Campos IC, Lessa NMV. Diagnóstico nutricional em idosos hospitalizados. Nutrir Gerais 2010;4(7):637-51. Available from: https://www.unilestemg.br/nutrirgerais/downloads/artigos/volume4/edicao_07/diagnostico-nutricional.pdf

38. Panissa CO, Vassimon HS. Risco de desnutrição de idosos hospitalizados: avaliando ingestão alimentar e antropometria. Demet 2012;7(1):13-22. Available from: http://www.e-publicacoes.uerj.br/index.php/demetra/article/view/3275/2270#.Wcmt-WhSyUk

39. Fidelix MSP, Santana AFF, Gomes JR. Prevalência de desnutrição hospitalar em idosos. Rasb 2013;5(1):60-8. Available from: https://www.rasbran.com.br/rasbran/article/view/8/10

40. Guerra RS, Fonseca I, Pichel F, Restivo MT, Amaral TF. Handgrip strength and associate factors in hospitalized patients. JPEN J Parenter Enteral Nutr 2015;39(3):322-30. DOI: 10.1177/0148607113514113

41. Camarano AA. Mulher idosa: suporte familiar ou agente de mudança? Estudos Avançados 2003;17(49):35-63.

Table I. Nutritional status according to nutritional parameters of hospitalized elderly patients

Nutritional parameters	*n (%)*
Mini Nutritional Assessment®	
Malnourished	42 (14.4)
Risk of malnutrition	116 (39.9)
Normal nutritional status	133 (45.7)
Body mass index	
Underweight	86 (26.1)
Eutrophic	132 (40.1)
Overweight	111 (33.8)
Arm circumference	
< 21 cm	19 (6.5)
21-22 cm	17 (5.9)
> 22 cm	255 (87.6)
Calf circumference	
< 31 cm	82 (28.5)
≥ 31 cm	206 (71.5)
Handgrip strength	
< P5	92 (35.2)
≥ P5	169 (64.8)

< P5: lower than percentile 5; ≥ P5: equal or higher than percentile 5. Note: 40 missing data were present for the MNA® and arm circumference analysis, two for the BMI, 43 for the calf circumference and 70 for the handgrip strength.

Table II. Adductor pollicis muscle thickness classification of elderly hospitalized patients according to sex and age

APMT	*Total sample (n = 331) n (%)*	*Men (n = 143) n (%)*	*Women (n = 188) n (%)*	*p*
Total sample (n = 331)				
APMT in mm (mean ± SD)	13.79 ± 4.27	15.26 ± 4.01	12.67 ± 4.13	*< 0.001**
Classification				
< P5	222 (67.1)	53 (37.1)	169 (89.9)	*< 0.001†*
≥ P5	109 (32.9)	90 (62.9)	19 (10.1)	
60-79 years old (n = 175)				
APMT in mm (mean ± SD)	14.83 ± 3.90	15.76 ± 3.89	13.80 ± 3.66	*0.001**
Classification				
< P5	101 (57.7)	28 (27.7)	73 (72.3)	*< 0.001†*
≥ P5	74 (42.3)	64 (86.5)	10 (13.5)	
80 years old or more (n= 156)				
APMT in mm (mean ± SD)	12.62 ± 4.38	14.36 ± 4.10	11.78 ± 4.28	*< 0.001**
Classification				
< P5	121 (77.6)	25 (49.0)	96 (91.4)	*< 0.001†*
≥ P5	35 (22.7)	26 (51.0)	9 (8.6)	

APMT: adductor pollicis muscle thickness; < P5: lower than percentile 5; ≥ P5: equal or higher than percentile 5. *Student t test; †Pearson's Chi-square test.

Table III. Comparison of average adductor pollicis muscle thickness between sex, according to the classification of nutritional parameters of hospitalized elderly patients

Nutritional parameters	*APMT (mm)* *Total sample* *Mean ± SD*	*p*	*Men* *Mean ± SD*	*p*	*Women* *Mean ± SD*	*p*
Mini Nutritional Assessment®		*< 0.001**		*0.001**		*0.001**
Malnourished	11.80 ± 4.40¶		13.92 ± 4.41¶		9.68 ± 3.28¶	
Risk of malnutrition	13.15 ± 4.02¶		14.0 ± 3.73¶		12.70 ± 4.12‖	
Normal nutritional status	14.89 ± 4.01‖		16.60 ± 3.80‖		13.39 ± 3.60‖	
Body mass index		*< 0.001**		*< 0.001**		*< 0.001**
Underweight	11.71 ± 4.12¶		13.60 ± 3.78¶		10.41 ± 3.87¶	
Eutrophic	14.01 ± 4.09‖		14.81 ± 3.65¶		13.16 ± 4.38‖	
Overweight	15.14 ± 3.99‖		17.44 ± 3.95‖		13.90 ± 3.43‖	
Arm circumference		*< 0.001**				
< 21 cm	9.63 ± 2.58¶		10.00 ± 0.67¶		9.56 ± 2.81¶	
21-22 cm	11.39 ± 5.01¶		11.16 ± 2.75¶	*< 0.001**	11.59 ± 6.60‖¶	*0.003**
> 22 cm	14.21 ± 4.05‖		15.73 ± 3.95‖		13.02 ± 3.73‖	
Calf circumference		*< 0.001†*		*< 0.001†*		*< 0.001†*
< 31 cm	11.16 ± 3.43		12.03 ± 2.96		10.78 ± 3.58	

Nutritional parameters	*APMT (mm)*					
	Total sample *Mean ± SD*	*p*	*Men* *Mean ± SD*	*p*	*Women* *Mean ± SD*	*p*
≥ 31 cm	14.74 ± 4.07		16.15 ± 3.93		13.51 ± 3.80	
Handgrip strength‡				*< 0.001*†		*0.021*†
< P5	-		13.51 ± 3.91		12.01 ± 4.14	
≥ P5	-		16.58 ± 3.65		13.51 ± 3.48	

MNA®: Mini Nutritional Assessment; APMT: adductor pollicis muscle thickness; HGS: handgrip strength. *Analysis of variance-ANOVA and Bonferroni post-hoc test. †Student's t-test. ‡Information presented only between sex, since there is no cut-off value for the total sample (handgrip strength P5: for men = 18 kgf and for women = 11 kgf).

Table IV. Multivariate analysis of Poisson regression in order to evaluate the adductor pollicis muscle thickness effect on nutritional parameters of hospitalized elderly patients

Nutritional parameters	*APMT*			
	PR (95% CI) Not-adjusted	*p*	*PR (95% CI) Adjusted**	*p*
MNA® Risk of malnutrition/malnutrition	0.95 (0.92-0.97)	*< 0.001*	0.96 (0.93-0.99)	*0.006*
Body mass index < 22 kg/m^2	0.88 (0.84-0.92)	*< 0.001*	0.89 (0.84-0.94)	*< 0.001*
Arm circumference < 21 cm	0.74 (0.65-0.83)	*< 0.001*	0.79 (0.68-0.93)	*0.004*
Calf circumference < 31 cm	0.85 (0.81-0.89)	*< 0.001*	0.88 (0.84-0.93)	*< 0.001*
Handgrip strength < P5	0.91 (0.86-0.95)	*< 0.001*	0.94 (0.90-0.99)	*0.017*

p: Poisson regression. *Adjusted for sex and age.