ABCS HEALTH SCIENCES

ORIGINAL ARTICLE

OPEN ACCESS

Association of adductor pollicis muscle thickness and anthropometric indicators in community older adults

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ABSTRACT

Introduction: The measurement of the adductor pollicis muscle thickness (APMT) has been investigated as an index for muscle mass and undernutrition. **Objective:** However, there are few studies related to community-living older adults. **Methods:** Cross-sectional study carried out with community-dwelling older adults, of both sexes. The APMT, the body mass index (BMI), arm circumference (AC), arm muscle circumference (AMC), and calf circumference (CC) were evaluated. For APMT classification, the 25th percentile value (P25 ≤9 mm) of the sample was considered to identify muscle mass deficit. Chi-square test, Pearson's correlation, and Poisson regression were performed, with a significance level of $p<0.05$. **Results:** Among men, APMT showed a correlation with AC ($r=0.350$; $p<0.01$), and among women it was with BMI ($r=0.337$; $p=0.01$). There was an association between the BMI classification and the APMT percentile ($p=0.020$). Older adults with BMI<23 kg/m² were 1.28 times more likely to have APMT≤P25 ($p=0.007$) and older adults with adequate BMI were 1.23 times more likely ($p=0.023$). Older adults with reduced CC have a 1.18 times more chance of presenting APMT≤P25 ($p=0.064$). **Conclusion:** APMT has been associated with BMI in older adults, proving to be a good parameter for the assessment of malnutrition.

Keywords: muscles; thumb; nutritional status; anthropometry; malnutrition; aged.

How to cite this article: Alves et al. Association of adductor pollicis muscle thickness and anthropometric indicators in community older adults.
ABCS Health Sci. 2023;48:e023201
https://doi.org/10.7322/abcshs.2021029.1756

Received: Feb 22, 2021
Revised: Apr 18, 2021
Approved: Jun 08, 2021

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Declaration of interests: nothing to declare

INTRODUCTION

The prevalence of malnutrition in older adult community outpatients ranges from 2 to 51% in several regions of the world, and in Brazil, it is estimated that this prevalence is 10% to 19%[1]. However, these data are scarce and even an underreporting of this information, considering the few studies on malnutrition in geriatric outpatient clinics in Brazil[2-6].

Malnutrition is associated with a worsening clinical prognosis, reduced functional status, and increased morbidity and mortality rates[4,7] so its early identification allows for a better and more effective approach to health care and nutrition for older adults, contributing to improved quality of life and maintenance of functional capacity.

In this sense, nutritional evaluation and/or screening methods are indispensable to identifying individuals at risk of malnutrition[7,8]. Anthropometry is an important nutritional assessment method to evaluate total body mass and body composition. The arm circumference (AC), arm muscle circumference (AMC), and calf circumference (CC), as well as the Body Mass Index (BMI) and the Adductor Pollicis Muscle Thickness (APMT), are indicators used in the nutritional assessment of the older adults[9-11].

The APMT is a low-invasive, low-cost and simple measurement, with easy reproducibility and practicality, important criteria in the choice of a tool to be measured in the outpatient geriatric population, being able to verify the loss of muscle mass[10,12]. However, there are no studies that evaluate the relationship of the APMT with other anthropometric indicators only with community-dwelling older adults, with most studies being conducted with adults and hospitalized, surgical, and/or chronically ill older adults[9,12-15].

Thus, the use of the APMT as an index of muscle mass and malnutrition in community-dwelling older adults can help prevent and recover functional status and quality of life, contributing to the reduction of healthcare costs for these individuals.

Therefore, this study aimed to verify the association of Adductor Pollicis Muscle Thickness with anthropometric indicators in older people from the community.

METHODS

Study design and sample

This study is part of a larger project of the research group entitled "Health conditions and nutritional status of the older adults assisted in a geriatrics outpatient clinic in Lagarto, Sergipe, Brazil".

This is a cross-sectional study, carried out with older adults people (≥60 years old) of both genders, seen at a geriatric outpatient clinic in the city of Lagarto, Brazil, with data collection carried out from August to December 2018.

The geriatric outpatient clinic sees 10 patients once a week, totaling an average of 480 visits per year. We used the list of geriatric medical appointments for the selection of patients so that 8 of the 10 patients scheduled for the day's appointments were randomly selected to participate in our study, using their appointment code in the selection process.

We estimated the sample size of our study based on the prevalence of underweight in geriatric outpatients to meet the main objective of the study. We used the official national average prevalence of low weight (14.2%) for older adults people in Lagarto, obtained from the SISVAN web platform, (http://sisaps.saude.gov.br/sisvan/relatoriopublico/index). We used a margin of error of 0.05, a confidence interval of 95%, and a design effect of 1, as recommended when estimating simple random samples. The minimum required sample size was 135 individuals, but as a precaution, considering the possibility of refusal to participate in the study, 10% of the older adults were added to the initial sample, making a total of 147 individuals. Every sample size estimate was determined using calculations made by OpenEpi software[16].

Inclusion criteria were: individuals aged 60 years or older, from any social class, able to walk, and who agreed to participate in the study by signing the Free and Informed Consent Form. The exclusion criteria were: individuals who presented some physical and/or postural limitation that did not allow the measurement of anthropometric measurements; those with cognitive impairment; those with edema, ascites, and/or visceromegaly.

Data Collection

For data collection, a standardized and pre-coded questionnaire was used, related to socio-demographic (age, sex, skin color, education, and income), clinical (presence of morbidities and use of medications) and anthropometric data of the patient, applied by nutrition students. Data collection procedures were previously standardized as a quality control measure.

Anthropometric evaluation

Weight, knee height (KH), arm circumference (AC), calf circumference (CC), and tropical skinfold thickness (TSF) were measured according to the standardized techniques proposed by Lohman et al.[17].

A digital electronic scale (Plena®) with a maximum capacity of 150 kg and precision of 100g was used to obtain weight. Circumference measurements were obtained using an inelastic and flexible tape measure. The KH was measured using an infantometer (Balmak®) and then height was estimated from the equation proposed by Chumlea et al.[18] . To measure TSF and APMT we used an adipometer (Lange®).

The anthropometric indicators evaluated were the AC and the arm muscle circumference (AMC), obtained through the equation $AMC = AC - [\pi \times (TSF \div 10)]$, classified as nutritional risk/ malnutrition when equal to or less than the 25th percentile (P25), according to gender and age group of the older adults as proposed by NHANES III[19]. The body mass index (BMI) was obtained by the ratio of the current weight to the square of the estimated height, classified according to the SABE/OPAS cutoff point[20].

The CC was measured with the individual seated, with the left leg forming a 90° angle with the knee, and the inelastic tape was positioned at the maximum circumference of the calf. Values ≤34cm for men and ≤33cm for women were considered indicative of reduced muscle mass[21].

The APMT was obtained using an adipometer with a constant pressure of 10 g/mm². The measurement was taken with the patient seated, with the arm flexed at approximately 90° and the forearm and hand resting on the knee. The APMT was clamped with the adipometer at the vertex of an imaginary triangle formed by the extension of the thumb and forefinger[22], and the procedure was performed three times on the right hand in right-handed subjects and on the left hand in left-handed subjects[13], and the average was used. For classification of the APMT, the 25th percentile value (P25 ≥ 9 mm) of the sample was considered to identify the muscle mass deficit. We chose this cut-off point because the values of the 5th percentile of reference for the healthy Brazilian population[23] are higher than the 75th percentile of the present study, thus all the older adults in this study would be considered with a deficit of muscle mass by the evaluation of the APMT.

Statistical Analysis

SPSS® software, version 20.0 was used. To characterize the sample, the variables were expressed in measures of central tendency and dispersion, as well as the absolute and relative frequency of categorical variables, and the analyses were stratified by gender. The normality of quantitative variables was tested using the Kolmogorov- Smirnov test.

Box-plot graphs were drawn with the distribution of the APMT by gender. Pearson's Correlation was used to evaluate the correlation between the APMT and the anthropometric indicators.

To evaluate the association between the percentile classification of the APMT and the anthropometric indicators, the Chi-square test was applied. In addition, Poisson regression analysis with robust variance was used to obtain prevalence ratio estimates and the respective 95% confidence intervals for the association between APMT and the other anthropometric indicators. For all tests a significance level of p<0.05 was adopted.

Ethical Aspects

This study was approved by the Research Ethics Committee of the Universidade Federal de Sergipe, following Resolution No. 466/2012[24], being approved with opinion No. 559.936. The study participants signed the Informed Consent Form.

RESULTS

A total of 159 older adult subjects were evaluated, with a mean age of 70.9 ± 29.4 years, 50.3% were female. It was observed that, among men, 43% presented BMI between 23.00 and 27.99 kg/m², and most of them presented nutritional risk/ malnutrition by the classification of AMC (72.2%) and AC (53.2%) (p<0.001). In addition, it was found that most of the older adults had adequate CC (73.6%), 65.8% for men, and 81.2% for women (p=0.027) (Table 1).

Figure 1 presents the box plot of the older adults' APMT, according to gender. It was found that men and women presented equal median values for APMT. However, men obtained higher values between the interquartile (Q1 and Q3) and amplitude of the data compared to women.

Evaluating the correlation between the APMT and anthropometric indicators (Table 2), it was found that among men the highest correlation value was for AC (r=0.350; p<0.01), and among women it was for BMI (r=0.337; p=0.01), however, the correlations were considered weak. For the sample, CC showed

Table 1: Characteristics of the variables age range and anthropometric indicators of the older adults, according to gender.

Variables	Total sample (n = 159)	Male (n = 79)	Female (n = 80)	p
Age Group				
60-69 years old	78 (49.1)	40 (50.6)	38 (47.5)	0.572
70-79 years old	56 (35.2)	29 (36.7)	27 (33.8)	
≥ 80 years old	25 (15.7)	10 (12.7)	15 (18.8)	
BMI Classification				
< 23.00 kg/m²	52 (32.7)	31 (39.2)	21 (26.2)	<0.001
23.00–27.99 kg/m²	52 (32.7)	34 (43.0)	18 (22.5)	
≥ 28.00 kg/m²	55 (34.6)	14 (17.7)	41 (51.2)	
AMC Classification				
Nutritional risk/malnutrition	89 (56.0)	57 (72.2)	32 (40.0)	<0.001
Adequate	70 (44.0)	22 (27.8)	48 (60.0)	
AC Classification				
Nutritional risk/malnutrition	64 (40.3)	42 (53.2)	22 (27.5)	<0.001
Adequate	95 (59.7)	37 (46.8)	58 (72.5)	
CC Classification				
Reduced	42 (26.4)	27 (34.2)	15 (18.8)	0.027
Adequate	117 (73.6)	52 (65.8)	65 (81.2)	

Chi-square
AC: arm circumference; AMC: arm muscle circumference; CC: calf circumference; SD: standard deviation; BMI: body mass index.

a weak correlation with APMT (r=0.163; p<0.01), and it did not show a significant correlation with APMT when stratified by sex.

In Table 3, it was observed that there was a statistically significant association between BMI classification and the percentile of the APMT (p=0.020). It was found that older adults with BMI <23 kg/m² are 1.28 times more likely to have an APMT ≤P25 (p=0.007), while those with adequate BMI are 1.23 times more likely (p=0.023). Furthermore, it was observed that 52.4% of the older adults with reduced CC have APMT ≤P25, that is, the older adults with reduced CC were 1.18 times more likely to have APMT ≤ P25, but without statistical significance (p=0.064) (Table 4).

DISCUSSION

The APMT showed an association with the BMI classification, so older adults with low weight and appropriate weight have a greater chance for APMT depletion. The evaluation of the APMT is an index of muscle mass and malnutrition, allowing the early identification of nutritional impairment, even when older adults have a BMI considered adequate.

The absence of APMT cut-off points for older adults, its heterogeneity and use in various clinical conditions, as well as the need for differences by sex and age groups, raise a gap in the scientific literature. Therefore, the importance of evaluating the use of the APMT as a sensitive indicator for community-dwelling older adults is highlighted.

Margutti et al.[15], in a study with hospitalized older adults, found similar results to the present study regarding the median value of the APMT, for both genders, and the presence of

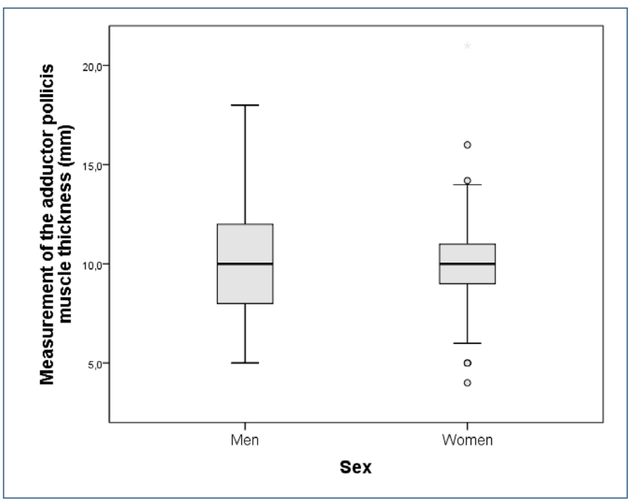

Figure 1: Distribution of the APMT values, according to sex.

Table 2: Correlation between APMT and anthropometric indicators in community-dwelling older adults, according to gender.

Variables	APMT		
	Total sample	Male	Female
BMI	0.270‡	0.276*	0.337‡
AMC	0.184*	0.224*	0.175
AC	0.255‡	0.350‡	0.241*
CC	0.163*	0.166	0.201

Pearson's Correlation; *p<0.05; ‡p<0.01.

AC: arm circumference (cm); AMC: arm muscle circumference (cm²); CC: calf circumference (cm); APMT: adductor pollicis muscle thickness (mm); BMI: body mass index (kg/m²).

Table 3: Association between APMT percentile classification and anthropometric indicators in community-dwelling older adults.

Variables	APMT		p
	≤ P25	> P25	
	(n = 64)	(n = 95)	
BMI Classification			
< 23.00 kg/m²	26 (40.6)	26 (27.4)	0.020
23.10 – 27.99	24 (37.5)	28 (29.5)	
≥ 28.00	14 (21.9)	41 (43.2)	
AMC Classification			
Nutritional risk/ malnutrition	40 (62.5)	49 (51.6)	0.174
Adequate	24 (37.5)	46 (48.4)	
AC Classification			
Nutritional risk/ malnutrition	31 (48.4)	33 (34.7)	0.084
Adequate	33 (51.6)	62 (65.3)	
CC Classification			
Reduced	22 (34.4)	20 (21.1)	0.062
Adequate	42 (65.6)	75 (78.9)	

Chi-square test.

AC: arm circumference; AMC: arm muscle circumference; CC: calf circumference; APMT: adductor pollicis muscle thickness; BMI: body mass index; P25: 25th percentile.

Table 4: Prevalence and prevalence ratio of the APMT percentile classification according to anthropometric indicators in community-dwelling older adults.

Variables	APMT prevalence ≤ P25* (%)	RP (IC 95%)	p
BMI			
< 23.00 kg/m²	50.0	1.28 (1.07 – 1.53)	0.007
23.10 – 27.99 kg/m²	25.5	1.23 (1.03 – 1.47)	0.023
AMC nutritional risk/malnutrition	44.9	1.11 (0.96 – 1.29)	0.169
AC nutritional risk/ malnutrition	48.4	1.15 (0.98 – 1.34)	0.084
Reduced CC	52.4	1.18 (0.99 – 1.40)	0.064

Poisson regression, adjusted by age and sex.

AC: arm circumference; AMC: arm muscle circumference; CC: calf circumference; APMT: adductor pollicis muscle thickness; BMI: body mass index; P25: 25th percentile; PR: prevalence ratio.

* 25th percentile APMT = 9 mm

a correlation between the APMT and the BMI. Evaluating the association between APMT and nutritional parameters in hospitalized older adults, Schwanke et al.[9] found that increased APMT was related to a 4% lower chance of malnutrition/risk of malnutrition as classified by MAN, 11% in BMI, 21% for AC <21cm and 12% in AC <31 cm, corroborating the results observed in the present study.

On the other hand, in a study with older adult patients with chronic kidney disease (CKD) under conservative treatment, Pereira et al.[25] found higher mean values of APMT for both genders and a correlation of APMT with CC, differently from the present study. However, these results may have been influenced by possible water retention with edema formation in the upper and lower limbs, which is common in patients with CKD in more advanced stages[26].

Souza et al.[27] although they found the median APMT higher than that observed in the present study, the authors verified that there was a statistically significant difference between the mean values of APMT when analyzed by classification of BMI, CC, and %AC for those with and without nutritional risk. However, it is worth noting that the study was conducted with adults and older adult patients seen in an emergency hospital and that the cutoff point used for the classification of CC differed from that adopted in the present study[21].

The evaluation of the APMT is an easy and quick method, low cost, and reliable[10,14,15,28-30], ratifying its importance in the nutritional assessment of older adults since this measure is directly influenced by the impairment of the nutritional status of the individual[12]. Furthermore, factors such as the aging process itself decreased work activities, muscle atrophy, and the presence of pathologies, contribute to the need for early detection of the risk of malnutrition in this age group through simple and low-cost indicators for use in clinical and population practice.

The cross-sectional nature of the study can be considered a limitation since it does not allow identifying the cause-effect relationship and/or changes in body composition and APMT behavior in the medium and long term. Our study did not use any gold standard method to assess muscle mass in older adults, which would allow better analysis of APMT with muscle reserves. The sample studied does not allow the observed results to be extrapolated to other populations. In addition, the sample of the present study presented a distribution of the APMT below the 5th percentile cut-off points suggested by a Brazilian study[23], which justifies the use of the cut-off point of the sample itself to perform the analyses.

It was concluded that the APMT was associated with BMI so the older adults with APMT ≤9mm were more likely to be thin and have adequate weight about the BMI classification. However, due to the heterogeneity among the studies as well as the scarcity of specific cut-off points for the Brazilian older adult population, there is a need for further studies to better understand the accuracy and performance of this muscle indicator.

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