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Original article

Is adductor pollicis muscle thickness a good predictor of lean mass in adults?

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SUMMARY

Background & aims: Lean mass (LM) is an important parameter in clinical outcomes, which highlights the necessity of reliable tools for its estimation. The adductor pollicis muscle thickness (APMT) is easily accessible and suffers minimal interference from the adjacent subcutaneous fat tissue.
Objective: To assess the relationship between the APMT and LM in a sample of Southern Brazilian adults.
Methods: Participants were adults from the 1982 Pelotas (Brazil) Birth Cohort. LM was measured by dual energy X-ray absorptiometry (DXA). LM and lean mass index (LMI – LM divided by the square of height – kg/m^2) were the outcomes. APMT was measured using a skinfold caliper. The mean of three measurements in the non-dominant hand was used in the analyses. APMT was described according to socio-demographic characteristics and nutritional status. The relationship between APMT and both LM and LMI was evaluated by correlation coefficient and linear regression using APMT as a single anthropometric parameter and also in addition to BMI.
Results: APMT was assessed in 3485 participants. APMT was higher in males, non-whites, less-schooled and obese individuals. APMT was moderately correlated to LM and LMI (ranged from 0.44 to 0.57). Correlation coefficients were higher for LMI as outcome and in females (LM: 0.51 and LMI: 0.57). APMT explained 19% and 26% of the variance in LM in males and females, respectively, whereas it explained 26% and 33% of the variance in LMI. APMT increased the prediction for LM in 3 and 4 percentage points in males and females, in comparison to explained by BMI. BMI explained 48% and 59% of the variance of LMI in males and females whereas APMT increased it to 51% and 62% for both sexes, respectively.
Conclusions: Results were not good enough to promote the APMT as a single predictor of LM or LMI in epidemiological studies. APMT has a little predictive capacity in estimating LM or LMI when BMI is also considered.

1. Introduction

Nowadays, there is a growing importance of body composition evaluation in several fields [1]. The measurement of body composition allows documenting the efficiency of nutrition support, tailoring the choice of nutritional behaviors and therapies, whereas only body weight does not allow objectively the same approach [1]. Assessment of fat mass has been the main focus of several studies in the last decades due to the importance of the evaluation of the body fat *per se* as well as its corporal distribution [2,3]. However, lean mass (LM) has also recently attracted major attention in the scientific literature, given its role as an important predictor of clinical outcomes [4,5]. It has been reported that LM is a fundamental determinant of growth and development [6], as well as an important clinical marker of diseases and aging processes [7].

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Several methods to evaluate body compartments have been developed and, subsequently, adapted for use in different scenarios. Devices such as dual energy X-ray absorptiometry (DXA) and air-displacement plethysmography have been proven reliable in epidemiological scenario [8]. Unfortunately, given the high costs, technical complexity and low availability of the methods, their use is restricted in clinical and research environments.

In population-based studies, the availability of simple and minimally invasive methods with lower costs is important. With that in mind, anthropometric measurements have been largely used in epidemiological studies to assess fat mass – such as waist and hip circumference and skinfold thickness [9,10]. However, the growing attention to LM as a predictor of clinical outcomes highlights the necessity of reliable tools, which can easily assess LM in different cohorts.

Previous studies have reported that low adductor pollicis muscle thickness (APMT) could be used as a proxy of low lean mass in clinical scenario [11–13]. This muscle has an easily accessible location in the hands and suffers minimal interference of the subcutaneous fat tissue in its thickness' assessment. APMT has been used mainly in the clinical environment, particularly in surgical, renal, long-term hospitalized or critical care patients [11,14–17], as a predictor of malnutrition, length of stay and mortality. However, its use in the general healthy population has been scarcely studied.

Few studies have described APMT in healthy subjects according to demographic characteristics. Lameu et al. [13] observed a positive correlation between APMT and arm muscle circumference, arm muscle area and calf circumference, but did not find any meaningful correlations with fat parameters. Gonzalez et al. [18] found a positive correlation of APMT with BMI, but weak correlations with weight, height and age. To our knowledge, no previous study has compared APMT and LM measured by reference methods are inexistent.

The present study aimed to assess the relationship between the APMT and LM among young adults in South Brazil.

2. Materials and methods

Data used for this analysis were collected as part of the last follow-up of the 1982 Pelotas Birth Cohort Study. These subjects (n = 5914 at birth) were followed-up on several occasions, and further details about this cohort are available elsewhere [19,20].

From June, 2012 to February, 2013, the cohort members were invited to visit the research clinic, where they were interviewed and examined. All procedures were approved by the Ethics Committee in Research of the Faculty of Medicine at Federal University of Pelotas and a written informed consent was obtained from all subjects.

Subjects were categorized by BMI according to the World Health Organization recommendation [21]. Standing height was measured to the nearest 1 mm, using a wooden stadiometer with the barefooted subjects. Weight was assessed using a pletismography scale (BodPod® – Cosmed, Italy), with the precision of 0.01 kg. Their economic status was also assessed, based on asset index, having a full-time maid and the head of the family's schooling. This allowed us to stratify subjects in wealth groups from A – richest – to E – poorest, according to the Brazilian Research Association Institute criterion.

APMT measurement (mm) was performed using a Lange® skinfold caliper (Beta Technology – Santa Cruz, CA, USA). Measurements were taken as subjects sat upright in a chair with their legs, arms and backs supported. Arms were set at a 90° angle from the elbow using the chairs arm rest. APTM was measured with the skinfold caliper in the vertex of an imaginary triangle formed by the extension of the thumb and the index finger, under the continuous pressure of 10 g/mm. The mean of three measurements was used [18]. The non-dominant APMT was chosen for consideration in this study – therefore, the values obtained from the left hand of right-handed subjects, and from the right hand of the left-handed ones, were used. Examiners were trained and standardized using acceptable technical errors of measurement calculated based on Habicht's publication [22] for all anthropometric measurements. Exclusion criteria for APMT were factors that could influence the execution of daily movements, such as pregnancy; tendinitis; current injuries or deterioration of mobility due to previous injuries or accidents in at least one of the arms or hands; fractures in the upper limbs in the last six months; wheelchair use, mental disorders and degenerative diseases (e.g. fibromyalgia).

LM was assessed using DXA (Lunar Prodigy Advance – GE®, Germany). Total body DXA scans were not performed in pregnant women and subjects weighing more than 120 kg or taller than 1.92 m. Subjects with metal surgical implants and irremovable metal items were excluded from examination. Subjects that could not fit in the DXA scan area were submitted to half-body scans of their right side to estimate total body composition. Lean Mass Index (LMI) was also calculated by dividing the LM (kg) by the square of height (m), as proposed by VanItallie [23].

All analyses were stratified by sex. Student's t-test or Analysis of Variance (ANOVA) was used in the bivariate analysis. Scatter plots were used to show the relationship between APMT and LM (kg) or LMI (kg/m^2), and Pearson's correlation was also determined. Regression coefficients and adjusted coefficient of determination (adjusted R^2) were both estimated using linear regression: first, for APMT only; later, using anthropometric variable in addition to BMI. Significance level was set in 5%.

3. Results

In 2012–3, 3701 participants from the original 1982 Pelotas Birth Cohort were interviewed. The follow-up rate was 68.1% (including 325 known deaths). After exclusion, 3338 individuals were DXA scanned. APMT was, on average, 24.2 mm (sd = 4.2) and 19.4 mm (sd = 3.9) for males and females, respectively. Table 1 shows that APMT was higher among non-white subjects. Females from the highest economic status presented lower APMT ($p < 0.001$), whereas among males the same relationship was observed but it was not statistically significant. The highest schooling group showed lower APTM than the two lowest groups in both males ($p < 0.001$) and females ($p < 0.001$). Nutritional status was positively associated with APMT ($p < 0.001$).

Fig. 1 shows that APMT was positively correlated with LM and LMI, regardless of the sex. Pearson's coefficients were higher in females than in males. In females, the correlation between APMT and LM was r = 0.51, whereas, in males, r = 0.44. For LMI, the correlation coefficient was 0.51 and 0.57, for males and females, respectively.

Regression coefficients of APMT in the LM prediction were similar for males (β = 0.71, 95% CI = 0.64; 0.78) and females (β = 0.71, 95% CI = 0.65; 0.76), though the coefficient of determination was slightly higher for females (26.3%) than males (19.1%). Coefficient of determination for APMT was higher in the LMI prediction than for the LM prediction. APMT explains 26% and 33% in the variation of LMI in males and females, respectively (Table 2).

BMI predicted around 30% and 41% of the LM variation in males and females, respectively (Fig. 2). APMT increased the LM prediction by 3 and 4 percentage points in males and females. BMI explained 48% and 59% of the LMI variation in males and females, whereas APMT increased it to 51% and 62% for both sexes, respectively.

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