Adductor pollicis muscle and hand grip strength: potential methods of nutritional assessment in outpatients with stroke

Músculo adutor do polegar e força de preensão palmar: potenciais métodos de avaliação nutricional em pacientes ambulatoriais com acidente vascular encefálico

Débora Rocha Oliveira¹, Vera Silvia Frangella²

ABSTRACT

Objective: To evaluate and compare the effectiveness of different methods used for nutritional assessment of outpatients who had hemiplegic stroke. Methods: A cross-section study with adult and elderly patients of both genders enrolled in a rehabilitation center. The analyzed variables were anthropometric measurements, bioelectrical impedance, hand grip strength and thickness of the adductor pollicis muscle. The Pearson \( \chi^2 \) test was used to check the association between variables with a significance level of \( \alpha = 5\% \). Results: When evaluating the association between indicators of muscle mass, it was observed that the hand grip strength in both genders was positively correlated with arm muscle circumference (\( p = 0.0196 \)) and lean mass (\( p = 0.0002 \)). Fat mass measured by the bioelectrical impedance method already showed a significant inverse relationship with the grip (\( r = -0.3879 \)). The thickness of the adductor pollicis muscle showed significant association with lean mass (\( p = 0.0052 \)) and hand grip (\( p = 0.0024 \)). Conclusion: In this study, the hand grip strength and thickness of the adductor pollicis muscle were well correlated with measurements determined by anthropometry and bioimpedance. The results show the applicability of grip strength and thickness of the adductor pollicis muscle in clinical practice as nutritional assessment methods for this population, especially elderly patients, since they detect functional changes not captured by other parameters in the short term and are important for early identification of risk nutrition.

Keywords: Stroke; Nutrition assessment; Muscle strength; Dynamometer; Anthropometry; Body composition

INTRODUCTION

Cerebrovascular accident (CVA) can be defined as a sudden focal neurological deficit due to a vascular injury, and it can be ischemic or hemorrhagic¹.

Study carried out at Centro Universitário São Camilo, São Paulo (SP), Brazil.

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According to the World Health Organization\(^2\), CVA is the third cause of death in developed countries, only surpassed by coronary diseases and cancer. In the Brazilian population, CVA is the main cause of mortality and functional disability, especially involving individuals older than 50 years and outnumbering even heart diseases and cancer\(^2,3\).

Acute neuropathies lead to a hypercatabolic status with fast loss of lean body mass due to mobilization of acute phase proteins and a negative nitrogen balance which can lead to malnutrition and, consequently, to an involvement of functional capacity\(^4\).

Therefore, evaluation of the nutritional status in patients with CVA is fundamental to make diagnosis on which the nutritional management will be based, in order to minimize the morbidity and mortality rates, in addition to assuring quality of life\(^5\).

There are several methods for estimating the body content with different levels of accuracy, cost and applicability, and recently new parameters have been included as support in the anthropometric evaluation.

The non-conventional evaluation methods include the hand grip strength (HGS), with the use of dynamometry – a method validated for nutritional evaluation – and the measurement of the adductor pollicis muscle (APM). Both are easily manageable, have low cost, and are easy and fast, allowing the identification of individuals in greater risk of developing complications related to malnutrition, and aid in the follow-up of patients with malnutrition and with neuromuscular disorders throughout the clinical investigation\(^6-9\).

Given these facts, it is evident that the individual with CVA is susceptible to nutritional status deficiencies, pointing to the importance of establishing a reliable nutritional diagnosis with the use of safe, practical, easily applicable and trustworthy measurement instruments. Therefore, this paper aimed to evaluate and compare the efficacy of different methods used to assess the nutritional status in hemiplegic outpatients who suffered CVA.

**METHODS**

This is a cross-sectional study performed from November 2008 to March 2009 involving patients aged between 20 and 59 years (adults) and aged 60 years or more (elderly), with no gender restriction, who suffered an ischemic or hemorrhagic CVA and were hemiplegic. The patients were seen at the Centro de Reabilitação Promove São Camilo, located in the city of São Paulo, after approval by the Research Ethics Committee of the Centro Universitário São Camilo under nº 157/08. The sample size was established by the number of healthcare assistance events in the characterized population of patients (for a period of five months assigned to data collection) who signed the informed consent form.

The evaluated variables included anthropometric data, bioimpedance analysis (BIA), HGS (Kgf) and APM thickness (mm).

Measurements of weight, height, arm circumference (AC), triceps skinfold (TSF) and subscapular skinfold (SCSF), arm muscle circumference (AMC) and APM (Figure 1) were obtained following standard techniques\(^10,11\). Bioimpedance was performed with Biodynamics® instrument, model 310, in accordance with the manufacturer’s protocol and dynamometry was measured with a Jamar® hand dynamometer according to standard recommendations\(^12,13\) (Figure 2). Weight was measured with an electronic platform scale, with a capacity of 500 kg and 100-g divisions (Micheletti®) that had been previously calibrated. A SECA® mobile stadiometer with millimeter divisions was used for measuring the height. Skinfolds were checked with Figures 1 and 2.
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a Lange® plicometer with 0.1-cm divisions duly calibrated; each measurement was repeated 3 times and the mean value obtained in the measurements was recorded(14).

Frisancho’s percentile classification(15-16) was used to rate TSF, AC and AMC in adult individuals. In elderly individuals, Kuczmarski, Kuczmarski and Najjar’s percentile classification(17) was employed to measure TSF, AMC and AC.

The cutoff point for rating the APM thickness was established according to Andrade and Lameu(7), who reported an adductor pollicis thickness greater than 14 mm as a negative predictor for septic complications, non-septic complications and mortality.

To analyze the results of BIA, the recommendations described in the printout issued by the bioimpedance instrument were used, taking into account the measurement of target values of each variable analyzed.

The differences between genders and age range were established by the Student’s t-test. Pearson’s χ² test was used to check the association between the variables evaluated. The level of significance used in all analyses was α = 5%. Statistical data were obtained with the statistical program named GraphPad Prism version 3.00 for Windows (GraphPad Software).

RESULTS

A total of 26 adult and elderly individuals were evaluated (15 males and 11 females) with mean age for both genders of 48.6 ± 2.97 years for adults, and 70.1 ± 2.21 years for elderly individuals, with no statistical difference.

In this study, effectiveness of the different methods of evaluation was verified. Thus, BIA was used as a reference standard for variables determining lean mass and fat mass. Correlation values (r coefficient) and significance values (p) of the variables evaluated in the study are presented in Chart 1.

Hand grip strength (Figure 3) was positively correlated with nutritional status indicators, in both genders, with the exception of the body mass index (BMI). This, in turn, showed a strong association with AC, TSF and AMC (Figure 4).

While evaluating the association between the muscular mass indicators, it was observed that lean

<table>
<thead>
<tr>
<th>Variables</th>
<th>BMI</th>
<th>AC</th>
<th>AMC</th>
<th>TSF</th>
<th>Lean mass (BIA)</th>
<th>%BF (BIA)</th>
<th>Hand grip strength</th>
<th>APM thickness</th>
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<tr>
<td>BMI</td>
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<td>0.5380</td>
<td>0.6973 **</td>
<td>0.3238</td>
<td>0.6570 ***</td>
<td>-0.05243</td>
<td>0.1074</td>
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<tr>
<td>AC</td>
<td>0.8707 **</td>
<td>–</td>
<td>0.7377 **</td>
<td>0.6654 ***</td>
<td>0.3999 ***</td>
<td>0.5044 ***</td>
<td>0.01909</td>
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<tr>
<td>AMC</td>
<td>0.5380</td>
<td>0.7377 **</td>
<td>–</td>
<td>-0.01308</td>
<td>0.6823 **</td>
<td>-0.04323</td>
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<td>TSF</td>
<td>0.6973 **</td>
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<td>-0.01308</td>
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<td>Lean mass (BIA)</td>
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<td>-0.3594</td>
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<tr>
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<td>0.01909</td>
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<td>0.5315 ***</td>
<td>0.6504 ***</td>
<td>-0.3879 ***</td>
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<tr>
<td>APM thickness</td>
<td>0.1074</td>
<td>0.1888</td>
<td>0.4618 ***</td>
<td>-0.2313</td>
<td>0.5315 ***</td>
<td>-0.3879 ***</td>
<td>0.5697 ***</td>
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</table>

BMI: body mass index; AC: arm circumference; AMC: arm muscle circumference; TSF: triceps skinfold; %BF: percentage of body fat; APM: adductor pollicis muscle.

* r: Pearson correlation; **p < 0.0001; ***p < 0.05.

Figure 3. Correlation of hand grip strength (HGS) and anthropometric variables.

Figure 4. Correlation of BMI and anthropometric variables.
mass estimated by the BIA method showed a strong correlation with the anthropometric indicator AMC (p = 0.0001) and with HGS (p = 0.002) (Figure 5). In addition, regarding the fat mass, there was a positive correlation between the body fat (BF) percentage measured by means of BIA and TSF (p < 0.0001) and inverse relation with hand grip (r = -0.3879 and p = 0.0052) (Figure 6).

BF percentage was strongly correlated with BMI and TSF and showed an inverse relation with HGS. Values of APM thickness showed a positive correlation with lean mass (p = 0.0052) and HGS (p = 0.0024) (Figure 7).

**DISCUSSION**

Nowadays, much has been discussed about the different instruments for nutritional evaluation and BMI is usually highlighted for being a method that is non-invasive, easily applicable and of low cost\(^{18,19}\). However, although in this study BMI also showed a strong correlation with the anthropometric indicators, it was not able to distinguish the body content and did not express fat tissue distribution and lean body mass. Thus, BMI cannot be used as the only estimation of obesity or fat body mass.

Several studies support the fact that HGS is positively associated with nutritional status\(^{20-22}\) and this data corroborates the findings of this study. Similarly, a study performed with 94 adult and elderly individuals in rural zones of Malawi to evaluate the relation between nutritional status and HGS showed a strong correlation of increased HGS and increased lean mass\(^{23}\).

An inverse relation was also found by Hulens et al.\(^{24}\) who observed lower peripheral muscular strength in obese women compared to eutrophic women, presenting a negative correlation between HGS and percentage of BF.

In addition to being an indicator of nutritional status, dynamometry is also well referenced for being a predictor of mortality, regardless of the BMI. It is a method very much used to evaluate hand strength and an excellent predictor in the prognosis of complications and health\(^{25-28}\).

The aspect of lean mass loss can be estimated by HGS. In this study, HGS was well correlated with the measurements established by anthropometry and BIA. Therefore, it is a legitimate fact that HGS is positively associated with nutritional status\(^{20-22}\).

In the United Kingdom, in a study with healthy individuals to evaluate the relation between the structural and functional measurements and the nutritional status, the authors found a strong association between hand grip and AMC\(^{29}\). Similar results were found in our study.

Lean mass and muscular strength are essential for functionality in elderly people. Arroyo et al.\(^{27}\), while evaluating the anthropometric indicators and body content with functionality in 377 elderly Chilean individuals, found a negative correlation between
functional limitation and HGS in both genders. This reduction in lean mass and in muscular strength induced by ageing is also documented by Landers et al.\(^\text{30}\).

Another instrument for nutritional evaluation that has been receiving attention is the APM thickness, a simple and straightforward method of evaluation with no need of calculations and is able to indicate the risk of malnutrition and prognosis for hospital complications and risk of malnutrition, thus reducing hospital costs and mortality.

**CONCLUSION**

In view of the strong association between nutritional status and HGS, it is suggested that dynamometry be included in the clinical practice as a method of nutritional evaluation, since HGS is able to detect functional abnormalities that are not detected by other parameters in the short term, and it is important for early identification of individuals at nutritional risk and in the follow-up of interventions and clinical progression, in addition to being an easily manageable method, fast, of low cost and non-invasive.

**REFERENCES**


