Medicina Universitaria. 2016;xxx(xx):xxx–xxx

MEDICINA UNIVERSITARIA

www.elsevier.es/rmuanl

ORIGINAL ARTICLE

Muscle mass measured using bioelectrical impedance analysis, calf circumference and grip strength in older adults

C.G. Quiñonez-Olivas[a,*], R. Salinas-Martínez[a], X.A. Ortiz-Jiménez[b], D.G. Gámez-Treviño[a], G. Guajardo-Álvarez[a], B. González-García[a]

[a] *Geriatric Services at the ''Dr. José Eleuterio González'' Hospital Univeristario de la Universidad Autónoma de Nuevo León, Nuevo León, Mexico*
[b] *School of Psychology, Universidad Autónoma de Nuevo León, Nuevo León, Mexico*

Received 4 March 2016; accepted 7 June 2016

KEYWORDS
Muscle;
Grip strength;
Calf circumference

Abstract
Objective: To determine the correlation between muscle mass, measured using bioelectrical impedance analysis (BIA), with calf circumference and grip strength.
Materials and methods: Cross-sectional and observational study. Including all functional adults over 60 years of age seen in our Geriatric Clinic during the months of March 2013–February 2014. Measurements of weight, height, BMI, calf circumference, grip strength and muscle mass by BIA were made after the signature of informed consent.
Results: 105 patients were evaluated, 73 women and 32 men, with a mean age of 76 years (SD ± 7.3). Muscle mass showed a mild positive correlation with calf circumference: Pearson ($r = 0.31$; $p = 0.000$) and a moderate positive correlation with grip strength: Pearson ($r = 0.50$; $p = 0.000$).
Discussion: Muscle mass by BIA has a positive correlation with calf circumference and grip strength, and is a reliable measure to assess muscle mass and physical performance in older adults in geriatric ambulatory clinics and can be used in the diagnosis of sarcopenia in Mexican patients.

* Corresponding author at: Servicio de Geriatría, Hospital Universitario ''Dr. José Eleuterio González'', Universidad Autónoma de Nuevo León, Colonia Mitras Centro, Avenida Gonzalitos y Madero en Monterrey, Nuevo León, Mexico. Tel.: +52 81 8123 2436.
E-mail address: carlos_quinonez@hotmail.com (C.G. Quiñonez-Olivas).

http://dx.doi.org/10.1016/j.rmu.2016.06.005

Please cite this article in press as: Quiñonez-Olivas CG, et al. Muscle mass measured using bioelectrical impedance analysis, calf circumference and grip strength in older adults. Medicina Universitaria. 2016. http://dx.doi.org/10.1016/j.rmu.2016.06.005

Introduction

The relation between muscle mass and aging has led scientists to investigate its changes, causes and consequences. Initially, Irwin Rosenberg proposed the term ''sarcopenia'' in 1989 (from the Greek ''sarx'' or ''meat'' + ''penia'' or ''loss'') to describe the decrease of muscle mass related to age.[1] Since its definition, authors have demonstrated the absolute loss of muscle mass from the age of 50, with a decrease of 1.1 and 1.9 kg per decade for man and women, respectively.[2]

Epidemiological studies of sarcopenia, with more representative samples from Europe and the U.S., show prevalence figures which range from 10% in adults older than 60 up to 60% in adults older than 80.[3,4]

In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP)[5,6] aided studies by Baumgartner, et al. and Janssen et al. to create diagnostic criteria. They used dual energy X-ray absorptiometry (DEXA) and bioelectrical impedance analysis (BIA) to determine muscular mass.[6–8] The EWGSOP's final intended result was an algorithm for sarcopenia that fulfilled the following criteria: low physical performance measured by walking speed (4 m course) and/or decreased grip strength, plus a criterion of low muscular mass below the standard deviations, to make a definitive diagnosis.[6,9]

In Mexico, the public health care system does not have the necessary tools to measure muscular mass. Thus, dynamometry has been widely used to evaluate grip strength and physical performance in older adults.[10] Grip strength is a predictive factor of adverse results such as institutionalization or mortality, but is limited in patients with deteriorated cognitive ability, due to the difficulties in its execution or a lack of motivation.[11] Anthropometric measures such as calf circumference (CC) have also been sought as a way to measure muscular mass and functionality, based principally on a study by Rolland et al. who demonstrated that older adults with a CC of less than 31 cm had a high specificity (91%) in a sarcopenia diagnosis, and were associated with disability in the activities of their daily lives.[12]

Arango et al. in the Coyoacan cohort, also used a CC less than 31 cm to estimate sarcopenia prevalence.[13] However, it is important to consider than anthropometrics such as CC are prone to error due to adipose deposits in muscle fibers and loss of skin elasticity in older adults, which can cause an underestimation in sarcopenia's prevalence in persons with obesity.[14]

Bioelectrical impedance analysis (BIA) is a reproducible method to measure body composition, and has been used to predict muscle mass decreases in older adults. However, there limitations, such as hydration state, inadequate protein ingestion and physical condition. Despite this, BIA could be a useful tool to measure muscular mass in the Mexican population, with a lower cost compared to imaging studies and a decrease in limitations compared to CC and grip strength in patients with obesity, depression or cognitive deterioration, which are common syndromes in the olderly.[15–17]

The objective of this study is to determine the relation between muscular mass measured by BIA and CC and grip strength in the older adult population of Northeastern Mexico.

Material and method

Design

This was a transversal study in Monterrey, Nuevo León between March 2013 and February 2014 in the ambulatory population of older adults that came to the Geriatric Services at the ''Dr. José Eleuterio González'' University Hospital of the Autonomous University of Nuevo León for their first consultation.

Population

A non-probabilistic sample was used for this study, included all patients which came for a consultation during the study's time period. The total sample size of those who came to their consultation between March 2013 and February 2014 was 283.

Out of these 283 patients, we selected 105 that met the inclusion criteria, which were: independet in their basic daily living activities, with Katz index $\geq$5. We excluded any patient with an articular prosthesis or osteosynthesis, use of pacemakers, hormone replacement therapy with androgens, growth hormone or steroid use in the past year and other chronic or acute severe comorbidity that cause cachexia (or secondary sarcopenia) due to the catabolic disease process itself, such as NYHAIII heart failure, chronic obstructive pulmonary disease GOLD C or D, chronic liver disease CHILD B or C and/or stage 5 chronic kidney disease (Terminal disease).

The study was approved by the Ethics and Research Committee of the ''Dr. José Eleuterio González'', University Hospital with the code number GE12-001.

Instruments

A routine clinical service case history, including relevant pathological history and clinimetry, composed of scales of function and cognitive status, was performed.

To evaluate the functionality, we used the Basic Activity of Daily Living Index, developed by Katz et al.[18] and Lawton-Brody's of Instrumental Activities of Daily Life Index.[19] To evaluate cognitive state, we applied the Mini-Mental State Examination (MMSE) developed by Folstein et al.[20] and the Geriatric Scale of Depression (GDS) by Yesavage et al.[21] was used to evaluate state of mind. The anthropometry was registered using weight, height, body mass index (BMI) and calf circumference (CC).

Grip strength of the dominant hand was determined with a Takei A5401 digital dynamometer (Medical Systems Plus Industry and Commerce Marketing Co. Ltd., Besiktas Istanbul, Turkey). This measurement was performed three times, with an interval of one minute between each measurement, and we used the average of the three results.

Body weight (kg) and height (cm) were measured using a scale with a stadiometer precision of 810–260 mm $\pm$ 0.1 cm (Holtain Ltd. Crosswell, Crymych Dyfed, UK) and CC was measured using a Rosscraft metallic measuring tape, with the patient lying down and their right leg flexed, with the measurement being performed at the biggest point of the calf.

Please cite this article in press as: Quiñonez-Olivas CG, et al. Muscle mass measured using bioelectrical impedance analysis, calf circumference and grip strength in older adults. Medicina Universitaria. 2016. http://dx.doi.org/10.1016/j.rmu.2016.06.005