Clinical Nutrition ESPEN xxx (2018) 1–4

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

The influence of 25-hydroxyvitamin D and High-Density Lipoprotein Cholesterol on BIA Resistance results and aging on BIA Reactance results in elderly people

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A R T I C L E I N F O

Article history:
Received 8 January 2018
Accepted 13 June 2018

Keywords:
Vitamin D
Aging
Bioelectrical impedance
BIA
25-hydroxyvitamin D
HDL-cholesterol

S U M M A R Y

Background & aims: The use of Bioimpedance (BIA) as a bedside method of evaluation of body composition increased in the last years. However there are still some questions about correct interpretation of the raw data, reactance and resistance, as measures of body composition. This study investigated the relationship of age, physical activity practice, Body Mass Index (BMI), 25-hydroxyvitamin D and serum lipoproteins in BIA data of resistance and reactance.
Methods: A transversal study was performed with elderly women who practiced regular physical activity (Group 1) and community dwelling elderly women (Group 2). Blood test, antrophometric measures and BIA exam were performed. As some studies had suggested, the ones with a BMI superior to 34 Kg/m^2 were excluded. Students T-test was applied to assess differences between both groups, and due to its results, it was performed a stepwise multiple regression analysis.
Results: The results of 320 elderly women with a BMI $\leq$34 Kg/m^2 (Group 1 = 225; Group 2 = 95) were analyzed. At the blood test, there was a statistically significant difference for total-cholesterol, LDL-cholesterol, High-Density Lipoprotein Cholesterol and 25-hydroxyvitamin D. We observed an increase of 0.42 OHMS in BIA Resistance for each increment of 1 nmol/dL of 25-hydroxyvitamin D ($p < 0.005$), and an increase of 1 mg/dL of High-Density Lipoprotein Cholesterol led to an increase of 0.655 OHMS in BIA Resistance ($p < 0.005$). Also, it was observed that an increment of 1 year old have showed a reduction of 0.038 OHMS in BIA Reactance ($p < 0.1$).
Conclusions: BIA Reactance was influenced by aging and BIA Resistance was influenced by High-Density Lipoprotein Cholesterol and 25-hydroxyvitamin D.

1. Introduction

The use of Bioimpedance (BIA) as a bedside method of evaluation of body composition increased in the last years [1], especially the use of BIA predictive equations to assess fat free mass. However there are still some questions about correct interpretation of the raw data, reactance and resistance, as measures of body composition [2].

Reactance is a measure of opposition to the flow of current caused by the capacitance produced by the cell membrane [3]; and since it is the effect on an electrical current caused by a material ability to store energy, the reactance is seen as a time delay between an applied electrical potential and a current. Meanwhile, the resistance is the ratio of electrical potential (voltage) to the current in a material, and it is a direct indicator of a material's propensity to dissipate energy [4]; this measure is the restriction of the flow of an electric current, and it is mainly related to the amount of water in the tissues [5].

Some factors can impact on BIA results: (1) contact between limbs and trunk, (2) Inaccurate body weight, (3) consumption of food and drink (overnight fast suggested), (4) moderate to intense

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https://doi.org/10.1016/j.clnesp.2018.06.003
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level physical activity 2–3 h before measurement, (5) medical conditions impacting fluid and electrolyte balance, (6) ambient temperature (cold increases impedance), (7) individual characteristics (abdominal obesity, muscle mass, weight loss, menstrual cycle, menopause), (8) ethnic variation, possibly mediated by body density and proportional limb length [6].

Considering the fact that variables as age, physical activity practice, body mass index (BMI), 25-hydroxyvitamin D (25 (OH) Vit D) and serum lipoproteins affect body composition and body fluids, and since there is a lack of studies correlating these variables with BIA Reactance and BIA Resistance, we have decided to examine the relationship between them and BIA data of resistance and reactance in a group of elderly women who had a regular physical activity practice and a group of elderly women who did not.

2. Materials and methods

The data of this transversal study came from elderly women who attended a local Physical Fitness Center in São Paulo, Brazil.

We divided the total sample in 2 groups according to the regular practice of physical activity. Group 1 was composed by elderly women who attended hydrogymnastic classes and physical fitness classes twice a week for 1 h; the physical education teachers, in charge of the classes, invited them to join our research. Group 2 was composed by community dwelling elderly women who were invited by the elderly women of Group 1. All of elderly women of Group 2 were independent for daily activities according to the Katz Index and lived in the same region as the elderly women of Group 1.

Inclusion criteria for Group 1 were attending the classes for at least 1 year, being 60 years old or more, having chronic disease under control or presenting an acute disease, not being enrolled in any hormonal therapy, and any changes in medicines prescription for at least one month. The attendance was assured by a strict system of control of absences in which after the third absence without a proper justification the individual has the attendance to the classes cancelled. The same inclusion criteria were applied for Group 2, except for the regular physical exercise practice.

The blood test was performed after 10–12 h of fasting. The cholesterol and triglycerides were tested by the method of Trinder, the HDL-cholesterol by colorimetric method and the Low-Density Lipoprotein (LDL-cholesterol) was calculated.

ATP III Guidelines [7] and Brazilian Dyslipidemia Guidelines [8] cutoffs for optimal Total-cholesterol (<200 mg/dL), LDL-cholesterol (<100 mg/dL) and HDL-cholesterol (≥60 mg/dL) were used for evaluation. Optimal triglycerides levels were considered <150 mg/dL that is the value suggested by Brazilian Cardiology Society [8]. The 25 (OH) Vit D levels cutoffs were from the US Institute of Medicine (IOM) [9] recommendations for 25 (OH) Vit D: serum 25 (OH) Vit D < 30 nmol/l is deficient, serum 25 (OH) Vit D of 30–50 nmol/l may be ‘inadequate’ in some people and serum 25 (OH) Vit D > 50 nmol/l is ‘sufficient’ for almost the whole population (97.5%). Only one measure of 25 (OH) Vit D was performed, but the measurement protocol was strictly followed to assure the most precise result.

Weight measurement was done using a Tanita® digital scale. We asked the elderly women to wear light clothes and to take off their shoes before stepping on the scale. Height was measured using a portable stadiometer. We asked the elderly women to stand erect against the wall, having the buttocks, scapulae, and head positioned in contact with the wall; their head was kept in the Frankfort Horizontal Plane position while the examiner lowered the stadiometer snugly to the crown of the head with sufficient pressure to compress the hair.

The Body Mass Index (BMI) was calculated through the formula weight (in kilograms) over the height squared (in centimeters). At first, we opted to use the cutoff points suggested by The Pan-American Health Organization (PAHO) for the SABE study [10] done with a Brazilian elderly population (BMI ≤ 23 Kg/m^2 = underweight, 23 Kg/m^2 < BMI > 28 Kg/m^2 = normal, 28 Kg/m^2 < BMI > 30 Kg/m^2 = overweight and BMI ≥ 30 Kg/m^2 = obesity) to evaluate and classify the elderly women. The preliminary results of the statistical analysis showed that it would be necessary to have more individuals in each BMI groups in order to have better results, so since many studies [11–17] and Brazilian Obesity Guidelines have concluded that the results of BIA are valid for individuals with a BMI ≤34 Kg/m^2 and that results from individuals with a BMI superior to this should be interpreted cautiously [18], we decided to exclude from analysis all the elderly women with a BMI > 34 Kg/m^2.

For the Bioimpedance (BIA) exam, we used a single-frequency Bioimpedance at 50 kHz. Before the exam, we asked all the participants to avoid eating or drinking anything for 4 h, to not drink alcoholic drinks for 48 h and not practice physical activities for 12 h before the test. The Bioimpedance was performed following the Bioimpedance analyzer protocol: the elderly women were instructed to remove from their body anything made of metal. After, they laid their back on a non-conductive surface and placed their head back; their feet were apart and we assured that their upper-inner thighs were not touching each other; also their hands were apart from the sides of their bodies. One pair of the sensor pads were placed on the right wrist and hand while the other pair was placed on the right foot and ankle.

Our study was approved by the Ethics Committee for Research of Federal University of São Paulo/São Paulo Hospital (CEP 1399/09) on October 23, 2009. All the participants have agreed to be part of this study.

Student's T-test was applied to assess the differences between the mean values of the variables: age, blood test, anthropometric measures and BIA results for BIA Reactance and BIA Resistance in Group 1 and 2. Because of the results of Student's T-test, a stepwise multiple regression analysis was applied using the variables age, 25 (OH) Vit D, HDL-cholesterol, LDL-cholesterol, physical activity and BMI group in order to estimate the relationship of these independent variables with BIA Reactance and BIA Resistance. Statistical significance was defined as a p value lower than 0.05.

3. Results

The size of the sample data was calculated using data from the Brazilian Institute of Statistic and Geography (Instituto Brasileiro de Geografia e Estatística, in Portuguese): number of elderly women aged 60–84 years old living in Sao Paulo City for the total universe value, a confidence interval of 95%, a width of confidence interval of 5% and an expected value of attribute of 50%. The calculated total was 385 people, in our research 456 elderly women, who had a regular physical activity practice for at least 1 year, were studied, but 74 were excluded due to incomplete data and 62 for having a BMI >34 Kg/m^2. In the end, we have analyzed the data from 320 elderly women classified as having a BMI ≤34 Kg/m^2 (Group 1 = 225, Group 2 = 95).

All the individuals presented optimal levels of lipid profile, but Group 1 had better levels of Total cholesterol, LDL-cholesterol and HDL-cholesterol compared to Group 2. On the other hand, both Groups presented unsatisfactory 25 (OH) Vit D levels. It was observed a statistically significant difference for total cholesterol, LDL-cholesterol, HDL-cholesterol and 25 (OH) Vit D while comparing both groups ($p < 0.05$) (Table 1).

In Table 2, we observed an increase of 0.42 OHMS in BIA Resistance for each increment of 1 nmol/dL of 25 (OH) Vit D ($p < 0.005$), and an increase of 1 mg/dL of HDL-cholesterol led to an increase of 0.655 OHMS in BIA Resistance results ($p < 0.005$).

Please cite this article in press as: Carvalho VA, et al., The influence of 25-hydroxyvitamin D and High-Density Lipoprotein Cholesterol on BIA Resistance results and aging on BIA Reactance results in elderly people, Clinical Nutrition ESPEN (2018), https://doi.org/10.1016/j.clnesp.2018.06.003