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Research paper

Systematic review: Prevalence of sarcopenia in ageing people using bioelectrical impedance analysis to assess muscle mass

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ABSTRACT

Objective: To examine the published scientific literature regarding the prevalence of sarcopenia in ageing people, with different diagnostic criteria, using bioelectrical impedance analysis (BIA) to assess the muscle mass.

Methods and material: A systematic review was carried out following the PRISMA Statement. Three online databases were searched during May 2015 using pre-defined search terms. Prevalence studies of sarcopenia in well-defined populations of adults ≥50 years, using BIA to measure body composition, were selected.

Results: Fifty-four articles were eligible for a full reading, and after a second round of exclusions a total of twelve studies met all the inclusion criteria. Eight were carried out in community-dwelling elderly people, two in nursing home residents, one in a convalescence and rehabilitation unit and one in hospitalized population. Five studies of sarcopenia's prevalence according to EWGSOP criteria were found, and in four of them the prevalence was higher in men. Prevalence of sarcopenia was higher in convalescence and rehabilitation units (77.6%), followed by elderly people living in nursing homes (32.8%).

Conclusions: Sarcopenia is highly prevalent in older individuals, especially in rehabilitation units. All the studies of prevalence carried out before the current sarcopenia consensus are studies to establish cutoff points of low muscle mass but they do not reflect sarcopenia's prevalence because they do not take into account muscle function.

1. Introduction

The term sarcopenia is derived from the Greek words 'sarx' (flesh) and 'penia' (loss). Dr. Rosenberg first introduced it in 1989 to describe the age-related decrease of muscle mass. However, the current definition of sarcopenia includes a loss of muscle strength and functional quality in addition to the loss of muscle mass [1–7].

The study of sarcopenia is very important due to its contribution to adverse outcomes in the elderly, such as poor quality of life, physical disability and risk of death [8–11].

The rate of sarcopenia continues to rise globally, which is probably as a result of the rise in ageing population all over the world, and in fact the conservative estimates based on the World Health Organization population counts suggest that more than 50 million people suffer from sarcopenia worldwide [12].

Reports have shown that a wide variation occurs in the prevalence of sarcopenia. This is dependent on the characteristics of the studied population (age, gender, comorbidity, race and differences in body composition across ethnic groups), but also depends on the methodology used to assess muscle mass and the definition of sarcopenia [13–18].

Over the last 20 years, several definitions and diagnostic criteria have been proposed to define sarcopenia [4,11,12] and until recently, there has been no widely accepted definition of sarcopenia and it was based mainly only on the criteria of low muscle mass [11,19–25].

However, in 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) provided a working definition for this condition [12]. They proposed that sarcopenia is diagnosed using the criteria of low muscle mass and low muscle function (either low strength and/or low physical performance).

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Apart from EWGSOP, several groups have published operational criteria to define sarcopenia [26], including: International Working Group (IWG) [27], Foundation for the National Institutes of Health (FNIH) [28], European Society for Clinical Nutrition and Metabolism Special Interest Group on cachexia-anorexia in chronic wasting diseases (ESPEN) [29], Society of Sarcopenia, Cachexia, and Wasting Disorders (SCWD) [30].

Although, the suggested techniques for the assessment of body composition in research are body-imaging techniques, computed tomography (CT) and magnetic resonance imaging (MRI) as the gold standards, the EWGSOP indicated that bioelectrical impedance analysis (BIA) is "a good, portable alternative" method. BIA is based on the measurement of tissue conductivity for the study of human body composition and has some advantages: it is a simple, portable, noninvasive, inexpensive method; it is easy to use, readily reproducible and appropriate for both ambulatory and bedridden patients, having found to have high concurrent validity in the estimation of muscle mass [31–35]. A possible limitation associated is that the hydration problems sometimes observed in older persons may result in an underestimation of the body fat and an overestimation of fat-free mass [10,25,36,37].

The aim of this systematic review was to examine the published scientific literature regarding the prevalence of sarcopenia in ageing people, with different diagnostic criteria, using BIA to assess the muscle mass.

2. Materials and methods

2.1. Search strategy

The search was carried out in three online databases, PubMed, Tripdatabase and Cochrane Plus in May 2015, initially with no restriction on year of publication.

The search limits established were: research on humans, in English, Spanish and French, and age group over 50 years, within the keywords in any field.

The pre-defined search terms were: "sarcopenia" or "muscle mass" and "aging" or "older people" or "elderly" and "prevalence" and "bioelectrical impedance" or "bioimpedance analysis".

This systematic review was carried out following the recommendations for reporting systematic reviews and meta-analyses of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (The PRISMA Statement) [38].

2.2. Eligibility criteria

Only studies published between January 2000 and May 2015, that enrolled participants aged 50 years and older, within well-defined populations (such us those in community-dwelling, nursing homes, convalescence and rehabilitation units, hospitals) were included. Eliminating duplicate documents refined the search. Within the search results obtained, manual searches were then carried out on the bibliographic references cited within the articles.

Subsequently, two authors screened all titles and abstracts of the remaining results independently, following the eligibility criteria. The inclusion criteria were: studies with participants older than 50 years; living at home, institutionalized or hospitalized, in which BIA was used to assess the participants' muscle mass; and exclusion criteria were: serious co-morbidities as cancer, obesity, stroke, or heart, renal, hepatic, cardiac or respiratory diseases, animal studies or those with a focus on genetics, biochemistry, biomarkers, or endocrinology. Moreover, reports, editorials and review articles were also excluded. The eligible articles were read in full and those that met all criteria were included.

2.3. Data extraction and quality evaluation

The retrieved studies were manually screened to assess their appropriateness for its inclusion. The bibliographies of all identified trials and review articles were reviewed to look for additional study of interest.

Two tables compiling the data presented in the selected studies were created. They included the following variables: author, year and study reference, country in which data were collected, type of population (community-dwelling older people, hospitalized older people, older people in nursing home and older people in convalescence and rehabilitation unit), sample size, population mean age (in years), BIA trademark, equation used to calculate muscle mass, criteria used to establish the diagnosis of sarcopenia, cut-off points of low muscle mass, and prevalence of sarcopenia (in percentage) for both genders and for the total population.

To assess the quality of the articles, we adopted the methodology proposed by Downs and Black [39], whose purpose is to guide auditors in identifying the methodological features of most relevant observational studies. The proposed score is composed of 27 questions that assess clarity of writing, external and internal validity, confounders and power of the study. This tool was adapted as described by Monteiro and Victora [40] because those criteria were originally designed for the evaluation of clinical trials being excluded four questions apply only to this type of study. Thus, the maximum possible score for each item was 24.

3. Results

With the search strategy, 2194 articles were identified, 2046 in PubMed and 148 in Tripdatabase. After reading all the titles and abstracts, 2140 were excluded, of which 1606 were off-topic, 124 were duplicates and 410 were exclude due to the type of study (clinical trials, review, meta-analysis). Fig. 1 shows a flow diagram for identification, screening, eligibility and inclusion of articles in this systematic review.

Fifty-four articles were eligible for a full reading, and after a second round of exclusions, the final sample size was of twelve articles (Tables 1 and 2). Critical appraisal of the studies included in our analysis revealed that they were of high quality. The main score of methodological quality was 18.3.

With regards to the characteristics of the articles, all the studies were performed on elderly populations living in several countries: seven of the studies were conducted in Europe, three were carried out in Asian populations and two in America. Ethnic origin of the patients was Caucasian, except for the studies carried out in Asia.

With regard to the type of population, eight were performed on community-dwelling elderly people, two of them were carried out on people living in a nursing home, and another one was conducted on a convalescence and rehabilitation unit. The last one was carried out on hospitalized people.

We have only find studies of prevalence of sarcopenia with BIA with EWGSOP criteria (we have found two studies with IWG criteria [41,42] and one with FNIH criteria [43] but in all cases with Dual-energy X-ray Absorptiometry (DXA), not with BIA).

With regard to the definition of sarcopenia, the eight studies of Table 1 only took into account the low muscle mass, comparing it with a young reference population and with different cut-off points, but not the muscle function.

In contrast, in Table 2 are included five studies using the EWGSOP criteria, taking into account the low muscle mass but also the low muscle strength or low physical performance. In EWGSOP consensus [12], low muscle mass is classified as the skeletal muscle index less than 8.87 and 6.42 kg/m^2 in men and women, respectively.