Experimental Gerontology 61 (2015) 31–37

Contents lists available at ScienceDirect

Experimental Gerontology

journal homepage: www.elsevier.com/locate/expgero

Estimation of sarcopenia prevalence using various assessment tools

C. Beaudart [a,b,*], J.Y. Reginster [a,b,c], J. Slomian [a,b], F. Buckinx [a,b], N. Dardenne [a,b], A. Quabron [a], C. Slangen [a], S. Gillain [d], J. Petermans [d], O. Bruyère [a,b,e]

[a] Department of Public Health, Epidemiology and Health Economics, University of Liège, Avenue de l'Hôpital 3, CHUB23, 4000 Liège, Belgium
[b] Support Unit in Epidemiology and Biostatistics, University of Liège, Belgium
[c] Bone, Cartilage and Muscle Metabolism Unit, CHU Liège, Quai Godefroid Kurth 45, 4000 Liège, Belgium
[d] Geriatric Department, CHU Liège, Rue de Gaillarmont 600, 4032 Chênée, Belgium
[e] Department of Motricity Sciences, University of Liège, Liège, Belgium

ARTICLE INFO

Article history:
Received 7 April 2014
Received in revised form 20 October 2014
Accepted 18 November 2014
Available online 20 November 2014

Section Editor: Christiaan Leeuwenburgh

Keywords:
Sarcopenia
Muscle mass
Prevalence
Diagnostic

ABSTRACT

Background: Sarcopenia is defined as a progressive and generalized loss of muscle mass with either a loss of muscle strength or a loss of physical performance but there is no recommendation regarding the diagnostic tools that have to be used. In this study, we compared the prevalence of sarcopenia assessed using different diagnostic tools.
Methods: To measure muscle mass, muscle strength and physical performance, we used for each outcome two different diagnostic tools. For muscle mass, we used Dual Energy X-Ray Absorptiometry (DXA) and bioelectrical impedance analysis (BIA); for muscle strength, we used a hydraulic dynamometer and a pneumatic dynamometer; for physical performance we used the Short Physical Performance Battery test (SPPB test) and the walk speed. Eight diagnostic groups were hereby established.
Results: A total of 250 consecutive subjects were recruited in an outpatient clinic in Liège, Belgium. Estimated prevalence of sarcopenia varied from 8.4% to 27.6% depending on the method of diagnosis used. Regarding muscle mass, BIA systematically overestimated muscle mass compared to DXA (mean estimated prevalence with BIA = 12.8%; mean prevalence with DXA = 21%). For muscle strength, the pneumatic dynamometer diagnosed twice more sarcopenic subjects than the hydraulic dynamometer (mean estimated prevalence with PD = 22.4%; mean estimated prevalence with HD = 11.4%). Finally, no difference in prevalence was observed when the walking speed or the SPPB test was used. A weak overall kappa coefficient was observed (0.53), suggesting that the 8 methods of diagnosis are moderately concordant.
Conclusion: Within the same definition of sarcopenia, prevalence of sarcopenia is highly dependent on the diagnostic tools used.

1. Introduction

Sarcopenia is an aging-related condition defined by a progressive and generalized loss of muscle mass and function (Baumgartner et al., 1998; Cooper et al., 2012). This geriatric syndrome, now recognized as a major clinical problem for older people, is an increasing public health issue in our society. Indeed, sarcopenia is associated with some adverse clinical outcomes such as physical impairment, limitation of mobility, decreased quality of life, increased risk of falls, hospitalization and mortality (Lauretani et al., 2003; Janssen, 2006; Visser et al., 2005; Janssen et al., 2002; Rantanen, 2003; Lang et al., 2010; Rizzoli et al., 2013) but also with major co-morbidities such as type 2 diabetes, obesity and osteoporosis (Sayer et al., 2005).

The definition of sarcopenia has been largely modified since the term "sarcopenia" was firstly introduced by Rosenberg in 1989 (Rosenberg, 1997). Originally, definitions of sarcopenia were based on decreased muscle mass only. Progressively, a qualitative dimension was added to focus on decreases in muscle strength and physical performance. These definitions have obviously a major impact on the assessment of the prevalence of the disease. Recently, Bijlsma et al. (Bijlsma et al., 2013) assessed the impact of these different definitions on the prevalence of sarcopenia and showed that it ranged from 0% to 45.2% depending on the definition used.

Recently the progress has been made in this field with the practical and consensual clinical definition of sarcopenia developed by the European Working Group on Sarcopenia in Older People (EWGSOP) (Cruz-Jentoft et al., 2010). According to this European consensual definition, sarcopenia is defined by the presence of low skeletal muscle mass and either low muscle strength or low muscle performance.

* Corresponding author at: Avenue de l'Hôpital 3, CHU B23, 4000 Liège, Belgium.
E-mail addresses: c.beaudart@ulg.ac.be (C. Beaudart), jyreginster@ulg.ac.be (J.Y. Reginster), jslomian@ulg.ac.be (J. Slomian), fanny.buckinx@ulg.ac.be (F. Buckinx), ndardenne@ulg.ac.be (N. Dardenne), a.quabron@student.ulg.ac.be (A. Quabron), catherine.slan@hotmail.com (C. Slangen), s.gillain@gmail.com (S. Gillain), jean.petermans@chu.ulg.ac.be (J. Petermans), olivier.bruyere@ulg.ac.be (O. Bruyère).

http://dx.doi.org/10.1016/j.exger.2014.11.014
0531-5565/

However, the EWGSOP does not recommend the use of specific tools to measure muscle mass, muscle strength and physical performance (Cooper et al., 2013). Indeed, the EWGSOP suggests two different methods to assess muscle mass in clinical practice (i.e. the Dual Energy X-Ray Absorptiometry (DXA) and the bio-electrical impedance analysis (BIA) but also two methods to assess the physical performance (i.e. the "Short Physical Performance Battery" test and the usual gait speed). The muscle strength is referenced to be assessed by the handgrip strength but no recommendation is given regarding the tools to be used for this measurement. However, the use of different diagnostic tools may lead to different prevalences of sarcopenia and may therefore have important consequences on clinical researches and development of therapeutic strategies. To our knowledge, no study has yet assessed the variation in prevalence of sarcopenia depending on the different tools used to measure the variables of muscle mass, muscle strength and physical performance. Therefore, through this cross-sectional study, we aim to assess the impact of the use of these different diagnostic tools on the estimated prevalence of sarcopenia.

2. Methods

2.1. Study population

Subjects were recruited consecutively in an outpatient clinic in Liège, Belgium in an osteoporotic and geriatric department but also by means of press advertisement. Volunteers had to be over 65 years old and had to read and sign an informed consent after being informed of the objectives and methods of the research. Subjects with an amputated limb, with a BMI above 50 kg/m^2 or wearing an electronic implant were excluded from the research.

The study was approved by the Ethics Committee of the University Teaching Hospital of Liège.

All subjects enrolled in this study were interviewed to gather their socio-demographic data and anamnesis. Anthropometric measurements (weight at the nearest 0.1 kg, height at the nearest 0.1 cm, calf, wrist and arm circumferences at the nearest 0.1 cm) as well as clinical measurements (walking speed, nutritional status with the "Mini-Nutritional Assessment", quality of life with the "Short-Form 36", cognitive status with the "Mini-Mental State Examination (MMSE)", depression with the "Geriatric Depression Scale", dependence in daily living activities with the "Lawton scale" and gait and body balance with the "Tinetti test") were also collected.

2.2. Diagnosis of sarcopenia

The definition of the EWGSOP was applied for this research (Cruz-Jentoft et al., 2010). According to these experts, sarcopenia diagnosis is based on the documentation of low muscle mass plus either low muscle strength or low physical performance.

Each variable was measured with 2 different tools, as presented in the following sections.

2.2.1. Assessment of appendicular muscle mass

We used the following two techniques to assess appendicular muscle mass.

Dual Energy X-Ray Absorptiometry (DXA) exams were performed with a Hologic Discovery A (Hologic, Inc., USA) device. This whole-body scan is able to distinguish fat, bone mineral and lean tissues and exposes the patient to minimal radiation. All evaluations were carried out by the same technician and the device was calibrated twice a week by scanning a spine phantom. Appendicular skeletal lean mass (ASM) was determined as the sum of the mass of the four limbs. Skeletal muscle mass index (SMI) was calculated by dividing appendicular lean mass by height squared. The cut-off informed by the EWGSOP group (Cruz-Jentoft et al., 2010) for the diagnosis of sarcopenia is fixed at 7.26 kg/m^2 for men and 5.5 kg/m^2 for women (Baumgartner et al., 1998). To find this cut-off, Baumgartner et al. (1998) developed in 1998 a population-based survey of 883 elderly subjects and compared results of body composition with a data set including 229 young subjects aged 18–40 years (Gallagher et al., 1997). They defined cut-off values for sarcopenia based on comparison of the distribution for muscle mass in young subjects versus elderly people. With this technique, they defined a SMI two standard deviations below the mean SMI of young male and female reference groups as the gender-specific cut-off point for sarcopenia. Sarcopenia, diagnosed using this approach, was significantly associated with disability and was independent of ethnicity, age, comorbidity, health behaviors and fat mass.

Bio-electrical impedance analysis (BIA) was performed with an InBody S10, Biospace device (Biospace Co., Ltd, Korea/Model JMW140). This non-invasive and easy to use method estimates the volume of fat and lean body mass based on the relationship between the volume of a conductor and its electrical resistance. Volunteers were seated on a chair and tactile electrodes were placed at 8 points on the body. All bio-electrical impedance analyses were carried out by the same technician. Cut-off criteria for sarcopenia, when using bio-electrical impedance analysis, were 8.87 kg/m^2 for men and 6.42 kg/m^2 for women (Chien et al., 2008), as recommended by the EWGSOP. These cut-offs were defined based on the comparison of a group of 302 individuals aged 65 years and older for the distribution of muscle mass with a group of 200 young subjects aged 18–40 years. Using a SMI of 2 standard deviations or more below the normal sex-specific means for young persons, they found a cut-off of 8.87 kg/m^2 for men and 6.42 kg/m^2 for women.

2.2.2. Assessment of muscle strength

We also used two types of dynamometer to assess handgrip strength, a pneumatic and a hydraulic dynamometer.

The hydraulic dynamometer used was a Hydraulic Hand Dynamometer, Saehan Corporation (MSD Europe Bvba, Belgium) and the pneumatic dynamometer used was a Squeeze Dynamometer, Saehan Corporation (MSD Europe Bvba, Belgium). Both dynamometers were calibrated for 10, 40 and 90 kg by the firm at the beginning of the recruitment period.

Subjects were asked to grip the two dynamometers as hard as they can three times with each hand. The maximum of the six measurements was recorded as the result, as recently recommended by Roberts (Roberts et al., 2011). We used the cut-off points for the diagnosis of sarcopenia, defined by the EWGSOP group (Cruz-Jentoft et al., 2010): 30 kg for men and 20 kg for women. These cut-offs were found by Lauretani et al. (2003) based on 1030 subjects aged 20–102 years. They found that 20 kg for women and 30 kg for men were the two thresholds that best discriminates subjects with mobility limitations. The EWGSOP also presented a BMI-dependant cut-off where cut-off points for subjects presenting a lower BMI are lower than those for subjects with a higher BMI (Fried et al., 2001). Given that the EWGSOP definition did not reach an international consensus regarding the cut-off to use for the diagnosis, we arbitrarily chose to use the cut-off of Lauretani et al. (2003).

2.2.3. Assessment of physical performance

We used the following two different methods to assess physical performance in our population, as recommended by the EWGSOP group.

The SPPB test is a composite of three separate tests: balance, 4-meter gait speed and chair stand tests. Each test is weighted equally with a score between 0 and 4 points. Sarcopenia diagnosis cut-off for this test, scored on 12 points, is below or equal to 8 points (Guralnik et al., 2000).

Usual gait speed was assessed by timing subjects asked to walk a 4-meter distance, at a comfortable speed. The cut-off point for a 4-meters course is set at 0.8 m/s (Lauretani et al., 2003). They chose this cut-off because, in their population of 1030 subjects aged 20–102 years, this