Experimental Gerontology 69 (2015) 27–35

Contents lists available at ScienceDirect

Experimental Gerontology

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

The role of muscle mass and body fat on disability among older adults: A cross-national analysis

Stefanos Tyrovolas [a,b,*], Ai Koyanagi [a,b], Beatriz Olaya [a,b], Jose Luis Ayuso-Mateos [b,c], Marta Miret [b,c], Somnath Chatterji [d], Beata Tobiasz-Adamczyk [e], Seppo Koskinen [f], Matilde Leonardi [g], Josep Maria Haro [a,b]

[a] Parc Sanitari Sant Joan de Déu, Universitat de Barcelona, Fundació Sant Joan de Déu, Dr Antoni Pujades, 42, 08830 Sant Boi de Llobregat, Barcelona, Spain
[b] Instituto de Salud Carlos III, Centro de Investigación Biomédica en Red de Salud Mental, CIBERSAM, Monforte de Lemos 3–5. Pabellón 11, 28029 Madrid, Spain
[c] Department of Psychiatry, Universidad Autónoma de Madrid, Instituto de Investigación Sanitaria Princesa (IP), Hospital Universitario la Princesa, Madrid, Spain
[d] Department of Health Statistics and Information Systems, World Health Organization, Geneva, Switzerland
[e] Department of Medical Sociology, Jagiellonian University Medical College, Krakow, Poland
[f] National Institute for Health and Welfare, Helsinki, Finland
[g] Neurology, Public Health and Disability Unit, Neurological Institute "Carlo Besta" Foundation IRCCS (Istituto di ricovero e cura a carattere scientifico), Milan, Italy

ARTICLE INFO

Article history:
Received 10 March 2015
Received in revised form 28 May 2015
Accepted 1 June 2015
Available online 3 June 2015

Section Editor: Holly M. Brown-Borg

Keywords:
Sarcopenia
Sarcopenic obesity
Disability
WHODAS 2.0
Older adults

ABSTRACT

Background: The aim of this study was to evaluate the association of sarcopenia and sarcopenic obesity with disability among older adults (≥65 years old) in nine high-, middle- and low-income countries from Asia, Africa, Europe, and Latin America.

Methods: Data were available for 53,289 people aged ≥ 18 years who participated in the Collaborative Research on Ageing in Europe (COURAGE) survey conducted in Finland, Poland, and Spain, and the WHO Study on global AGEing and adult health (SAGE) survey conducted in China, Ghana, India, Mexico, Russia, and South Africa, between 2007 and 2012. Skeletal muscle mass, skeletal muscle mass index, and percent body fat were calculated with specific population formulas. Sarcopenia and sarcopenic obesity were defined by specific cut-offs used in previous studies. Disability was assessed with the WHODAS 2.0 score (range 0–100) with higher scores corresponding to higher levels of disability. Multivariable linear regression analysis was conducted with disability as the outcome.

Results: The analytical sample consisted of 18,363 people (males; n = 8116, females; n = 10247) aged ≥65 years with mean (SD) age 72.9 (11.1) years. In the fully-adjusted overall analysis, sarcopenic obesity was associated with greater levels of disability [b-coefficient 3.01 (95% CI 1.14–4.88)]. In terms of country-wise analyses, sarcopenia was associated with higher WHODAS 2.0 scores in China [b-coefficient 4.56 (95% CI: 3.25–5.87)], Poland [b-coefficient 6.66 (95% CI: 2.17–11.14)], Russia [b-coefficient 5.60 (95% CI: 2.03–9.16)], and South Africa [b-coefficient 7.75 (95% CI: 1.56–13.94)].

Conclusions: Prevention of muscle mass decline may contribute to reducing the global burden of disability.

1. Introduction

Population aging is occurring at an unprecedented speed globally. It has been projected that between 1970 and 2025, a demographic growth of more than 200% is expected in the group of older adults (WHO, 2002). Advanced age is accompanied by various physiological changes, as well as with various co-morbidities (Sakuma and Yamaguchi, 2013; Cesari et al., 2009; Newman et al., 2006) that affect health status and quality of life (Janssen et al., 2002; Newman et al., 2003; Delmonico et al., 2007; Landi et al., 2013). This will unarguably affect population health as the result of rapid demographic changes. This aggregation of health risk factors and comorbidities is known to be related to the concept of disability in older adults (Stuck et al., 1999; Fried and Guralnik, 1997). Disability is a concept that encompasses impairments in body function as well as problems in task performance and social participation (Garin et al., 2014), and is strongly related to decrements in quality of life, higher health care service use, hospitalization, institutionalization (Guralnik et al., 1994; Branch and Jette, 1982), and mortality among older individuals (Forman-Hoffman et al., 2015).

Physiological changes associated with aging include body composition transitions such as the decrease in skeletal muscle mass (SMM) and increase in fat mass (Sakuma and Yamaguchi, 2013; Roubenoff, 2004). Studies have shown that SMM is the constituent of almost half of total body mass and that it plays an important role in body function, mobility, and various metabolic functions (Cesari et al., 2009; Newman et al., 2006). Moreover, the maintenance of SMM in older adults has been reported to be one of the most important factors for independent living (Cesari et al., 2009; Newman et al., 2006). Sarcopenia, which

* Corresponding author at: Parc Sanitari Sant Joan de Déu, Fundació Sant Joan de Déu, CIBERSAM, Dr. Antoni Pujadas, 42, 08830 Sant Boi de Llobregat, Barcelona, Spain.
E-mail address: s.tyrovolas@pssjd.org (S. Tyrovolas).

http://dx.doi.org/10.1016/j.exger.2015.06.002
0531-5565/

previously referred only to this muscle mass decline associated with aging, has more recently been redefined to integrate the concept of muscle strength (power) and physical performance (Alchin, 2014; Stenholm et al., 2008).

Sarcopenia is related with various adverse health outcomes such as mental disorders, poor quality of life, and mortality (Cesari et al., 2009; Newman et al., 2006; Hsu et al., 2014). A few studies focusing on limited aspects of disability have also found a relation between sarcopenia and disability. Specifically, compared to those without sarcopenia, a recent study reported that sarcopenic males have a three times greater likelihood of being physically disabled (Chien et al., 2010), while one of the first studies of its kind has shown that both genders have an almost four times greater likelihood of having physical disability (Baumgartner et al., 1998). Furthermore, sarcopenic obesity, which refers to the coexistence of sarcopenia and high accumulation of fat mass, may also be associated with disability, as previous studies have shown that obesity may cause disability mainly through the effects of cardiovascular diseases for which the obese are at higher risk (Goya Wannamethee et al., 2004). In addition, according to recent data, obesity and SMM act synergistically in the pathogenesis of chronic diseases (Dominguez and Barbagallo, 2007; Aubertin-Leheudre et al., 2006). However, to date, there have only been a few studies which specifically focus on the association between sarcopenic obesity and disability (Baumgartner et al., 1998; Levine and Crimmins, 2012).

According to the World Health Organisation (WHO), 15% of the global population is living with some form of disability, and this rate is expected to increase due to rapid aging occurring globally (WHO, 2011). This global increase in disability underlines the importance of planning preventive interventions to improve population well-being (Vos et al., 2012). However, although sarcopenia and sarcopenic obesity can theoretically lead to more disability and potentially be targets for preventive interventions (Cesari et al., 2014), little is known about the association of sarcopenia and sarcopenic obesity with disability in the older population, especially in low- or middle-income countries. The few studies which exist to date are from high-income countries which focus on limited aspects of disability and do not use a multidimensional measure to assess disability.

Thus, the aim of the present study was to evaluate the association of sarcopenia and sarcopenic obesity with disability, as well as to assess the effect of low SMM alone and the contribution of the addition of indicators of body fat, muscle strength, and physical performance on disability among older adults (≥65 years old) in nine high-, middle- and low-income countries from Asia, Africa, Europe, and Latin America. Indirect methods of assessment of SMM and body fat (i.e., with the use of anthropometric prediction models) were used. Although several direct methods [magnetic resonance imaging (MRI), computed axial tomography (CT), dual-energy X-ray absorptiometry (DXA), etc.] exist for the estimation of SMM and body fat, most of them are costly and some of them are impractical especially for population-based surveys. For these reasons, alternative indirect methods of SMM and body fat assessment have been proposed based on anthropometric indicators (Lee et al., 2000; Deurenberg et al., 2001). Although these indirect prediction models of SMM and body fat have not been tested in all ethnic groups and age groups, they have been shown to present good agreement with direct methods (Lee et al., 2000; Deurenberg et al., 2001). To measure disability, we used the WHODAS 2.0, which encompasses multiple domains of functioning, and is linked directly to the concepts of the International Classification of Functioning, Disability and Health (Üstün et al., 2010). We analyzed data from the Collaborative Research on Ageing in Europe (COURAGE) and the WHO Study on global AGEing and adult health (SAGE) surveys which are among the few large population-based nationally-representative health studies that used standard design and survey procedures across all countries.

2. Research design and methods

2.1. Materials and methods

2.1.1. The COURAGE and SAGE surveys

Data for the current analysis came from the COURAGE and SAGE surveys. The COURAGE (Finland, Poland, and Spain) was conducted between 2011 and 2012 while the SAGE (China, Ghana, India, Mexico, Russia, and South Africa) was undertaken between 2007 and 2010. The goal of these surveys was to create global comparable databases with information on health and well-being of adults. According to the World Bank classification at the time of the survey, the countries of COURAGE and SAGE surveys corresponded to high-, and middle-/low-income countries respectively (World Bank Group, 2015). The SAGE countries were selected to broadly represent different geographical locations and levels of socioeconomic and demographic transition.

In all countries, a multistage clustered sampling design was used to obtain nationally-representative samples. The sample consisted of adults aged ≥18 years with oversampling of those aged ≥50 years. Following a common research protocol across countries, trained interviewers collected information via face-to-face interviews and measurements. The questionnaires were translated from English into the local languages, following the WHO translation guidelines for assessment instruments which consist of a forward translation, a targeted back-translation, review by a bilingual expert group, and detailed translation reports. If the respondent was unable to undertake the interview due to limited cognitive function, a separate questionnaire was administered to a proxy respondent. Sampling weights were constructed to adjust for the population structure as reported by the National Institute of Statistics and the United Nations Statistical Division for the COURAGE and SAGE respectively. Ethical approval for the COURAGE and SAGE was obtained from the WHO Ethical Review Committee and local ethics research review boards. The survey response rate ranged from 51% (Mexico) to 93% (China). Further details of the survey methodology have been published elsewhere (Tyrovolas et al., 2015a, 2015b; Kowal et al., 2012).

2.1.2. Measurements

A stadiometer and a routinely calibrated electronic weighting scale were used to measure height and weight respectively. Using standard protocols, blood pressure was measured two and three times in the COURAGE and SAGE respectively with a less than one-minute interval. Grip strength was measured twice for both hands in the SAGE and only for the dominant hand in the COURAGE. If the participant had any surgery in the last three months or arthritis or pain in the hand, grip strength was not measured for that hand. Gait speed was based on a 4-m timed walk. The participant was asked to walk at a rapid pace, as fast as he/she safely can and the use of a cane or other walking aids was allowed. The time to completion of the 4-m walk was recorded by the interviewer.

2.1.3. Functioning and disability

Functioning and disability were assessed by the use of the 12-item validated version of the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) (Üstün et al., 2010). The WHODAS 2.0 is a tool to identify standardized disability levels and it may be used across all diseases including mental disorders. It is applicable in both clinical and community-based settings, different cultures, and all adults. It is linked directly to the concepts of the International Classification of Functioning, Disability and Health (Üstün et al., 2010). Details of this instrument may be found in http://www.who.int/classifications/icf/whodasii/en/. The WHODAS 2.0 score was obtained by assessing six domains: cognition, mobility, self-care, getting along, life activities, and participation. The answer options to the questions on the level of difficulty that the participant had in conducting these activities in the past-30 days were none (1), mild (2), moderate (3), severe (4), and