Prevalence of sarcopenia and its association with activities of daily living among Japanese nursing home residents

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ARTICLE INFO

Article history:
Received 18 January 2018
Received in revised form 15 February 2018
Accepted 19 February 2018
Available online

Keywords:
Sarcopenia
Nursing home
Activities of daily living

ABSTRACT

Sarcopenia is an important predictor of adverse outcomes in elderly people. Based on a common clinical experience, sarcopenia may be associated with activities of daily living (ADL). To our knowledge, no study has investigated the association between sarcopenia and ADL in nursing home residents requiring long-term care. This cross-sectional study included 250 nursing home residents. Nutritional status, physical function, ADL and cognitive function were assessed using Mini Nutritional Assessment-Short Form (MNA-SF), Short Physical Performance Battery (SPPB), Barthel Index (BI) and Mini-Mental State Examination (MMSE). To examine the factors that may affect self-care capacity, a stepwise multiple linear regression analysis was performed. The prevalence of sarcopenia was 45.2%. Age, MMSE, MNA-SF, SPPB, and grip strength were independently associated with BI. A high prevalence of sarcopenia was observed among nursing home residents in Japan. However, sarcopenia was not associated with ADL.

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Introduction

Sarcopenia is defined as the age-related decrease in muscle mass. Over the last decade, this definition has evolved, and a qualitative dimension was added to focus on decreases in muscle strength and function. Sarcopenia is a well-defined common feature of aging that affects the quality of life and socioeconomic status of individuals, with an estimated direct health care cost of $18.5 billion in the United States in 2000. The prevalence of sarcopenia increases exponentially with age, from 9.6% at 65 years, 25.9% at 75 years, and 48.6% at 85 years. Different studies showed that 5–13% of individuals aged 60 years and over have low muscle mass, with an increased prevalence as high as 50% in individuals over the age of 80 years in different settings and countries. Few studies have included institutionalized older adults, with the reported sarcopenia prevalence being between 17.7% and 85.4%. Sarcopenia is an important predictor of adverse outcomes in elderly people. Previous studies have shown that sarcopenia was associated with decline in physical function and increased risk of fall in community-dwelling older adults. In addition, sarcopenia was an independent risk factor for fracture. Based on a common clinical experience, sarcopenia may be associated with activities of daily living (ADL). To our knowledge, no study has investigated the association between sarcopenia and ADL in nursing home residents requiring long-term care. We hypothesized that sarcopenia affects the overall ability to engage in ADL in nursing home residents requiring long-term care. The present study aimed to assess the association between sarcopenia and ADL in nursing home residents who require long-term care.

Methods

Study population

This cross-sectional study was carried out among 288 residents who were eligible to receive long-term care insurance in three nursing homes in two different cities. Inclusion criteria for the participants were (1) institutionalized older adults who were eligible to receive long-term care insurance and (2) age ≥65 years. Exclusion criteria for the participants were (1) refusal to participate or proxy, (2) age <65 years or (3) temporarily residency in nursing homes, that is, for short-term rehabilitation. This study was in accordance with the Declaration of Helsinki, and informed consent was obtained from all participants.

0197-4572/8 — see front matter © 2018 Elsevier Inc. All rights reserved.
https://doi.org/10.1016/j.gerinurse.2018.02.011
Methods of investigation

All measurements were carried out by specially trained physical therapists. Health status was assessed by reviewing the medical records of nursing home residents with hip fracture, dementia, cerebrovascular disease, hypertension, cancer, diabetes, osteoarthritis, congestive heart failure, depression, and Parkinson disease. Height was measured to the nearest 1 mm and estimated from knee height. Weight was measured using a weighing scale (PW-650A, Tanita, Tokyo, Japan). Body mass index (BMI) (kg/m²) was calculated using the weight and height measurements.

Nutritional status was assessed using the Mini Nutritional Assessment Short Form (MNA-SF), which includes an alternative to calf circumference (CC) measurement when the BMI measurement cannot be used for participants who are bedridden and immobile. The MNA-SF can be completed in less than 10 min. Each answer has a numerical value and contributes to the final maximum score of 14. Threshold values that have been established for the frail elderly population in Japan are as follows: a score of 12 indicates that the participants are well nourished, a score of 8–11 indicates a risk for malnutrition, and a score < 8 indicates malnutrition. Cognitive function was assessed using the Mini Mental State Examination (MMSE). MMSE scores range from 0 to 30, with lower scores indicating a more severe impairment in the cognitive domains (orientation, memory, attention, and executive functions). Physical function was assessed using the Short Physical Performance Battery (SPPB), a well-established, reliable, and valid tool that is used to measure functional status. Testing involves the assessment of balance while standing, a timed 4-meters walking test, and a timed test of 5 repetitions of rising from a chair and sitting down. All times are measured to the nearest 0.01 seconds using a stopwatch. Each test is scored between 0 and 4, and the scores are combined with a maximum score of 12. Higher scores represent better functioning. SPPB scores can predict disability within 1–6 years in several older individuals. ADL was assessed using the Barthel Index (BI), which covers all the aspects of self-care independence in ADL, such as transfer, walking, the use of stairs and bathing. A total score of 100 points indicates complete self-sufficiency, whereas a score of zero indicates complete dependence.

Assessment of sarcopenia

The present study followed the criteria of the Asian Working Group for Sarcopenia (AWGS). According to their recommendation, the diagnosis of sarcopenia in the present study required the documentation of low muscle mass and either low muscle strength or low physical performance.

Muscle mass was measured via near-infrared spectroscopy (NIRS Fitness Analyzer BFT-3000, Kett Electric Laboratory, Tokyo, Japan). This device uses optical densities (OD) at two wavelengths (OD1 = 937 nm and OD2 = 947 nm) measured at each site. The NIRS instrument was tested immediately before taking measurements on each participant by using an optical standard, in which an instrument was provided and placed in a flexible light shield, to ensure the consistency of its performance throughout the study. OD values were obtained at the distal biceps (5 cm from the olecranon). NIRS demonstrated reliability and validity. For example, Josse et al. have reported that the correlation coefficient between fat mass, as predicted by the Fourier transformed NIRS method and dual energy X-ray absorptiometry (DXA) was 0.95 (p < 0.001). Muscle mass was calculated using the NIRS protocol described by Yoshida and colleagues:

Appendicular muscle mass (kg) = \[0.17 \times \text{height} + (0.17 \times \text{weight}) + (8.45 \times \text{OD1}) - 28.97\]

where height is measured in cm, weight is measured in kg, and OD1 is measured in NIRS. Absolute skeletal muscle mass was converted to skeletal muscle index (SMI) by dividing height by meters squared (kg/m²). Using the cutoff points indicated in the AWGS consensus paper, low muscle mass was classified as a skeletal muscle index that is less than 7.0 kg/m² and 5.4 kg/m² in men and women, respectively.

Muscle strength was assessed by hand grip strength, which is measured using a mechanical hand dynamometer (model TKK5001; Takei Scientific Instruments Co., Ltd., Niigata, Japan). Two trials for each hand were performed, and the result from the strongest hand was used in the present analyses. When the cutoff points indicated in the AWGS consensus paper were used, low muscle strength was classified as hand grip that is less than 26 kg and 18 kg in men and women, respectively.

Physical performance was assessed via a 4-meters walking test. Walking speed was evaluated by measuring the participants’ usual gait speed (m/s) over a 4-m course. A cutoff point of more than 0.8 m/s was used to identify participants with low physical performance. Calf circumference (CC) was measured using a measuring tape.

Statistical analysis

Data are presented as mean and standard deviation (SD). All statistical analyses were conducted by using EZR (version 1.35; Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (R Foundation for Statistical Computing, Vienna, Austria). More precisely, it is a modified version of R commander (version 2.3.0), which is designed to add statistical functions frequently used in biostatistics.

Differences in the demographic information and variables between the 2 groups were analyzed using the unpaired t-test and \( \chi^2 \) test. The relationship between sarcopenia and clinical and functional variables was estimated by obtaining odds ratios (ORs) from stepwise multiple logistic regression models. Sarcopenia identified by the AWGS algorithm was included as a dependent variable in such models. Based on previous studies, factors, such as age, gender, ADL (BI score), cognitive performance (MMSE score), nutritional status (MNA-SF score), the number of medications, BMI, diagnosis of hip fracture, and specific diseases (dementia, cerebrovascular diseases, hypertension, cancer, diabetes, osteoarthritis, congestive heart failure, depression, and Parkinson’s disease), are potentially associated with sarcopenia. These factors are considered as independent variables in the models. To evaluate the goodness-of-fit of the regression equations to the data, Akaike information criterion (AIC) was used for model selection. To examine the factors that may affect self-care capacity, we performed stepwise multiple linear regression analysis. The coefficient of determination was used to examine the fitness of the model. Variance inflation factor (VIF) was used to check for multicollinearity. The significance level of p < 0.05 was determined a priori.
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