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Sarcopenia and falls in community-dwelling elderly subjects in Japan: Defining sarcopenia according to criteria of the European Working Group on Sarcopenia in Older People

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ABSTRACT

This study assessed the association between sarcopenia (using the definition of the European Working Group on Sarcopenia in Older People) and fall in the past year among community-dwelling Japanese elderly. Subjects were 1110 community-dwelling Japanese aged 65 or older. We used bioelectrical impedance analysis (BIA) to measure muscle mass, grip strength to measure muscle strength, and usual walking speed to measure physical performance in a baseline study. "Sarcopenia" was characterized by low muscle mass and low muscle strength or low physical performance. "Presarcopenia" was characterized only by low muscle mass. Subjects who did not have any of these deficiencies were classified as "normal." We then administered a questionnaire assessing age, sex, household status, chronic illness, lifestyle-related habits, and fall. This study showed the prevalence of fall was 16.9% and 21.3% in men and women, respectively, while that of sarcopenia was 13.4% and 14.9% in men and women, respectively. In men and women, the prevalence of sarcopenia was higher among those who had fallen. A logistic regression analysis using age, body fat, current drinker status, and physical inactivity for men, and age, body fat, smoking, and diabetes for women as covariate variables revealed that sarcopenia was significantly associated with a history of fall. The odds ratio for fall in the sarcopenia group relative to the normal group was 4.42 (95%CI 2.08–9.39) in men and 2.34 (95%CI 1.39–3.94) in women. This study revealed sarcopenia to be associated with falling in elderly Japanese. Sarcopenia prevention interventions may help prevent falls among elderly individuals.

1. Introduction

Sarcopenia is defined as the loss of muscle mass and strength that occurs with advancing age. There is growing evidence that sarcopenia contributes to functional disability in elderly individuals (Baumgartner et al., 1998; Lima et al., 2009; Rolland et al., 2008; Tanimoto et al., 2012a, 2012b, 2013). Sarcopenia is also considered one of the most important public health concerns, especially in industrialized countries (Lynch, 2004).

The Japanese population has the highest worldwide life expectancy (2012: 79.9 years in men and 86.4 years in women) and the highest population proportion of people above the age of 65 (24.1% in 2012). The number of people who require long-term care insurance due to disability, and subsequently require support for their activities of daily living (ADL) has increased about 2.5 times over the past 10 years (Ministry of Health, 2013). The key causes for long-term care insurance use amongst the Japanese elderly are fall and fall-related fractures.

Fall are a common event among older adults, and falling is the leading cause of severe injuries, such as hip fractures, in older people (Edwards et al., 2013). A study of 2299 residents in Hertfordshire, UK, showed that a history of any type of fall from the age of 45 onwards resulted in an unadjusted fracture hazard ratio of 7.31 (95% CI; 3.78–14.14) and 8.56 (95% CI; 4.85–15.13) in men and women, respectively. For older community residents, effective fall prevention may potentially reduce serious fall-related injuries. Reducing fall risk in older individuals is, therefore, an important public health objective.

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According to a study of 883 elderly individuals in New Mexico, sarcopenia was defined as appendicular skeletal muscle mass/height that is less than two standard deviations below the mean of the young reference group (Lima et al., 2009). In men, sarcopenia was significantly associated with falling during the past year (odds ratio [OR] 2.58, 95% CI: 1.42–4.73) (Baumgartner et al., 1998). Sarcopenia has been defined by not only deficits in muscle mass but also impaired muscle strength and physical performance by the European Working Group on Sarcopenia in Older People (EWGSOP; Cruz-Jentoft et al., 2010); using these criteria, a study examined 260 individuals aged 80 years or older in Italy, and found that sarcopenic individuals had a high risk of fall incidents compared with non-sarcopenic individuals (adjusted HR, 3.23; 95%CI, 1.25–8.29; Landi et al., 2012). Nevertheless, there are still few reports on the topic of sarcopenia defined by EWGSOP and fall in an elderly population. Furthermore, muscle mass and incidence of fall may be related to ethnicity; therefore, the temporal relationship between sarcopenia and falling in a Japanese population requires examination (Berg et al., 1997).

The purpose of the present study was to determine the association between sarcopenia—as defined by muscle mass, muscle strength, and physical performance—with fall in community-dwelling elderly in Japan.

2. Methods

2.1. Subjects

Takatsuki City is home to 80 695 individuals aged 65 or older; the proportion of the elderly in the population is 22.5%. Takatsuki City is a metropolitan suburb in the north of Osaka Prefecture, where welfare centers for the aged and community centers are the main organizations providing social support to community-dwelling elderly people. All participants were recruited through local newspapers, and through the local welfare commissioner. A total of 1120 elderly subjects aged 65 years or older who had registered at or used the community welfare centers were entered into the study. Subjects wearing a pacemaker ($n = 5$) were excluded because BIA could not have been conducted; subjects with incomplete data ($n = 5$) were also excluded from the analysis. Thus, 1110 elderly subjects (372 men and 738 women) were included in the final analysis. All measurements were performed at the welfare and community centers from May to June in 2006, 2007, and 2009. This study was approved by the Osaka Medical College ethics committee. All subjects provided their written informed consent.

2.2. Muscle mass measurements

Muscle mass was measured through BIA, using the Body Composition Analyzer MC-190 (Tanita Corp., Tokyo, Japan) (Nemoto et al., 2012; Tanimoto et al., 2012a). This system applies electricity at frequencies of 5, 50, 250, and 500 kHz throughout the body. Whole-body impedance was measured using an ipsilateral foot-hand electrical pathway. The recommended BIA measurement conditions were explained to the subjects: (1) fasting for 4 h and no alcohol for 8 h before measurement; (2) bladder voided before measurement; and (3) no exercise in the 8 h prior to measurement (Gibson et al., 2004; Kyle et al., 2004a). Appendicular muscle mass (AMM) was derived as the sum of the muscle mass of the arms and the legs. Absolute AMM was converted to an appendicular muscle mass index (AMI) by dividing it by height in meters squared (kg/m^2) (Baumgartner et al., 1998; Delmonico et al., 2009). Low muscle mass was defined as an AMI that was greater than 2 SD below that of young adult values. These classification criteria were based on previously published studies (Baumgartner et al., 1998; Janssen et al., 2002). To establish the normal AMI range, 1719 young, healthy Japanese volunteers, aged 18–39, were recruited from public facilities, universities, and companies (Tanimoto et al., 2012a). From these data, we categorized low muscle mass as AMI <7.0 kg/m^2 in men, and <5.8 kg/m^2 in women.

2.3. Muscle strength measurement

Muscle strength was assessed through grip strength, which was measured using a grip strength dynamometer (Takei Scientific Instruments, Niigata, Japan) (Cruz-Jentoft et al., 2010). One trial for each hand was performed, and the result from the strongest hand was used for this analysis. The lowest grip strength quartile was classified as low muscle strength. We used the findings from our study as reference values, because at present there is no reference cut-off value for grip strength to diagnose sarcopenia in Japan.

2.4. Physical performance measurement

Physical performance was assessed through usual walking speed. Participants were asked to walk straight for 11 m at their usual speed. Usual walking speed was derived from the middle 5 m. The slowest usual walking speed quartile was classified as having slow walking speed. We used the findings from our study as reference values, because at present there is no reference cut-off value for usual walking speed to diagnose sarcopenia in Japan.

2.5. Sarcopenia classification

Subjects were classified as having sarcopenia based on muscle mass, muscle strength, and physical performance. This classification is based on recommendations by EWGSOP (Cruz-Jentoft et al., 2010). "Sarcopenia" was characterized by low muscle mass and low muscle strength or low physical performance. "Severe sarcopenia" was characterized by all three conditions. "Presarcopenia" was characterized by only low muscle mass. Subjects who did not have any of these deficiencies were classified as "normal." In addition, subjects were classified as having "low strength or performance" if they had low muscle strength and/or low physical performance.

2.6. Questionnaire assessment

Participants were mailed a self-reported questionnaire in advance. We collected these after confirming that all questions had been answered at the time of anthropometric measurement administration. The questionnaire assessed the following demographic attributes: age, sex, household status (whether participants were living alone or not), chronic illness (hypertension, diabetes, and hyperlipidemia), lifestyle-related habits (current drinker status, current smoker status, and exercise status), and fall. Drinker and smoker statuses were categorized into two groups: current vs. past, and never drinker/smoker. Exercise status was also divided into two groups: three or more episodes per week (indicating "physical activity") and less than three episodes of exercise per week labeled as "physical inactivity." Fall were defined as when subjects unintentionally change in position causing an individual to land or on some other lower level, not as a result of a major intrinsic event or overwhelming external force. Self-reported fall during the year preceding the measurements was evaluated as a part of the *kaigo-yobo* (care prevention) checklist that reliability and validity were established (Murayama et al., 2012; Shinkai et al., 2010, 2013).