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Original article

Sarcopenia as a risk factor for falls in elderly individuals: Results from the ilSIRENTE study

Francesco Landi [a,*], Rosa Liperoti [a], Andrea Russo [a], Silvia Giovannini [a], Matteo Tosato [a], Ettore Capoluongo [b], Roberto Bernabei [a], Graziano Onder [a]

[a] Department of Gerontology and Geriatrics, Catholic University of Sacred Heart, Roma, Italy
[b] Institute of Biochemistry and Clinical Biochemistry, Catholic University of Sacred Heart, Roma, Italy

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SUMMARY

Background & aims: Sarcopenia has been indicated as a reliable marker of frailty and poor prognosis among the oldest individuals. We evaluated the relationship between sarcopenia and 2-year risk of falls in a population of persons aged 80 years or older.

Methods: Data are from the baseline and follow-up evaluations of the Aging and Longevity Study in the Sirente Geographic Area (ilSIRENTE Study) ($n = 260$). According to the European Working Group on Sarcopenia in Older People (EWGSOP), sarcopenia was diagnosed in presence of low muscle mass (mid-arm muscle circumference) plus either low muscle strength (hand grip) or low physical performance (4-m walking speed). The primary outcome measure was the incident falls during the follow-up period of 2 years. The relationship between sarcopenia and incident falls was estimated by deriving hazard ratios (HRs) from multiple logistic regression models considering the dependent variable of interest at least one fall during the follow-up period.

Results: Sixty-six participants (25.4%) were identified as affected by sarcopenia. Eighteen out of 66 (27.3%) participants with sarcopenia and 19 out of 194 (9.8%) without sarcopenia reported incident falls during the two-year follow-up of the study ($p < 0.001$). After adjusting for age, gender, cognitive impairment, ADL impairment, sensory impairments, BMI, depression, physical activity, cholesterol, stroke, diabetes, number of medications, and C-reactive protein, participants with sarcopenia had a higher risk of incident falls compared with non sarcopenic subjects (adjusted hazard ratio [HR], 3.23; 95% confidence interval [CI], 1.25–8.29).

Conclusions: The present study suggests that sarcopenia – assessed using the EWGSOP algorithm – is highly prevalent among elderly persons without gender differences (25%). Sarcopenic participants were over three times more likely to fall during a follow-up period of 2 years relative to non sarcopenic individuals, regardless of age, gender and other confounding factors.

1. Introduction

Falls and their related injuries represent one major health care issue in the elderly population. Falls are a common event among older adults and are associated with increased morbidity and disability.[1] The prevalence of falls in older community-dwelling elderly individuals is approximately 30%[2] and such estimate increases to 40% among the "oldest-old".[3] Moreover, older individuals have a high susceptibility to fall-related injuries.[4] It has been estimated that, in such population, two-thirds of the death from unintentional injuries are related to a fall event.[5] Due to their high frequency and to their serious consequences on health and functional status, falls contribute substantially to the health care expenditure for elderly individuals. According to recent studies, about 6% of all medical expenditures for elderly persons in the United States are due to fall-related injuries.[5] Hospitalization is needed in 5% of elderly people who fall.[5,6]

Falls have many different causes. Several risk factors that predispose elderly individuals to falls have been identified. Risk factors can be classified as either intrinsic or extrinsic.[7] The first category includes factors related to functional and health status (e.g., functional impairment, balance disorders); the second category includes adverse drug reactions, prostheses, use of restraints and environmental factors (e.g., poor lighting or lack of bathroom safety equipment).

* Corresponding author. Centro Medicina dell'Invecchiamento (CEMI), Istituto di Medicina Interna e Geriatria, Università Cattolica del Sacro Cuore, Largo Agostino Gemelli 8, 00168 Roma, Italy. Tel.: +39 06 3388546; fax: +39 06 3051911.
E-mail address: francesco_landi@rm.unicatt.it (F. Landi).

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Sarcopenia is a condition characterized by loss of muscle mass and strength and decreased physical performance. It may represent an important risk factor for falls. In fact, sarcopenia has been associated with poor endurance, physical inactivity, slow gait speed and decreased mobility. These factors represent common features of the frailty syndrome and may contribute to an increased risk of falling.[8,9]

To date, information on the association between sarcopenia and falls is limited. Also the underlying mechanisms of such association have yet to be clarified. In the present study, we estimated the effect of sarcopenia on increasing the 2-years risk of falls in a population of community-dwelling individuals aged 80 years or older enrolled in the "Invecchiamento e Longevità nel Sirente" (Aging and longevity in the Sirente geographic area, ilSIRENTE Study) study.

2. Methods

We used data from the *il*SIRENTE, a prospective cohort study conducted in the mountain community living in the Sirente geographic area (L'Aquila, Italy) and developed by the teaching nursing home Opera Santa Maria della Pace (Fontecchio, L'Aquila, Italy) in a partnership with local administrators and primary care physicians. The Catholic University of Sacred Heart ethical committee ratified the entire study protocol. All the participants signed an informed consent at the baseline visit. The *il*SIRENTE study protocol is described in details elsewhere.[10]

2.1. Study population

A preliminary list of all persons living in this well-defined area was obtained at the end of October 2003 from the Registry Offices of the 13 municipalities involved in the study. From this preliminary list, potential study participants were identified by selecting all persons born in the Sirente area before 1st January 1924 and actually living in such area (inclusion criteria). No exclusion criteria were applied. General practitioners presented the *il*SIRENTE study protocol to their clients, inviting them to participate to the study. Persons who refused to be enrolled were contacted at least two additional times by the study personnel before being considered as refusals. Of the initial 514 subjects screened, 32 men and 53 women died or moved away from the area before the baseline assessment. Among those eligible ($n = 429$), prevalence of refusals was very low (16%), without significant differences across age or gender groups.

The resulting sample included 364 participants; ninety-nine of them were lost to follow-up (including 90 individuals who died during the follow-up period and 9 individuals who left the study area). The present analysis was conducted on 260 individuals, after excluding 5 additional participants with missing data respect to the main variables of interest (Fig. 1).

2.2. Data collection

Participants' baseline assessments began in December 2003 and were completed in September 2004. Assessors were trained on how to perform each component of the *ilSIRENTE* study protocol.[10] The Minimum Data Set for Home Care (MDS-HC) form was administered to all study participants according to the guidelines published in the MDS-HC manual.[11] The MDS-HC contains over 350 data elements including socio-demographics, physical and cognitive status variables, as well as major clinical diagnoses.[11] Moreover, the MDS-HC includes information on an extensive array of signs, symptoms, syndromes and treatments.[11] The MDS items have shown an excellent inter-rater and test–retest reliability when completed by nurses performing usual assessment duties (average weighted Kappa = 0.8).[12] Additional information on family history, lifestyle, physical activity and behavioral factors were collected using specific questionnaires shared with the "Invecchiare in Chianti Study".[13]

2.3. Assessment of incident falls

History of fall was assessed by a multidisciplinary team of professionals (general practitioner, nurses, and geriatrician) using the MDS-HC instrument. The assessors were instructed to ask simple and direct questions about whether the patients experienced falls. Participants (or proxy) were asked to report any fall event they had experienced during the follow-up period of 2 years. According to the MDS-HC manual,[14] the "fall event" was considered to be a sudden loss of balance causing the contact of any part of the body above the feet with the floor. Independent, dual assessment of falls in a diverse sample of nursing home patients during the testing and revision of the MDS showed that the inter-rater reliability for fall assessment was excellent (weighted kappa correlation coefficient = 0.90).[11,15]

2.4. Assessment of sarcopenia

For the present study we adopted the European Working Group on Sarcopenia in Older People (EWGSOP) criteria.[16] The EWGSOP recommends using the presence of both low muscle function (strength or performance) and low muscle mass for the diagnosis of sarcopenia. Thus, diagnosis of sarcopenia in the present study sample required the documentation of low muscle mass plus the documentation of either low muscle strength or low physical performance.

2.4.1. Muscle mass assessment – mid-arm muscle circumference

The muscle mass was measured by the mid-arm muscle circumference (MAMC). The MAMC was calculated using the following standard formula[17]:

$$\text{MAMC} = \text{mid} - \text{arm circumference} - (3.14 \times \text{triceps skinfold thickness})$$

Measurement of triceps skinfold thickness (to the nearest 0.2 mm) was made using Harpenden skinfold caliper (range: 0.00–50.00 mm; minimum graduation: 0.20 mm). Mid-arm circumference (to the nearest 0.1 cm) was made using a flexible steel measuring tape, on the right side of the participant's body unless affected by disability or disease. For both these two variables the average of three measurements was computed. In a previous study,[17] the MAMC measure has shown an excellent reliability when performed by expert personnel. In the absence of reliable cut-off points, we considered the MAMC tertile previously calculated.[18] The lower tertile identified the subjects with low muscle mass. As consequence, low muscle mass was classified as MAMC less than 21.1 cm and 19.2 cm in men and women, respectively.[18]

2.4.2. Physical performance assessment – 4-m walking test

Walking speed was evaluated measuring participants' usual gait speed (in m/sec) over a 4-m course. As suggested in the EWGSOP consensus paper,[16] a cut-off point of <0.8 m/s identifies subjects with low physical performance. This cut-off point was similar to that obtained among 469 men and 561 women (age range from 20 to 102 years) from the InCHIANTI study population.[19]

2.4.3. Muscle strength measure – hand grip

Muscle strength was assessed by hand grip strength which was measured using a dynamometer (North Coast Hydraulic Hand Dynamometer, North Coast Medical Inc, Morgan Hill, CA, USA). One