Clinical Nutrition xxx (2015) 1–8

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu

Original article

Nutritional status, body composition, and quality of life in community-dwelling sarcopenic and non-sarcopenic older adults: A case-control study

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ARTICLE INFO

Article history:
Received 22 September 2015
Accepted 22 November 2015

Keywords:
Protein
Micronutrient
Frailty
Observational
Sarcopenia

SUMMARY

Background & aim: Sarcopenia, the age-related decrease in muscle mass, strength, and function, is a main cause of reduced mobility, increased falls, fractures and nursing home admissions. Cross-sectional and prospective studies indicate that sarcopenia may be influenced in part by reversible factors like nutritional intake. The aim of this study was to compare functional and nutritional status, body composition, and quality of life of older adults between age and sex-matched older adults with and without sarcopenia.

Methods: In a multi-centre setting, non-sarcopenic older adults (n = 66, mean ± SD: 71 ± 4 y), i.e. Short Physical Performance Battery (SPPB): 11–12 and normal skeletal muscle mass index, were recruited to match 1:1 by age and sex to previously recruited adults with sarcopenia: SPPB 4–9 and low skeletal muscle mass index. Health-related quality of life, self-reported physical activity levels and dietary intakes were measured using the EQ-5D scale and index, Physical Activity Scale for the Elderly (PASE), and 3-day prospective diet records, respectively. Concentrations of 25-OH-vitamin D, α-tocopherol (adjusted for cholesterol), folate, and vitamin B-12 were assessed in serum samples.

Results: In addition to the defined components of sarcopenia, i.e. muscle mass, strength and function, reported physical activity levels and health-related quality of life were lower in the sarcopenic adults ($p < 0.001$). For similar energy intakes (mean ± SD: sarcopenic, 1710 ± 418; non-sarcopenic, 1745 ± 513, $p = 0.50$), the sarcopenic group consumed less protein/kg (−6%), vitamin D (−38%), vitamin B-12 (−22%), magnesium (−6%), phosphorus (−5%), and selenium (−2%) (all $p < 0.05$) compared to the non-sarcopenic controls. The serum concentration of vitamin B-12 was 15% lower in the sarcopenic group ($p = 0.015$), and all other nutrient concentrations were similar between groups.

Conclusions: In non-malnourished older adults with and without sarcopenia, we observed that sarcopenia substantially impacted self-reported quality of life and physical activity levels. Differences in nutrient concentrations and dietary intakes were identified, which might be related to the differences in muscle mass, strength and function between the two groups. This study provides information to help strengthen the characterization of this geriatric syndrome sarcopenia and indicates potential target areas for nutritional interventions.

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http://dx.doi.org/10.1016/j.clnu.2015.11.013

Please cite this article in press as: Verlaan S, et al., Nutritional status, body composition, and quality of life in community-dwelling sarcopenic and non-sarcopenic older adults: A case-control study, Clinical Nutrition (2015), http://dx.doi.org/10.1016/j.clnu.2015.11.013

1. Introduction

Sarcopenia is a syndrome that is defined predominantly by the simultaneous occurrence of low skeletal muscle mass, strength and function [1]. The definition of sarcopenia overlaps partially with physical frailty [2], and the consequences of both syndromes are increased incidence of falls and fractures, loss of independence, and increased rates of hospitalization. Poor dietary intake has been associated with individual components of sarcopenia, possibly due to dietary pattern changes, reduced response of ageing muscle to anabolic stimuli from meals (anabolic resistance), or oxidative stress from ageing and co-morbidities [3].

Higher dietary intake of protein has been consistently associated with greater muscle mass in older adults [3–5]. Consequently, a higher recommended protein intake of 1.0–1.2 g/kg body weight was recently proposed for healthy maintenance of ageing muscles and up to 1.2–1.5 g/kg body weight/day for older adults with acute or chronic disease [6,7]. Several serum nutrient deficiencies (or inadequacies) are associated with measures of sarcopenia through pathways that are still not well-understood [3]. The risk of becoming frail increases with the number of micronutrient deficiencies [8]. A low 25-OH-vitamin D level was cross-sectionally related to appendicular lean mass, leg strength and leg muscle quality [9], and also to functional outcomes such as increased rates of falls and nursing home admissions [10,11] among older adults. Vitamin B12, B6 and folate are nutrients that may have an impact on sarcopenia, since they help to reduce serum levels of homocysteine, higher levels of which are related to reduced muscle strength and gait speed [12–14].

Relatively little information is available comparing nutrient intake and serum nutrient concentrations between sarcopenic and healthy older adults [1]. Such knowledge can help to eventually guide health care professionals in identifying the most appropriate nutritional recommendations and interventions. The goal of this study was to compare functional and nutritional status, body composition, and quality of life of older adults between age and sex-matched older adults with and without sarcopenia.

2. Methods

2.1. Study design and participants

This study is based on a matched case-control observational cohort of older adults with sarcopenia and their non-sarcopenic controls.

Older adults with sarcopenia were selected from the PROVIDE study population. The PROVIDE study was a multi-centre randomized controlled trial investigating the effect of a vitamin D and leucine-enriched whey protein supplement on muscle mass, strength and function in older adults with sarcopenia. The PROVIDE study is registered under the Dutch trial register with the identifier: NTR2329. A total of 380 volunteers with sarcopenia participated in this 13-week intervention, which is published elsewhere [15]. The major eligibility criteria for the sarcopenic participants (i.e. cases) were: 1) Aged ≥65 years; 2) a short physical performance battery (SPPB) score of 4–9; 3) low skeletal muscle mass index (SMI: skeletal muscle mass/BW × 100): ≤37% (men) and ≤28% (women) measured using bioelectric impedance analysis (BIA 101 Akern, Florence, Italy) [16]; 4) a body mass index (BMI) between 20 and 30 kg/m^2; 5) were able and willing to provide written informed consent. A sub-sample of these sarcopenic participants (n = 66) who were screened and recruited between June 2010 and May 2013 from sites in the United Kingdom was matched with non-sarcopenic controls. Non-sarcopenic controls were identified through advertisements, contacts to organisations such as senior clubs, churches, sports centres and associations offering activities for older people, as well as by word of mouth through other potential volunteers who had expressed interest but did not meet the study criteria.

Non-sarcopenic older adults (n = 66) were recruited to match by age (- 1 year, + 2 years accepted) and sex with a ratio of 1:1 to the sarcopenic participants. They were identified from three sites in the United Kingdom (Manchester, Lancashire and Newcastle) between September 2013 and June 2014; using the following inclusion criteria: 1) Aged ≥ 65 years; 2) a SPPB score of 11–12; 3) Normal SMI defined as SMI ≤ one standard deviation below the sex-specific mean for young adults (aged 18–40), using BIA [16] or DXA [17]; 4) a body mass index (BMI) between 20 and 30 kg/m^2; 5) able and willing to provide written informed consent.

2.2. Outcome measures and data collection

All data from the sarcopenic older adults were collected at the screening or baseline visit of the intervention trial (i.e. before the start of the nutritional intervention). Data on background characteristics, nutritional status, anthropometrics and physical performance were collected on a single visit (in a few cases blood samples were collected during a second visit) from the non-sarcopenic controls.

2.2.1. Anthropometry

Body composition was assessed using dual energy x-ray absorptiometry (DXA, different models from Hologic, Bedford, USA; and Lunar, Fairfield, USA). Appendicular muscle mass (arms and legs) and fat mass (total) were measured and a central check was done to ensure uniformity in the analysis.

2.2.2. Muscle strength and function

Handgrip strength was measured using a hydraulic hand dynamometer (Jamar™, Preston, Jackson, Missouri, USA). Two consecutive measures of grip strength in each hand were recorded to the nearest kg with the participant in an upright position and the arm of the measured hand parallel to the body. Maximum grip strength was calculated by taking the average of the highest measurement from both hands.

SPPB consists of three components: gait speed (4-m walk at a usual pace), chair stand test (time taken to rise five consecutive times from a chair as quickly as possible without arm rests), and balance (feet side-by-side, semi-tandem and tandem) according to the method outlined by Guralnik et al. [18]. Each component was scored from 0 (not possible) to 4 (best performance) and summed in a total score ranging from 0 to 12.

2.2.3. Reported physical activity levels and health-related quality of life

Self-reported amount of physical activity was measured using the European version of the Physical Activity Scale for the Elderly (PASE). The Barthel index was used to measure the level of independence in activities of daily living with possible scores between 0 and 100 (highest scores best). Health-related quality of life was measured using the EQ-5D, both as an index and as a visual analogue scale (VAS) between 0 and 100.

2.2.4. Assessment of frailty status

Participants in both groups were categorized into non-frail, pre-frail, or frail based on adapted Fried [19] criteria. The following criteria were used: 1) involuntary weight loss; having responded "yes" to a question on the mini-nutritional assessment short-form about experiencing involuntary weight loss of 1–3 kg or more than 3 kg in the past 3 months; 2) exhaustion; having responded

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