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Abstract

Objective: Sarcopenia is highly prevalent in older adults. Knowledge among community-dwelling adults is important for effective prevention and treatment of sarcopenia. This study aims to assess current knowledge about sarcopenia, investigate willingness for treatment and prevention, and awareness of muscle health. **Method:** Participants who attended health educational events completed a questionnaire on knowledge about sarcopenia. Self-perceived muscle health was assessed by visual analog scale. Objective muscle measures included muscle mass, handgrip strength, and gait speed. **Results:** Included participants were 197 (median aged 67.9 years [interquartile range = 57.0-75.1]). Eighteen participants (9%) reported to know what sarcopenia is. Participants' self-perceived muscle health showed a low correlation with all objective muscle measures. 76% were willing, in case of sarcopenia diagnosis, to start treatment and 71% were willing to prevent sarcopenia. **Discussion:** Knowledge about sarcopenia is limited while participants were willing to start treatment and prevention. Strategies to increase knowledge among community-dwelling adults are needed.

Keywords

education, muscle, nutrition, physical activity, sarcopenia

Introduction

Sarcopenia affects up to 36% of community-dwelling adults aged 60 years and older (Shafiee et al., 2017), and the prevalence is expected to increase in the coming decades (Ethgen, Beaudart, Buckinx, Bruyère, & Reginster, 2017). Proposed definitions of sarcopenia include a combination of low muscle mass, low muscle strength, and/or low gait speed (Cruz-Jentoft et al., 2010; Vandervoot & Symons, 2001; Waters, Baumgartner, & Garry, 2000). Muscle mass and strength start to decline around the third decade of life, with an acceleration from the fifth decade onward (Beenakker et al., 2010; Doherty, 2001). In community-dwelling older adults, sarcopenia is associated with adverse outcomes such as falls (Landi et al., 2012), fractures (Yu, Leung, & Woo, 2014), institutionalization and hospitalization (Tang et al., 2018), functional dependency (Dos Santos, Cyrino, Antunes, Santos, & Sardinha, 2017), and mortality (Brown, Harhay, & Harhay, 2016). Due to the high prevalence and negative health outcomes, the economic burden on health care is excessive (Janssen, Shepard, Katzmarzyk, & Roubenoff, 2004). Preventing the development of sarcopenia in community-dwelling adults appears crucial and achievable (Beaudart et al., 2017). Modifiable risk factors in the prevention and treatment of sarcopenia include malnutrition (Boirie, Morio, Caumon, & Cano, 2014) and low physical activity (English & Paddon-Jones, 2010). For prevention, early diagnosis and timely treatment of sarcopenia, knowledge among health care professionals along with community-dwelling adults is a prerequisite.

The recognition of sarcopenia as a disease in September 2016 with the assignment of an International Classification

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of Disease Clinical Modification code (ICD-10-CM-code; Anker, Morley, & von Haehling, 2016), should advocate more awareness of sarcopenia among health care professionals. However, recent results revealed that only one tenth to one fifth of health care professionals attending educational events ("Sarcopenia Road Show") in the Netherlands, Australia, and New Zealand know how to formally diagnose sarcopenia (Reijnierse, de van der Schueren, et al., 2017; Yeung et al., unpublished data). Improving knowledge and awareness about sarcopenia among community-dwelling adults may be just as important to increase adherence and motivation to lifestyle changes.

In this study, we aimed to describe the current knowledge about sarcopenia in a cohort of community-dwelling adults attending health educational events, to investigate the willingness for treatment and prevention, and to assess the awareness of muscle health by correlating self-perceived muscle health with objective muscle measures.

Materials and Methods

Design

A total of 377 community-dwelling adults aged 18 years and older visited health educational events in 2017 and 2018 at three different locations in the Netherlands: (a) Philips Veterans meeting at the Academisch Genootschap, Eindhoven, (b) VU University Medical Center, Amsterdam, (c) Amstelland Hospital, Amstelveen. A total of 197 (58.5%) volunteered to participate in the current study. All participants visiting the health educational events were invited to participate in the inception cohort, no exclusion criteria were applied. All questionnaires and measurements were completed before commencement of the health educational event. Participants did not receive any information about sarcopenia before participating in the study. The research complies with the ethical rules for human experimentation that are stated in the Declaration of Helsinki, and was approved by the medical ethical committee of the VU University Medical Center, Amsterdam, by the Scientific and Ethical Review Board of the Vrije Universiteit Amsterdam, and by the medical ethical committee of the Amstelland Hospital, Amstelveen. All participants provided written informed consent.

Data Collection

Characteristics. The questionnaire on characteristics comprised of self-reported questions on age in years, sex, retirement (yes or no), career in health care (yes or no, including previous career), years of education (including day-care, primary school and part time study), current smoking (yes or no), current alcohol consumption (yes or no), if participants are performing muscle strengthening exercises ≥ 2 times a week (yes or no), if participants are performing moderate-vigorous activities ≥ 150 min a week (yes or no), use of walking aid (yes or no), self-reported difficulty walking 100 m (yes or no), experienced any falls in the last 12 months (yes or no), experiencing self-reported balance problems (yes or no), if participants need any help performing activities of daily living (ADL; yes or no), number of medications and morbidities. Morbidities included asthma or chronic obstructive pulmonary disease, hypertension, cerebrovascular accident, arthrosis or rheumatoid osteoarthritis, Parkinson, malignancy, diabetes, myocardial infarction. Height (in cm) and weight (in kg) were measured using a standard standing ruler and weight scale, and body mass index (BMI, in kg/m^2) was calculated.

Sarcopenia awareness questionnaire. A sarcopenia awareness questionnaire was developed by the authors during several expert meetings, and the questionnaire was subsequently tested in $n = 10$ community-dwelling adults aged 60 years and older to test face validity of the questionnaire. We included older adults to test the questionnaire, as predominantly older adults were expected to attend the health educational events. The questionnaire was translated to Dutch, and comprised of questions on terminology, etiology, consequences, treatment and prevention of sarcopenia (see Supplementary Material). After answering questions about terminology, the European Working Group on Sarcopenia in Older People (EWGSOP) definition of sarcopenia was introduced (low muscle mass, low muscle strength, and/or low physical performance; Cruz-Jentoft et al., 2010). Questions mostly comprised multiple-choice answers with an additional open option. Among the multiple-choice options, three correct answers for the etiology of sarcopenia were provided, including aging (Tieland, Trouwborst, & Clark, 2018), malnutrition (Boirie et al., 2014) and physical inactivity (English & Paddon-Jones, 2010), and three correct consequences were provided, including falls (Landi et al., 2012), fractures (Yu et al., 2014), and admission to a nursing home (Tang et al., 2018). After answering questions on etiology, consequences, and treatment, the participants were informed about appropriate treatment of sarcopenia (high protein intake and muscle strength training; Montero-Fernandez & Serra-Rexach, 2013; Paddon-Jones & Rasmussen, 2009; Peterson, Rhea, Sen, & Gordon, 2010). Participants were asked to rate their self-perceived muscle health and to judge the importance of muscle for overall health, the contribution of muscle to independency at older age, and the contribution of physical activity and nutrition in maintenance of muscle. It was scored using a 100-mm visual analog scale (VAS; McCormack, Horne, & Sheather, 1988) with higher scores implying higher importance of the item.

Objective muscle measures. All objective muscle measures were performed in the same measurement room by trained research staff. Muscle mass was assessed using direct segmental multifrequency bioelectrical impedance analysis (*DSM*-BIA; In-Body S10; Biospace Co., Ltd, Seoul, Korea), with participants in supine position, and expressed as (a) skeletal muscle mass (SMM) in kg, (b) SMM index (SMI:

SMM/height^2) in kg/m^2, (c) SMM relative to body weight (relative SMM: SMM/weight × 100) in %, (d) appendicular lean mass (ALM) in kg, (e) ALM/height^2 in kg/m^2, (f) ALM relative to body weight (relative ALM: ALM/weight × 100) in %. HGS was measured using a handheld dynamometer (JAMAR hand dynamometer; Sammons Preston, Inc., Bolingbrook, IL, USA), performed 3 times for each hand (Reijnierse, de Jong, et al., 2017). The best score was used for analyses and expressed in kilogram. Gait speed was assessed using a timed 4-m walking test at preferred pace from a standing start using a stopwatch. The fastest time of two trials was used for analyses and gait speed was expressed in meters per second (m/s). Enough space was allowed after the walking track to minimize deceleration during the 4-m walking test. Data on muscle mass, HGS, and gait speed were missing in nine, four, and five participants, respectively. The EWGSOP definition of sarcopenia was used, including sex-specific cut-off points for low SMI (≤10.75 kg/m^2 for males and ≤6.75 kg/m^2 for females), combined with low HGS (<30 kg for males and <20 kg for females) and/or low gait speed (≤0.80 m/s for both males and females; Cruz-Jentoft et al., 2010).

Statistical analysis. Descriptive statistics were visualized using GraphPad Prism for Windows (Version 7.0. GraphPad Software, Inc.). Normality of the variables was checked and presented as mean with *SD* for normally distributed variables, number with % for categorical variables and median with interquartile range (IQR) for skewed variables. The objective muscle measures were standardized using sex-specific *z* scores to account for gender differences. The awareness of muscle health was tested using Pearson's bivariate and partial correlations between self-perceived muscle health and the *z* scores of objective muscle measures, controlling for age and number of morbidities. Pearson correlations < .3 were considered negligible, .3-.5 were considered low, and ≥.5 were considered moderate to high (Mukaka, 2012). Analyses were performed using the Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY, IBM Corp).

Results

Participant characteristics are shown in Table 1. The median age of the participants was 67.9 years (IQR = 57.0-75.1). Seventy-one percent of the participants were female. Participants had a mean educational level of 18.4 years (*SD* = 4.8).

Terminology

Thirty-four participants (17%) stated to have heard of the term sarcopenia. Fifty-seven participants (29%) answered to have heard of the Dutch lay term for sarcopenia "Spierarmoede." Eighteen participants (9%) reported to know the definition of sarcopenia. Participants thought that sarcopenia was related to muscles (43%), brain (15%), and bones (14%).

Etiology

Indicated causes of sarcopenia are shown in Figure 1. Correct answers were selected, namely, aging (24%), malnutrition (19%), and physical inactivity (25%). Participants also selected high blood pressure (4%), use of medication (10%), and obesity (17%) as causes of sarcopenia. Figure 2 shows the distribution of the age at which participants thought muscle mass starts to decline, with a mean age of 46.2 years, (*SD* = 15.5). Twenty-four percent thought the decline starts before the age of 30 years, and 27% thought it starts after the age of 60 years. High VAS scores were given to the importance of muscles for overall health, for independency at older age, the importance of physical activity and nutrition for maintaining muscle (Figure 3).

Consequences

Figure 1 shows the indicated consequences of sarcopenia. Correct answers were selected, namely, falls (33%), fractures (26%), and admission to a nursing home (11%). Participants also selected dehydration (1%), dementia (3%), loss of vision (2%), and pain in the upper legs (20%) as consequences of sarcopenia.

Table 1. Participant Characteristics of the "Sarcopenia Awareness Show."

Characteristics	Total (*n* = 197)
Age, years, *Mdn* (IQR)	67.9 (57.0-75.1)
Sex, female	140 (71.1)
Retired	129 (65.5)
Career in health care	61 (31.3)
Education, years, *M* (*SD*)	18.4 (4.8)
Current smoking	6 (3.1)
Alcohol use	172 (88.2)
Muscle strengthening exercises ≥ 2 times per week	138 (70.1)
Moderate-vigorous activities ≥ 150 min per week	168 (85.3)
Use of walking aid	8 (4.1)
Difficulty walking 100 m	9 (4.6)
Falls in previous 12 months	50 (25.4)
Self-reported balance problems	30 (15.5)
ADL-dependent	0 (0)
Polypharmacy[a]	21 (10.7)
Multimorbidities[b]	33 (16.8)
Weight, kg, *M* (*SD*)	73.0 (12.5)
Height, cm, *M* (*SD*)	169.7 (9.3)
BMI, kg/m^2, *M* (*SD*)	25.4 (3.8)
Sarcopenia[c]	10 (5.3)

Note. All variables are presented as *n* (%), unless otherwise indicated. *n* = number of participants; IQR = interquartile range; ADL = activities of daily living; BMI = body mass index.
[a]Number of medications > 4.
[b]Number of morbidities > 1.
[c]European Working Group on Sarcopenia in older people definition (Cruz-Jentoft et al., 2010).

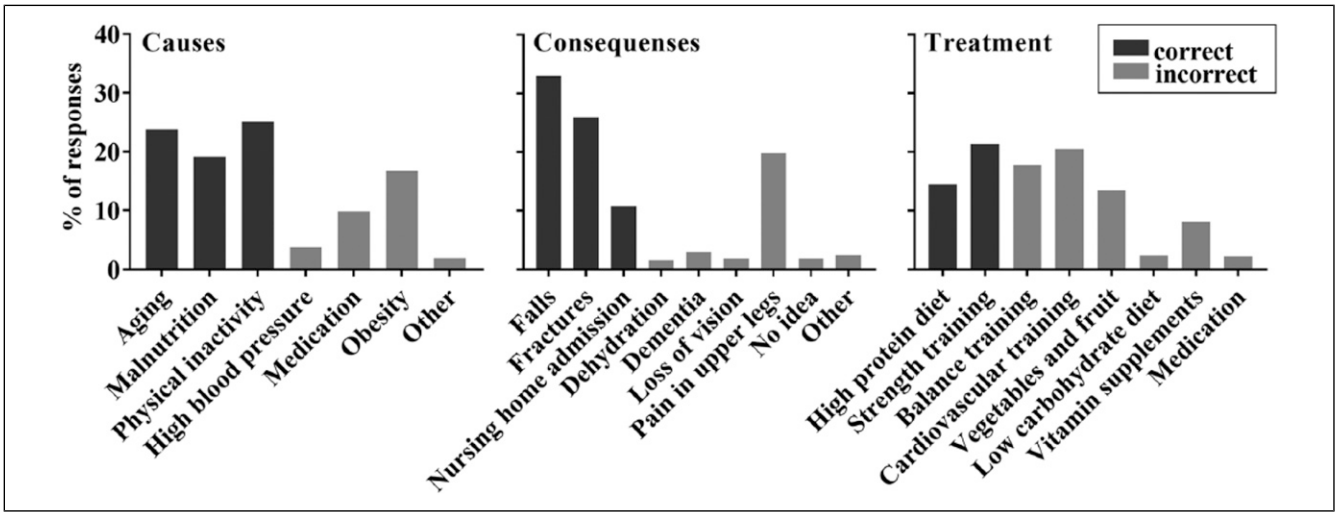

Figure 1. Knowledge in community-dwelling adults about indicated causes, consequences, and treatment of sarcopenia.

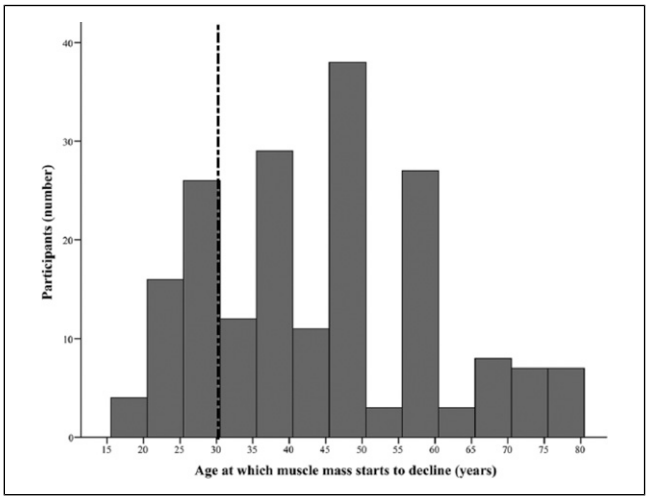

Figure 2. Distribution of the age at which participants thought muscle mass starts to decline.
Note. Dotted line represents the third decade of life (Doherty, 2001).

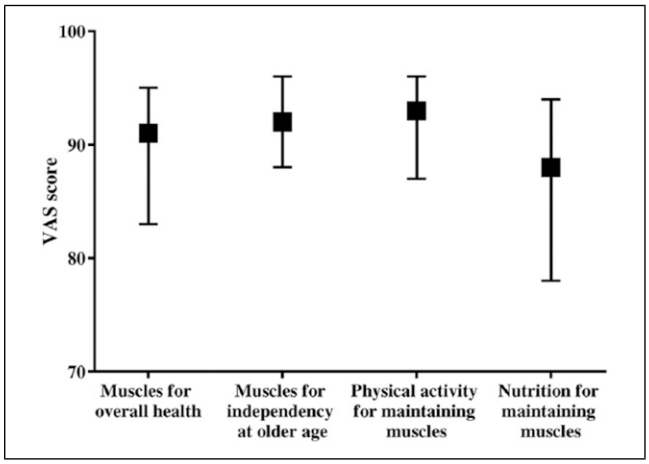

Figure 3. Rating of the importance of items related to muscle.
Note. Box represents median; error bars: interquartile range. VAS = visual analog scale.

Treatment

The correct answers for the appropriate treatment of sarcopenia, for example, a high protein diet (14%) and muscle strength training (21%), were chosen, as well as balance training (18%), cardiovascular training (20%) and eating more vegetables and fruit (13%; Figure 1). After participants were informed about the correct treatment, the largest proportion stated to be willing to start both a high protein diet and muscle strength training (76%) in case they would be diagnosed with sarcopenia. An overview of the reported obstacles for treatment of sarcopenia is provided in Table 2. Forty-four percent of participants reported obstacles, and most frequently reported time constraints (32%), expenses (23%), and aversion of visiting a health care professional (15%) as obstacles.

Prevention

Seventy-one percent of participants were willing to increase both their protein intake and physical activity levels to prevent the development of sarcopenia. Other participants indicated they only wanted to increase protein intake (7%) or physical activity (14%). Eight percent of participants indicated not willing to prevent the development of sarcopenia. After exclusion of 10 participants (5%) that met the EWGSOP criteria for sarcopenia (Cruz-Jentoft et al., 2010), these percentages did not change.

Awareness

The correlation between self-perceived muscle health and the objective muscle measures are shown in Table 3. The

correlations were negligible for muscle mass (range r = .18-.29), HGS (r = .12, p = .092) and gait speed (r = .19, p = .008). Controlling for age and number of morbidities did not change the results. Two of the 10 participants that met the EWGSOP criteria for sarcopenia indicated to have sarcopenia. Seventeen participants (10%) that did not meet the EWGSOP criteria for sarcopenia thought to have sarcopenia. The number of participants with sarcopenia is visualized in Figure 4 using the EWGSOP flowchart (Cruz-Jentoft et al., 2010).

Discussion

In a cohort of community-dwelling adults, the knowledge about etiology and consequences of sarcopenia was limited. Although participants acknowledged the importance of muscle health and generally expressed willingness to treat sarcopenia, or change lifestyle to prevent the development of sarcopenia, the awareness of their own muscle health was low, as self-perceived muscle health did not correlate with objectively measured muscle measures.

Table 2. Potential Obstacles for Treatment of Sarcopenia.

	n (%)
Obstacles reported, yes	84 (43.8)
Reported obstacles (multiple answers possible)	
Treatment is too time-consuming	36 (31.9)
Treatment could be expensive	26 (23.0)
I don't like to go to health care professionals	17 (15.0)
The consequences of sarcopenia are not severe enough	14 (12.4)
Health care professionals are too far away	6 (5.3)
Other obstacles reported	14 (12.4)

Only few community-dwelling adults stated to know what sarcopenia is. In previous studies among health care professionals, 70% stated to know the concept of sarcopenia, whereas only 13%-21% stated to know how to diagnose sarcopenia (Reijnierse, de van der Schueren, et al., 2017; Yeung et al., unpublished data). In comparison, studies investigating the knowledge about osteoporosis in community-dwelling adults have showed that over 85% to 90% of the participants know about this disease (Kasper, Peterson, & Allegrante, 2001; Kasper, Peterson, Allegrante, Galsworthy, & Gutin, 1994; Ungan & Tumer, 2001). Sarcopenia is an unfamiliar term in community-dwelling Dutch adults, considering it was only recently recognized as a disease (Anker et al., 2016), and has not yet received frequent public notice. Participants thought that the decline of muscle mass starts at a rather late age (on average 46 years), instead of the third decade (Doherty, 2001). This misguided conception may be a result of the maintenance of physical performance until a later age (Rojer et al., 2017). Out of different types of exercise and dietetic options, the majority of the participants could not identify the appropriate treatment for sarcopenia. However, correct causes and consequences of sarcopenia were selected, and, additionally, the importance of muscle health for overall health and independency was recognized, indicated by the high VAS scores.

The combination of muscle strength training and protein consumption has been shown to be effective interventions to counteract sarcopenia (Kim et al., 2012; Tieland et al., 2012). Recommendations include intensive muscle strength training 3 times a week (Montero-Fernandez & Serra-Rexach, 2013; Peterson et al., 2010) and protein supplementation during three meals per day (Paddon-Jones & Rasmussen, 2009). The majority of participants indicated that they were willing to prevent sarcopenia, and in case of diagnosis of sarcopenia to comply with treatment.

Table 3. Descriptives and Pearson's Correlations of Objective Muscle Measures and Self-Perceived Muscle Health.

	Descriptives (*n* = 197), *M* (*SD*)			
	Male (*n* = 57)	Female (*n* = 140)	Bivariate correlation,[a] r (p)	Partial correlation,[a,b] *r* (*p*)
Self-perceived[c]	72.8 (16.7)	68.1 (19.1)		
Objective				
SMM, kg	33.5 (5.1)	24.9 (3.2)	.25 (.001)	.25 (.001)
SMI, kg/m^2	10.4 (1.2)	9.1 (1.0)	.25 (.001)	.27 (<.001)
SMM, %	40.8 (3.9)	36.6 (4.7)	.29 (<.001)	.28 (<.001)
ALM, kg	26.8 (4.0)	19.4 (2.7)	.18 (.014)	.19 (.011)
ALM/height^2, kg/m^2	8.3 (0.8)	7.1 (0.8)	.19 (.011)	.22 (.003)
ALM, %	32.6 (3.0)	28.4 (3.5)	.24 (.001)	.20 (.009)
HGS, kg	38.0 (9.9)	27.4 (7.5)	.12 (.092)	.10 (.198)
Gait speed, m/s	1.3 (0.3)	1.3 (0.2)	.19 (.008)	.13 (.083)

Note. SMM = skeletal muscle mass; SMI = skeletal muscle index; ALM = appendicular lean mass; HGS = hand grip strength.
[a]Using sex-specific z scores of objective muscle measures.
[b]Controlled for age and morbidities.
[c]Self-perceived muscle health, scored using a 100-mm visual analog scale.

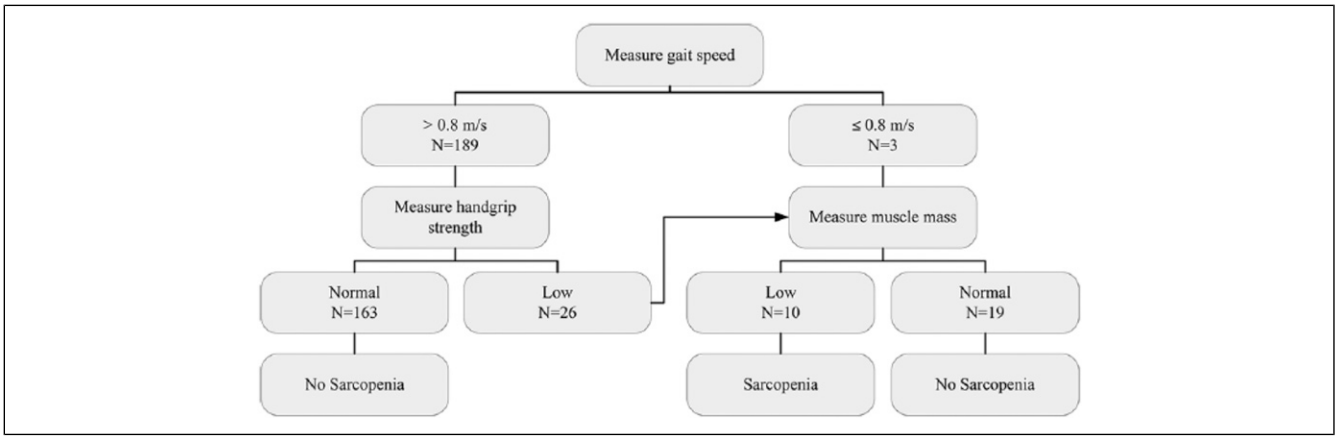

Figure 4. Number of participants with sarcopenia using the EWGSOP flowchart (Cruz-Jentoft et al., 2010).
Note. EWGSOP = European Working Group on Sarcopenia in Older People.

In contrast to their acknowledgment of the importance of muscle health, participants seemed largely unaware of their own muscle health considering the low correlations between self-perceived ratings and objective measures. In addition, we observed a minimal overlap between their assumption and actually having sarcopenia, with indication for both over- and underestimation. Awareness on muscle health may increase with increasing knowledge. These findings highlight the necessity for objective measures to assess muscle health and diagnose sarcopenia.

To the best of our knowledge, this is the first study addressing the knowledge about sarcopenia in a community-dwelling cohort. In absence of a validated disease-specific questionnaire to measure knowledge about sarcopenia, a custom questionnaire had to be developed. This is a limitation to this study, as content, concurrent, and construct validity of the questionnaire could not be tested. Some other limitations should be addressed. Multiple-choice questions were used to minimize bias from missing data, but may have provided desirable answers compared with individual answers to open questions. Selection bias by attracting mostly highly educated participants with probably relatively high levels of physical activity and low prevalence of sarcopenia could not be avoided due to the specific study setting. No follow-up assessment was performed to address retention of knowledge.

Preventing rather than counteracting sarcopenia would strongly reduce negative health outcomes and health care burden. Current evidence shows that prevention of sarcopenia is of most importance for healthy aging (Brown et al., 2016; Dos Santos et al., 2017; Landi et al., 2012; Tang et al., 2018; Yu et al., 2014). Education has been shown to increase knowledge and raise awareness, and encourage people to improve their lifestyle (Brunello, Fort, Schneeweis, & Winter-Ebmer, 2016; Cusack, Del Mar, Chalmers, Gibson, & Hoffmann, 2018; Li & Powdthavee, 2015). A previous study on osteoporosis prevention highlighted the need for more comprehensive and personalized education complementary to class room–based education (Gaines, Narrett, & Parrish, 2010). Our findings indicate that in community-dwelling adults, education should focus on extending knowledge about the terminology, the need for timely prevention given the early decline of muscle mass, and appropriate treatment to counteract sarcopenia. A considerable role in the education lies with the health care professional, of which the majority states to be acquainted with sarcopenia (Reijnierse, de van der Schueren, et al., 2017). Future studies should investigate if educational activities increase knowledge about sarcopenia and raise muscle health awareness, and whether this could lead to prevention of sarcopenia and reduction of health care burden.

In conclusion, in a cohort of community-dwelling adults with a high mean education, we demonstrated limited knowledge about sarcopenia and one's own muscle health. In contrast, the assumed importance of muscle health and willingness to treat and prevent were acknowledged, showing the potential benefits of targeted educational programs to improve prevention and timely intervention.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Supplemental Material

Supplemental material for this article is available online.

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