Detection of sarcopenia in community-dwelling older adults using the SARC-F questionnaire: findings from the Southampton Longitudinal Study of Ageing (SaLSA)

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## *Conflict of interest*

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Abstract

Introduction

Sarcopenia is associated with substantial morbidity and mortality. The SARC-F self-rated questionnaire is a simple tool that can be rapidly implemented by clinicians to identify individuals with probable sarcopenia who may require further in-depth assessment. A score ≥4 is predictive of sarcopenia and poorer outcomes. We sought to identify the prevalence and demographic correlates of probable sarcopenia in a newly formed cohort of community-dwelling older adults.

Methods

A cross-sectional analysis of 480 participants (219 men, 261 women) identified from Primary Care in whom a questionnaire ascertaining demographic, lifestyle factors, comorbidities, nutrition risk and SARC-F score was completed between 2021-2022. Participant characteristics in relation to probable sarcopenia were examined using sex-stratified logistic regression. Age was included as a covariate.

Results

The median (lower quartile, upper quartile) age was 79.8 (76.9, 83.5) years. 12.8% (28) of men and 23% (60) of women had probable sarcopenia. Older age was associated with probable sarcopenia in both sexes (odds ratio (95% CI): men 1.10 (1.02, 1.19) p=0.01, women 1.08 (1.02, 1.14), p=0.01) as was higher malnutrition risk score (men: 1.30 (1.12, 1.51), p=0.001; women: 1.32 (1.17, 1.50), p<0.001 per unit increase). Among men, being married or in a civil partnership or cohabiting was protective against probable sarcopenia (0.39 (0.17, 0.89), p=0.03) as was reporting drinking any alcohol (0.34 (0.13, 0.92), p=0.03), while in women generally similar relationships were seen though these were weaker. Higher BMI (1.14 (1.07, 1.22), p<0.001 per unit increase) and more comorbidities (1.61 (1.34, 1.94), p<0.001 per extra medical condition) were also associated with probable sarcopenia in women.

Conclusions

Probable sarcopenia (SARC-F score ≥4) was common in older adults living in their own homes. In addition to advancing age and malnutrition, socio-demographic factors were also important. Patients with a higher SARC-F and who are living with associated risk factors should be prioritised for further in-depth assessment for sarcopenia to allow the planning and implementation of interventions to mitigate potential adverse consequences.

Key words: Sarcopenia, SARC-F, community-dwelling older people

Introduction

Estimates place the number of people aged 65 and above at 761 million in 2021 with this projected to rise to 1.6 billion by 2050, equivalent to 16 percent of the total population or 1 in every 6 people (1). The number of people over 80 years old is expected to triple in this time, reaching 426 million. Consequently, the prevalence and burden of multiple morbidity, dementia, sarcopenia, and frailty will increase commensurate with these data.

The syndrome of sarcopenia is characterised by progressive and generalised loss of skeletal muscle strength, muscle function as well skeletal muscle mass that leads to the loss of physical function. Pending consensus on a unifying definition for sarcopenia from the Global Leadership In Sarcopenia (GLIS) consortium (2), these diagnostic criteria have broadly been agreed amongst several international working groups (3-8). As an example, the revised EWGSOP diagnostic algorithm (EWGSOP2) uses a pathway for defining sarcopenia by first recommending screening, followed by testing muscle strength if screening is positive or there is clinical suspicion. The presence of low muscle strength i.e., gip strength <16kg in women and <27kg in men, provides an opportunity for targeted interventions that could involve improving physical activity and or nutrition as part of a comprehensive geriatric assessment (4). Skeletal muscle mass is then measured, and if low, sarcopenia is confirmed. If the individual has slow gait speed or a long chair-rise time sarcopenia is classified as severe. Sarcopenia has been assigned an International Classification of Disease, Tenth Revision, Clinical Modification (ICD-10-CM) Code to recognise the condition as failure of skeletal muscle, giving it the same gravitas as cardiovascular or neurological disease (9). Sarcopenia is associated with a variety of adverse outcomes ranging from frailty, falls, fractures, hospitalisation, and high health care costs in older adults (10, 11). Sarcopenia is also associated with poorer outcomes in association with coexistent morbidity, underscoring the important metabolic and physical properties of skeletal muscle (12). Early recognition of sarcopenia and implementation of ways to mitigate the effects of sarcopenia in the community to improve health of older people is of urgent importance.

Recommended by both EWGSOP2 and the AWGS 2019 (4, 5), the SARC-F self-rated questionnaire is a simple tool to detect probable presence of sarcopenia. It is based on 5 questions that determine an individual’s Strength (S), Assistance needed with walking (A), capability to rise from a chair (R), stair climbing ability (C) and history of falls (F) on a rating scale 0-2, with a maximum score of 10 (13, 14). A score of ≥ 4 identifies individuals at risk of adverse outcomes from sarcopenia. The SARC-F has been validated in community-dwelling older adults across ethnicities and populations and is predictive of objective deficits in activities of daily living (ADL), lower muscle strength, lower physical performance, slower walking speed and chair rise time (13, 15). However, several analyses conclude that the SARC-F is associated with lower sensitivity but higher specificity to detect sarcopenia, suggesting a proportion of individuals with sarcopenia will remain undetected, and requires further study across a range of diverse community-dwelling older people (16-19). Nevertheless, SARC-F remains a simple tool that can be rapidly implemented in a variety of clinical settings to identify individuals at risk and in whom further assessment is warranted (20-23).

The aim of this study was to implement the SARC-F to examine the prevalence of probable sarcopenia and identify the lifestyle and demographic correlates of this condition in a contemporary cohort of community-dwelling older men and women.

Methods

*Study design*

Between 2021-2022, we formed a collaboration with a large general practice in the City of Southampton UK (Living Well Partnership (LWP), https://livingwellpartnership.nhs.uk). Our main objective was to establish a new local cohort of community dwelling older men and women in the post pandemic era, in whom the effects of lifestyle and ageing on general and musculoskeletal health can be explored both cross-sectionally and longitudinally - named Southampton Longitudinal Study of Ageing (SaLSA). We identified all patients over the age of 75 within the practice database. Our sole inclusion criterion was the age of participants at the time of recruitment. Eligibility to participate in the study was decided by their primary care physician. Our exclusion criteria included patients with safeguarding issues, mental health, and problems with mental capacity, those who were living with dementia or who were unable to provide consent, those with learning disabilities precluding participation, those on end-of-life care plans, and those with permanent domiciles that were either residential or nursing homes and those who were bed-bound. The recruitment methods for SaLSA have previously been described in detail (24). We previously reported on changes in diet in relation to lifestyle and medical correlates (25). In the current study, we explored the cross-sectional associations between demographic, lifestyle factors and comorbidities in relation to probable sarcopenia (SARC-F ≥ 4) from patient completed questionnaires.

*Study conduct*

All eligible participants were sent a participant information sheet (PIS), two copies of a consent form, and a questionnaire that ascertained educational attainment, living circumstances and lifestyle factors, questions around the impact of COVID-19, medical conditions and medication history, self-reported walking speed, bone health, Fried frailty components, SARC-F, and the malnutrition risk score (DETERMINE) checklist. DETERMINE is a tool designed by the American Academy of Family Physicians with other groups as part of the Nutrition Screening Initiative which can be used by professionals working with older people to assess their risk for poor nutritional status or malnutrition (26). Participants were regarded as having self-reported exhaustion during the past week for more than three days if they reported that everything was an effort or that they could not get going for at least three days in the previous week. In total, 480 participants (219 men, 261 women) comprised the analysis sample for this study as they had non-missing data on all the responses to the SARC-F questions.

*Ethics approval*

Ethics and HRA approval were obtained from South Central Oxford Research Ethics Committee reference 21/SC/0036, project ID 288051. Informed written consent was obtained from all participants.

*Statistical methods*

Participant characteristics were described using summary statistics. To examine correlates of the SARC-F score, logistic regression was implemented with probable sarcopenia (SARC-F score ≥4) as the outcome and the following as exposures: lives in own property (yes/no); married/civil partnership/cohabiting (yes/no); height; BMI; ever smoked regularly (yes/no); currently drink alcohol (yes/no); DETERMINE malnutrition score; number of comorbidities; lost more than 10 pounds unintentionally in the past year (yes/no); self-reported exhaustion in the past week for more than 3 days (yes/no); self-reported walking speed (‘fast’, ‘fairly brisk’, ‘normal speed’, ‘stroll at an easy pace’, ‘very slow’, ‘unable to walk’); fracture since age 45 years (yes/no); and fracture since the first UK lockdown started (yes/no). The age-adjusted association between each exposure and probable sarcopenia was examined separately; exposures that were statistically significant (p<0.05) in the age-adjusted models were then included in a mutually-adjusted model. These analyses were then repeated with slow walking speed (self-reported walking speed of 'very slow' or 'unable to walk' as opposed to 'fast', 'fairly brisk', 'normal speed' or 'stroll at an easy pace') as the outcome instead of probable sarcopenia; this was performed to compare how probable sarcopenia and self-reported walking speed were related to the exposures of interest. To assess homogeneity of the odds ratios for probable sarcopenia, the statistical significance of all possible two-way interactions between exposures was assessed separately using likelihood ratio tests for each model that was fitted. All analyses were sex-stratified and conducted using STATA, version 17; p<0.05 was regarded as statistically significant.

The sample size used for analysis was the largest possible, given the available data (480 participants had non-missing data on all the responses to the SARC-F questions). With this number of observations available (men n=219, women n=261), and the prevalence of probable sarcopenia (men 12.8%, women 23.0%), we had 80% power at the 5% significance level to detect an odds ratio for probable sarcopenia of 1.768 among men and 1.513 among women for an SD increase in a continuous exposure (27).

Results

*Participant characteristics*

Participant characteristics of the analysis sample are presented in Table 1. Median age was approximately 80 years among men and women respectively. The prevalence of probable sarcopenia (SARC-F score ≥4) was higher among women (23.0%) compared to men (12.8%). Overall, 36 (16.5%) men and 63 (24.3%) women had slow self-reported walking speed ('very slow' or 'unable to walk').

*Correlates of probable sarcopenia (SARC-F score* ≥4*)*

Associations between participant characteristics and risk of probable sarcopenia (SARC-F score ≥4) are presented in Table 2. As expected, self-reported walking speed was strongly associated with probable sarcopenia after adjustment for age (men: odds ratio (OR) 10.39 (95% CI: 4.55, 23.72), p<0.001; women: 11.42 (5.98, 21.80), p<0.001 per lower band). Given walking ability is included within the SARC-F screening tool, it was excluded from further analysis. Among men, the following characteristics were related to increased risk of probable sarcopenia after adjustment for age: not being married, in a civil partnership or cohabiting (0.39 (0.17, 0.89) for not having this relationship status, p=0.026); not consuming alcohol (0.34 (0.13, 0.92) for consuming alcohol, p=0.033); higher DETERMINE score (1.30 (1.12, 1.51) per unit increase, p=0.001); and self-reported exhaustion in the past week (7.77 (3.20, 18.83), p<0.001). In mutually-adjusted models that also accounted for age, only the DETERMINE score (1.29 (1.08, 1.55) per unit increase, p=0.005) and self-reported exhaustion (7.13 (2.52, 20.13), p<0.001) remained significantly associated with probable sarcopenia.

Among women, not living in one’s own property (0.30 (0.14, 0.66) for living in own property, p=0.003); higher BMI (1.14 (1.07, 1.22) per unit increase, p<0.001), DETERMINE score (1.32 (1.17, 1.50) per unit increase, p<0.001) and number of comorbidities (1.61 (1.34, 1.94) per unit increase, p<0.001); and self-reported exhaustion in the past week (9.36 (4.80, 18.26), p<0.001) were related to greater risk of probable sarcopenia after adjustment for age. Associations for these exposures, apart from the DETERMINE score, were robust in mutually-adjusted analyses; for example, odds ratios (95% CI) for probable sarcopenia for living in one’s own property, per additional comorbidity and for the presence versus absence of self-reported exhaustion were 0.29 (0.09, 0.87) (p=0.027), 1.34 (1.05, 1.71) (p=0.017) and 4.00 (1.75, 9.11) (p=0.001) respectively in the mutually-adjusted model.

None of the two-way interactions were statistically significant regarding any of the exposure variables used in the age-adjusted or mutually-adjusted models for probable sarcopenia. This suggests that the relationship between exposures in the models and risk of probable sarcopenia did not differ substantially according to other values of the exposures included in these models.

*Correlates of slow self-reported walking speed*

Associations between participant characteristics and risk of slow self-reported walking speed ('very slow' or 'unable to walk' as opposed to 'fast', 'fairly brisk', 'normal speed' or 'stroll at an easy pace') are presented in Supplementary Table 1. These associations were broadly similar to associations between participant characteristics and probable sarcopenia. For example, among men and women, correlates (p<0.05) of slow self-reported walking speed after adjustment for age included: older age; not being married, in a civil partnership or cohabiting; higher DETERMINE score; having more comorbidities; and self-reported exhaustion. Among women only, greater BMI was also associated with slow self-reported walking speed after adjustment for age. However, in mutually-adjusted analyses, only self-reported exhaustion was a significant correlate of slow self-reported walking speed among men. Among women, significant correlates included older age, greater BMI, having more comorbidities and self-reported exhaustion.

Discussion

In this study of community-dwelling older people there were associations between social, physical and lifestyle factors with a higher SARC-F score. As older age is associated with a higher risk of sarcopenia, we first completed a univariate analysis on exposures associated with having probable sarcopenia after adjusting for age. Only characteristics associated with probable sarcopenia in the age-adjusted analysis were included in the mutually adjusted model. In men, not being married, in a civil partnership or cohabiting, having a higher DETERMINE malnutrition score, self-reported exhaustion (SE) and not drinking alcohol were associated with a higher SARC-F score after adjustment for age; similarly in women, a higher risk of being malnourished and self-reported exhaustion, a higher BMI and greater co-morbidity (MM) and not living in one’s own property were associated with a higher SARC-F score. Associations between the exposures considered and self-reported walking speed were broadly similar compared to associations between the exposures and probable sarcopenia.

Not having a partner, being married, or cohabiting in older adults, risks loneliness (28). There is substantial information linking loneliness with adverse mental and physical health outcomes in older adults (29). In support of our findings, a systematic review and meta-analysis of 68 studies comprising 98502 people exploring risk factors for sarcopenia in community-dwelling older people by Gao et al (30) reported that the odds of being sarcopenic were increased in older people if they were living alone (OR 1.55, 95% CI: 1,2.40) as well as being single. In another study, adults living alone were at high risk of developing sarcopenia (31) whilst social isolation was associated with higher odds of having depressive symptoms and decline in physical capability in a follow up study of community-dwelling older people in the UK (32).

The DETERMINE checklist identifies community-dwelling older people whose estimated nutrient intake may be below the recommended daily allowance (RDA) (26). We found that older people with greater malnutrition risk, indicated by a higher DETERMINE score, were at greater risk of having probable sarcopenia. Our results are supported by a previous observational study which concluded that being malnourished or being at risk of malnutrition (18-item Mini Nutritional Assessment (MNA) scores of <24) was associated with higher sarcopenic risk (31). In a systematic review and meta-analysis, Gao et al (30) found that amongst other lifestyle and disease associated risk factors, malnutrition or higher malnutritional risk, ascertained using various assessment tools in the different studies considered, conferred a higher risk of being sarcopenic. Furthermore, results from recent observational studies report higher DETERMINE scores and poorer self-reported physical function as well as greater likelihood of frailty in community-dwelling older people (33).

Our findings of significant associations between SE and probable sarcopenia are broadly in keeping with existing literature that report SE increases with age but also with decreased physical activity and timed up-and-go tests, both objective measures are used in diagnostic criteria for sarcopenia (34). There may be multiple reasons for participants being exhausted which include multimorbidity, disability in activities of daily living (ADL), or poor sleep – factors that have previously been associated with poor physical function and/or sarcopenia (30, 35).

There was an increased likelihood of probable sarcopenia in men but not women who did not drink alcohol. This suggests alcohol has a protective effect on sarcopenia. However, as this analysis was cross-sectional, a causal relationship cannot be drawn. Results from previous studies of the association between alcohol intake and sarcopenia are inconsistent. For example, an analysis of 13 studies of 13155 participants concluded alcohol was a risk factor for sarcopenia (36). In another study of 19 observational studies of 3826 individuals with sarcopenia, alcohol consumption was not significantly associated with sarcopenia risk. In fact, in support of our findings, alcohol consumption was associated with a significant decrease in risk of sarcopenia in older men (OR 0.70, 95%CI 0.46,1.07) as well as in women (37). In the UK Biobank study, cross-sectional analysis suggested declines in muscle mass with increased alcohol consumption but conversely, an increase in grip strength. No associations were seen in longitudinal analysis (38). Further longitudinal studies are needed to explore the relationship between levels of alcohol intake and muscle function in older people.

The association between higher BMI and probable sarcopenia in women was surprising given the published literature suggesting lower BMI is associated with higher likelihood of probable sarcopenia (39, 40). For example, in the English Longitudinal Study of Ageing (ELSA), there were significant associations between lower BMI and higher likelihood of probable sarcopenia in cross-sectional analysis (OR 2.25, P=0.015). Being overweight appeared to have a favourable effect on higher grip strength (40). In a 2-year longitudinal follow up study of women in Korea, higher BMI correlated with lower incidence of sarcopenia (41). A potential explanation for our findings is that overweight individuals may be more likely to report difficulties in completing physical tasks as detailed in the SARC-F questionnaire, even though they may have higher grip strength and lean mass. These associations will be explored in further phases of the SaLSA where objective measurements of physical performance, muscle strength and mass will be obtained.

Multimorbidity was determined from self-report of medical conditions. Recent studies have explored associations between comorbid conditions and sarcopenia. For example, in the analysis of UK Biobank data by Dodds et al (42), having more than 2 long-term conditions (LTC) was associated with higher odds of probable sarcopenia compared with those who had fewer LTC. In a 12-year follow up of longitudinal data from ELSA, those with ≥ 2 conditions at baseline had a higher risk of being sarcopenic even after adjustment for multiple confounders (OR 2.06, 95% CI: 1.61, 2.62) (43). In a study of community-dwelling older men and women, sarcopenia was associated with having ≥ 2 co-morbidities (OR 4.71, 95% CI: 1.50, 4.76, p=0.05) (44). Finally, in the systematic review by Gao et al 2021, individual illnesses, such as diabetes, heart, or respiratory diseases, were associated with having sarcopenia (30). These studies support the notion that being multimorbid confers a higher risk of living with sarcopenia as well as frailty.

Not living in one’s own property increased the risk of probable sarcopenia in women. Not owning a property could be personal choice or reflect socioeconomic position (SEP). In support of the relationship between SEP and sarcopenia, an analysis of participants from ELSA reported that the prevalence of sarcopenia was greater than 2-fold higher in those who were in the most disadvantaged SEP versus least disadvantaged group after adjustment of multiple confounders which included physical activity, underweight BMI, presence of long-term condition and ethnicity (45). Similar observations were also seen in the Irish Longitudinal Study of Ageing (ILSA) cohort (39).

There are several limitations that need to be acknowledged. SARC-F scores are associated with future decline in physical functioning (46), predict declines in morbidity in systemic disease such as heart failure, diabetes, liver disease and Parkinson’s Disease and mortality, indicating the usefulness of SARC-F in clinical practice (20, 47). However, several systematic reviews have examined the reliability and validity of the SARC-F tool. For example, in a meta-analysis of 7 studies conducted by Ida et al (21), the sensitivity of SARC-F was poor but specificity was high, making it an effective tool for selecting individuals who should undergo further testing to confirm a diagnosis of sarcopenia. In a meta-analysis of 29 studies by Voelker et al (16), despite good reliability of the SARC-F, it had low to moderate sensitivity and moderate to high specificity, concluding that the SARC-F is not optimal for sarcopenia screening. The authors did not recommended screening but to proceed directly with applying sarcopenia diagnostic criteria. However, this may be impractical due to the limited primary care resources for community-dwelling populations. The associated low sensitivity is likely because the questions are related to muscle strength and physical performance and not objective measures of anthropometry. The low utility of SARC-F for the purpose of excluding sarcopenia, but high specificity, suggests SARC-F is a valid tool for selecting subjects who should undergo further evaluation of muscle strength and mass (21, 22). Other studies have suggested other ways of increasing sensitivity which include adding measures of calf circumference, other anthropometry measures or in combination with other valid sarcopenia screening tools, which may also be impractical in the primary care setting (47). Another limitation is that the supplementary analyses used self-reported walking speed as opposed to measured walking speed. However, in a study comprising 1729 community-dwelling older people, aged 61 to 73 years, self-reported walking speed was strongly associated with measured walking speed and both measures were similarly associated with clinical characteristics and risk of mortality (48). The authors of this study concluded that self-reported walking speed is a good marker of measured walking speed and could serve as a useful marker of physical performance when direct measurement of walking speed is not feasible.

All information on SARC-F was ascertained through self-reported questionnaires so recall bias may have occurred as participants reported changes in lifestyle since the UK national lockdown. Our sample size was relatively small. However, a previous study which tested the feasibility of setting up a UK sarcopenia registry only achieved a 12% response rate when potential participants aged 65 and over were approached via mailshots from local primary care practices (49). This suggests that our response rate was not unusually low, given that we were contacting participants from the community. Participants who consented to be included are likely to have been healthier than those who refused which may limit the generalisability of study findings. First, given that a total of 1993 identified LWP patients were invited to participate, after applying our exclusion criteria to the LWP database, only 480 (24%) returned questionnaires with complete SARC-F data. Despite this, the prevalence of probable sarcopenia in men and women was quite high in this healthier sample of community-dwelling older people. Second, 87.0% of participants lived in their own property and 52.5% were in a current relationship. However, as our analyses were internal, substantial bias should only have been introduced if the associations examined differed markedly between those who participated in the study and those who did not, and this seems unlikely. To confirm this, we assessed demographic characteristics of our population against national survey data for England (accessed at https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england). Prevalence of current smoking in our analysis sample (men 3%, women 3%) was slightly lower than reported among participants aged 75 years and older from the nationally representative 2019 Health Survey for England (men 6%, women 6%). Mean BMI in our analysis sample (men 26.0 kg/m2, women 26.5 kg/m2) was slightly lower than reported among participants aged 75 years and older from the 2019 Health Survey for England (men 27.6, women 27.7), suggesting that our cohort may indeed be slightly healthier than national averages.

A strength of this study is that we have established a strong collaboration with Living Well Primary Care Partnership and findings from this and subsequent phases of the study can be rapidly translated to improvements in clinical care or inform the development of beneficial interventions not only for MSK health but also for diet, health, and well-being.

Conclusions

Probable sarcopenia (SARC-F score ≥4) was common in older adults living in their own homes. In addition to advancing age and malnutrition, socio-demographic factors were also important. Our findings highlight the need for early identification and in-depth assessment of sarcopenia in primary care, supported by health and social care services to facilitate timely interventions that can mitigate potential adverse consequences and maintain independence of older people. Future phases of SaLSA should explore these relationships across a broader age range as well as in diverse populations and include objective measures of muscle function.

References

1. Ageing and health [Internet]. 2023. Available from: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>.

2. Kirk B, Cawthon PM, Arai H, Ávila-Funes JA, Barazzoni R, Bhasin S, et al. The Conceptual Definition of Sarcopenia: Delphi Consensus from the Global Leadership Initiative in Sarcopenia (GLIS). Age Ageing. 2024;53(3).

3. Bhasin S, Travison TG, Manini TM, Patel S, Pencina KM, Fielding RA, et al. Sarcopenia Definition: The Position Statements of the Sarcopenia Definition and Outcomes Consortium. J Am Geriatr Soc. 2020;68(7):1410-8.

4. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019;48(4):601.

5. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, et al. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. J Am Med Dir Assoc. 2020;21(3):300-7.e2.

6. Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE, Newman AB, et al. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. J Am Med Dir Assoc. 2011;12(4):249-56.

7. Studenski SA, Peters KW, Alley DE, Cawthon PM, McLean RR, Harris TB, et al. The FNIH sarcopenia project: rationale, study description, conference recommendations, and final estimates. J Gerontol A Biol Sci Med Sci. 2014;69(5):547-58.

8. Zanker J, Sim M, Anderson K, Balogun S, Brennan-Olsen SL, Dent E, et al. Consensus guidelines for sarcopenia prevention, diagnosis and management in Australia and New Zealand. J Cachexia Sarcopenia Muscle. 2023;14(1):142-56.

9. Cao L, Morley JE. Sarcopenia Is Recognized as an Independent Condition by an International Classification of Disease, Tenth Revision, Clinical Modification (ICD-10-CM) Code. J Am Med Dir Assoc. 2016;17(8):675-7.

10. Cruz-Jentoft AJ, Sayer AA. Sarcopenia. Lancet. 2019;393(10191):2636-46.

11. Pinedo-Villanueva R, Westbury LD, Syddall HE, Sanchez-Santos MT, Dennison EM, Robinson SM, et al. Health Care Costs Associated With Muscle Weakness: A UK Population-Based Estimate. Calcif Tissue Int. 2019;104(2):137-44.

12. Morley JE. Frailty and sarcopenia in elderly. Wien Klin Wochenschr. 2016;128(Suppl 7):439-45.

13. Malmstrom TK, Miller DK, Simonsick EM, Ferrucci L, Morley JE. SARC-F: a symptom score to predict persons with sarcopenia at risk for poor functional outcomes. J Cachexia Sarcopenia Muscle. 2016;7(1):28-36.

14. Malmstrom TK, Morley JE. SARC-F: a simple questionnaire to rapidly diagnose sarcopenia. J Am Med Dir Assoc. 2013;14(8):531-2.

15. Dodds RM, Murray JC, Robinson SM, Sayer AA. The identification of probable sarcopenia in early old age based on the SARC-F tool and clinical suspicion: findings from the 1946 British birth cohort. Eur Geriatr Med. 2020;11(3):433-41.

16. Voelker SN, Michalopoulos N, Maier AB, Reijnierse EM. Reliability and Concurrent Validity of the SARC-F and Its Modified Versions: A Systematic Review and Meta-Analysis. J Am Med Dir Assoc. 2021;22(9):1864-76.e16.

17. Ibrahim K, Mullee MA, Cox N, Russell C, Baxter M, Tilley S, et al. The feasibility and acceptability of assessing and managing sarcopenia and frailty among older people with upper limb fracture. Age Ageing. 2022;51(1).

18. Kera T, Kawai H, Hirano H, Kojima M, Watanabe Y, Motokawa K, et al. SARC-F: A validation study with community-dwelling older Japanese adults. Geriatr Gerontol Int. 2019;19(11):1172-8.

19. Kera T, Kawai H, Hirano H, Kojima M, Watanabe Y, Motokawa K, et al. Limitations of SARC-F in the diagnosis of sarcopenia in community-dwelling older adults. Arch Gerontol Geriatr. 2020;87:103959.

20. Ida S, Kaneko R, Imataka K, Okubo K, Shirakura Y, Azuma K, et al. Verification of the predictive validity for mortality of the SARC-F questionnaire based on a meta-analysis. Aging Clin Exp Res. 2021;33(4):835-42.

21. Ida S, Kaneko R, Murata K. SARC-F for Screening of Sarcopenia Among Older Adults: A Meta-analysis of Screening Test Accuracy. J Am Med Dir Assoc. 2018;19(8):685-9.

22. Lu JL, Ding LY, Xu Q, Zhu SQ, Xu XY, Hua HX, et al. Screening Accuracy of SARC-F for Sarcopenia in the Elderly: A Diagnostic Meta-Analysis. J Nutr Health Aging. 2021;25(2):172-82.

23. Malas F, Kara M, Özçakar L. SARC-F as a case-finding tool in sarcopenia: valid or unnecessary? Aging Clin Exp Res. 2021;33(8):2305-6.

24. Laskou F LA, Aggarwal P, Dennison EM, Patel HP. Establishing a resource to assess musculoskeletal health in older adults in the post-COVID-19 era: time to SaLSA? Osteology. 2022;2:41-51.

25. Laskou F, Bevilacqua G, Westbury LD, Bloom I, Aggarwal P, Cooper C, et al. A study of diet in older community-dwelling adults in the UK during the COVID-19 pandemic: Findings from the Southampton Longitudinal Study of Ageing (SaLSA). Front Nutr. 2022;9:988575.

26. Posner BM, Jette AM, Smith KW, Miller DR. Nutrition and health risks in the elderly: the nutrition screening initiative. Am J Public Health. 1993;83(7):972-8.

27. Hsieh FY, Bloch DA, Larsen MD. A simple method of sample size calculation for linear and logistic regression. Stat Med. 1998;17(14):1623-34.

28. Teater B, Chonody JM, Davis N. Risk and Protective Factors of Loneliness among Older Adults: The Significance of Social Isolation and Quality and Type of Contact. Soc Work Public Health. 2021;36(2):128-41.

29. Giné-Garriga M, Jerez-Roig J, Coll-Planas L, Skelton DA, Inzitari M, Booth J, et al. Is loneliness a predictor of the modern geriatric giants? Analysis from the survey of health, ageing, and retirement in Europe. Maturitas. 2021;144:93-101.

30. Gao Q, Hu K, Yan C, Zhao B, Mei F, Chen F, et al. Associated Factors of Sarcopenia in Community-Dwelling Older Adults: A Systematic Review and Meta-Analysis. Nutrients. 2021;13(12).

31. Cheng L, Sit JWH, Chan HYL, Choi KC, Cheung RKY, Wong MMH, et al. Sarcopenia risk and associated factors among Chinese community-dwelling older adults living alone. Sci Rep. 2021;11(1):22219.

32. Bevilacqua G, Jameson KA, Zhang J, Bloom I, Ward KA, Cooper C, et al. The association between social isolation and musculoskeletal health in older community-dwelling adults: findings from the Hertfordshire Cohort Study. Qual Life Res. 2021;30(7):1913-24.

33. Bloom I, Zhang J, Parsons C, Bevilacqua G, Dennison EM, Cooper C, et al. Nutritional risk and its relationship with physical function in community-dwelling older adults. Aging Clin Exp Res. 2022;34(9):2031-9.

34. Tsutsumimoto K, Doi T, Shimada H, Makizako H, Yoshida D, Uemura K, et al. Self-reported exhaustion associated with physical activity among older adults. Geriatr Gerontol Int. 2016;16(5):625-30.

35. Denison HJ, Jameson KA, Sayer AA, Patel HP, Edwards MH, Arora T, et al. Poor sleep quality and physical performance in older adults. Sleep Health. 2021;7(2):205-11.

36. Steffl M, Bohannon RW, Petr M, Kohlikova E, Holmerova I. Alcohol consumption as a risk factor for sarcopenia - a meta-analysis. BMC Geriatr. 2016;16:99.

37. Hong SH, Bae YJ. Association between Alcohol Consumption and the Risk of Sarcopenia: A Systematic Review and Meta-Analysis. Nutrients. 2022;14(16).

38. Skinner J, Shepstone L, Hickson M, Welch AA. Alcohol Consumption and Measures of Sarcopenic Muscle Risk: Cross-Sectional and Prospective Associations Within the UK Biobank Study. Calcif Tissue Int. 2023;113(2):143-56.

39. Swan L, Warters A, O'Sullivan M. Socioeconomic Inequality and Risk of Sarcopenia in Community-Dwelling Older Adults. Clin Interv Aging. 2021;16:1119-29.

40. Curtis M, Swan L, Fox R, Warters A, O'Sullivan M. Associations between Body Mass Index and Probable Sarcopenia in Community-Dwelling Older Adults. Nutrients. 2023;15(6).

41. Yoo MC, Won CW, Soh Y. Association of high body mass index, waist circumference, and body fat percentage with sarcopenia in older women. BMC Geriatr. 2022;22(1):937.

42. Dodds RM, Granic A, Robinson SM, Sayer AA. Sarcopenia, long-term conditions, and multimorbidity: findings from UK Biobank participants. J Cachexia Sarcopenia Muscle. 2020;11(1):62-8.

43. Veronese N, Smith L, Cereda E, Maggi S, Barbagallo M, Dominguez LJ, et al. Multimorbidity increases the risk for sarcopenia onset: Longitudinal analyses from the English Longitudinal Study of Ageing. Exp Gerontol. 2021;156:111624.

44. Laskou F, Fuggle NR, Patel HP, Jameson K, Cooper C, Dennison E. Associations of osteoporosis and sarcopenia with frailty and multimorbidity among participants of the Hertfordshire Cohort Study. J Cachexia Sarcopenia Muscle. 2022;13(1):220-9.

45. Swan L, Warters A, O'Sullivan M. Socioeconomic Disadvantage is Associated with Probable Sarcopenia in Community-Dwelling Older Adults: Findings from the English Longitudinal Study of Ageing. J Frailty Aging. 2022;11(4):398-406.

46. Woo J, Leung J, Morley JE. Defining sarcopenia in terms of incident adverse outcomes. J Am Med Dir Assoc. 2015;16(3):247-52.

47. Nishikawa H, Asai A, Fukunishi S, Takeuchi T, Goto M, Ogura T, et al. Screening Tools for Sarcopenia. In Vivo. 2021;35(6):3001-9.

48. Syddall HE, Westbury LD, Cooper C, Sayer AA. Self-reported walking speed: a useful marker of physical performance among community-dwelling older people? J Am Med Dir Assoc. 2015;16(4):323-8.

49. Witham MD, Heslop P, Dodds RM, Clegg AP, Hope SV, McDonald C, et al. Developing a UK sarcopenia registry: recruitment and baseline characteristics of the SarcNet pilot. Age Ageing. 2021;50(5):1762-9.

**Tables**

|  |  |  |
| --- | --- | --- |
| Table 1: Participant characteristics | |  |
| Participant characteristic | Men (n=219) | Women (n=261) |
| Age (years) | 79.6 (76.7, 83.2) | 80.0 (77.2, 83.7) |
| High educational attainment | 54 (24.7%) | 38 (14.6%) |
| Lives in their own property | 185 (86.4%) | 223 (87.5%) |
| Marital status (married/civil partnership/cohabiting) | 151 (69.9%) | 99 (38.1%) |
| Self-reported height (cm) | 174.8 (7.6) | 160.6 (6.2) |
| BMI (kg/m2) from self-reported height and weight | 26.0 (3.4) | 26.5 (5.1) |
| Ever smoked regularly | 134 (61.8%) | 98 (37.8%) |
| Currently drink alcohol | 191 (87.2%) | 185 (71.2%) |
| DETERMINE malnutrition risk score | 3 (1, 5) | 3 (1, 5) |
| Number of comorbidities | 2 (1, 3) | 2 (1, 3) |
| Lost >10 pounds unintentionally in past year | 21 (9.6%) | 18 (7.0%) |
| Self-reported exhaustion in the past week (≥3 days) | 39 (18.0%) | 70 (27.5%) |
|  |  |  |
| Self-reported walking speed |  |  |
| Fast | 2 (0.9%) | 5 (1.9%) |
| Fairly brisk | 43 (19.7%) | 37 (14.3%) |
| Normal speed | 77 (35.3%) | 86 (33.2%) |
| Stroll at an easy pace | 60 (27.5%) | 68 (26.3%) |
| Very slow | 35 (16.1%) | 61 (23.6%) |
| Unable to walk | 1 (0.5%) | 2 (0.8%) |
|  |  |  |
| SARC-F score | 0 (0, 2) | 2 (1, 3) |
| High SARC-F score (≥4) | 28 (12.8%) | 60 (23.0%) |
| *High educational attainment: University degree / Higher National Diploma / Higher professional qualifications. SARC-F: Strength, Ambulation, Rising from a chair, stair Climbing and history of Falling* | | |
|  | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 2: Odds ratios for having probable sarcopenia (SARC-F score** ≥4**) according to participant characteristics** | | | | | | | | |
|  |  |  |  |  |  |  |  |  |
| **Characteristic** | **Men** | | | | **Women** | | | |
| **Age-adjusted** | | **Mutually-adjusted** | | **Age-adjusted** | | **Mutually-adjusted** | |
| **Odds ratio**  **(95% CI)** | **P-value** | **Odds ratio**  **(95% CI)** | **P-value** | **Odds ratio**  **(95% CI)** | **P-value** | **Odds ratio**  **(95% CI)** | **P-value** |
| Age (years) | 1.10 (1.02, 1.19) | 0.013 | 1.07 (0.96, 1.19) | 0.204 | 1.08 (1.02, 1.14) | 0.011 | 1.11 (1.03, 1.21) | 0.008 |
| High educational attainment | 0.63 (0.22, 1.78) | 0.387 |  |  | 0.91 (0.39, 2.13) | 0.832 |  |  |
| Lives in own property | 0.86 (0.28, 2.62) | 0.788 |  |  | 0.30 (0.14, 0.66) | 0.003 | 0.29 (0.09, 0.87) | 0.027 |
| Married/civil partnership/cohabiting | 0.39 (0.17, 0.89) | 0.026 | 0.98 (0.31, 3.10) | 0.969 | 0.55 (0.28, 1.07) | 0.080 |  |  |
| Self-reported height (cm) | 1.00 (0.95, 1.06) | 0.868 |  |  | 1.01 (0.96, 1.06) | 0.649 |  |  |
| BMI (kg/m2) from self-reported height and weight | 1.04 (0.92, 1.18) | 0.510 |  |  | 1.14 (1.07, 1.22) | <0.001 | 1.10 (1.01, 1.19) | 0.023 |
| Ever smoked regularly | 2.10 (0.84, 5.27) | 0.113 |  |  | 0.74 (0.40, 1.39) | 0.353 |  |  |
| Currently drink alcohol | 0.34 (0.13, 0.92) | 0.033 | 0.45 (0.12, 1.69) | 0.238 | 0.65 (0.35, 1.20) | 0.166 |  |  |
| DETERMINE malnutrition score | 1.30 (1.12, 1.51) | 0.001 | 1.29 (1.08, 1.55) | 0.005 | 1.32 (1.17, 1.50) | <0.001 | 1.11 (0.95, 1.31) | 0.187 |
| Number of comorbidities | 1.27 (0.99, 1.62) | 0.059 |  |  | 1.61 (1.34, 1.94) | <0.001 | 1.34 (1.05, 1.71) | 0.017 |
| Lost >10 pounds unintentionally in past year | 0.31 (0.04, 2.44) | 0.263 |  |  | 1.25 (0.42, 3.69) | 0.688 |  |  |
| Self-reported exhaustion in the past week (≥3 days) | 7.77 (3.20, 18.83) | <0.001 | 7.13 (2.52, 20.13) | <0.001 | 9.36 (4.80, 18.26) | <0.001 | 4.00 (1.75, 9.11) | 0.001 |
| Self-reported walking speed (per lower band) | 10.39 (4.55, 23.72) | <0.001 |  |  | 11.42 (5.98, 21.80) | <0.001 |  |  |
| Fracture since age 45 | 0.96 (0.33, 2.85) | 0.948 |  |  | 0.80 (0.43, 1.49) | 0.487 |  |  |
| Fracture since the first UK lockdown started | 0.97 (0.10, 9.76) | 0.977 |  |  | 1.38 (0.41, 4.65) | 0.606 |  |  |
| *High educational attainment: University degree / HND / Higher professional qualifications* | | | | | | | | |
| *SARC-F: Strength, Ambulation, Rising from a chair, Stair climbing and history of Falling* | | | | | | | | |
| *Odds ratios presented for age are univariate in the column showing the age-adjusted associations* | | | | | | | | |

Supplementary Table

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Supplementary Table 1: Odds ratios for having slow self-reported walking speed (‘very slow’ or ‘unable to walk’) according to participant characteristics | | | | | | | | |
| Characteristic | Men | | | | Women | | | |
| Age-adjusted | | Mutually-adjusted | | Age-adjusted | | Mutually-adjusted | |
| Odds ratio  (95% CI) | P-value | Odds ratio  (95% CI) | P-value | Odds ratio  (95% CI) | P-value | Odds ratio  (95% CI) | P-value |
| Age (years) | 1.12 (1.04, 1.21) | 0.002 | 1.07 (0.98, 1.18) | 0.146 | 1.13 (1.07, 1.20) | <0.001 | 1.20 (1.10, 1.30) | <0.001 |
| High educational attainment | 0.42 (0.15, 1.18) | 0.101 |  |  | 1.23 (0.54, 2.78) | 0.620 |  |  |
| Lives in own property | 0.77 (0.28, 2.10) | 0.610 |  |  | 0.49 (0.21, 1.14) | 0.097 |  |  |
| Married/civil partnership/cohabiting | 0.44 (0.21, 0.93) | 0.032 | 0.91 (0.32, 2.62) | 0.862 | 0.45 (0.22, 0.91) | 0.026 | 0.83 (0.34, 2.02) | 0.675 |
| Self-reported height (cm) | 1.01 (0.96, 1.06) | 0.757 |  |  | 1.03 (0.98, 1.08) | 0.226 |  |  |
| BMI (kg/m2) from self-reported height and weight | 1.08 (0.96, 1.20) | 0.188 |  |  | 1.20 (1.12, 1.29) | <0.001 | 1.15 (1.06, 1.26) | 0.001 |
| Ever smoked regularly | 2.11 (0.92, 4.85) | 0.078 |  |  | 1.27 (0.69, 2.33) | 0.447 |  |  |
| Currently drink alcohol | 0.50 (0.19, 1.32) | 0.161 |  |  | 0.65 (0.34, 1.21) | 0.173 |  |  |
| DETERMINE malnutrition score | 1.20 (1.05, 1.38) | 0.006 | 1.18 (0.99, 1.41) | 0.066 | 1.29 (1.14, 1.46) | <0.001 | 1.11 (0.94, 1.31) | 0.201 |
| Number of comorbidities | 1.27 (1.01, 1.59) | 0.043 | 0.95 (0.68, 1.34) | 0.785 | 1.56 (1.30, 1.88) | <0.001 | 1.36 (1.07, 1.74) | 0.014 |
| Lost >10 pounds unintentionally in past year | 0.82 (0.22, 3.09) | 0.766 |  |  | 1.63 (0.57, 4.64) | 0.361 |  |  |
| Self-reported exhaustion in the past week (≥3 days) | 10.22 (4.42, 23.64) | <0.001 | 10.35 (4.11, 26.07) | <0.001 | 8.50 (4.28, 16.89) | <0.001 | 3.73 (1.63, 8.54) | 0.002 |
| Fracture since age 45 | 1.00 (0.38, 2.61) | 0.998 |  |  | 1.18 (0.64, 2.18) | 0.589 |  |  |
| Fracture since the first UK lockdown started | 1.90 (0.30, 12.02) | 0.493 |  |  | 1.32 (0.38, 4.56) | 0.664 |  |  |
| *High educational attainment: University degree / Higher National Diploma / Higher professional qualifications* | | | | | | | | |
| *Odds ratios presented for age are univariate in the column showing the age-adjusted associations* | | | | | | | | |