The New Tsunami: Are we Heeding the Warning? The Challenges of Sarcopenia and Frailty in Older People

Kareeann KF Khow1 and Solomon CY Yu2

1Aged and Extended Care Services, The Queen Elizabeth Hospital, Central Adelaide Local Health Network, Adelaide Geriatrics Training and Research with Aged Care (G-TRAC) Centre, Australia
2School of Medicine, Faculty of Health Science, University of Adelaide, Adelaide, South Australia, Australia

Corresponding author: Dr Solomon Yu, Aged and Extended Care Services, Level 8B Main Building, The Queen Elizabeth Hospital, 21 Woodville Road, Woodville South SA 501, Australia, Tel: +61 8 8222 8178; E-mail: solomon.yu@adelaide.edu.au

Introduction

Worldwide, population ageing is constantly increasing, from 461 million people older than 65 years in 2004 to an estimated 2 billion by 2050 [1]. One of the critical challenges of population ageing is the clinical condition of frailty and the closely associated manifestation of sarcopenia. Frailty at its most basic level of definition has been defined as “a medical syndrome with multiple causes and contributors that is characterized by diminished strength, endurance and reduced physiologic function that increases an individual’s vulnerability for developing increased dependency or death” [2]. Sarcopenia, on the other hand, has been defined as progressive loss of skeletal muscle mass, strength and function [3].

Over the last two decades, multiple operational definitions of frailty and sarcopenia have been proposed but wide consensus has not been reached. At present, although there is no gold standard definition for frailty, two operational frailty concepts are commonly used: phenotypic and frailty index of accumulated deficits [4,5]. Sarcopenia is also regarded as a key component of frailty [6]. Some have considered it to be both the biological substrate for the development of frailty and the pathophysiological pathway, through which adverse health outcomes of frailty ensue [6]. Similar to frailty definition, six consensuses were put forward to define sarcopenia [7]. The most prevailing definition used to date is the European Working Group on Sarcopenia in Older People (EWGSOP) [3]. Frailty and sarcopenia are both characterized by a similar condition: impairment of physical function, which is usually measured objectively by gait speed and muscle strength. Such impairment can be responsible for the development of disability. In general, both frailty and sarcopenia are treatable conditions if recognized and intervened early.

It is clear from the last three decades of research that both frailty and sarcopenia leads to significant adverse clinical outcome. There is no doubt that both conditions, when untreated will lead to increased risk of falls, fracture, worsening disability, functional decline, hospitalization and mortality (Table 1) [8-14]. Furthermore, in the year 2000, it was estimated that sarcopenia will cost the healthcare system of US$1 billion US dollars [15].

The epidemiological data on frailty and sarcopenia sends an ominous warning of an impending “tsunami” that will affect a significant proportion of the older population. The prevalence of frailty varies substantially depending on the operational definitions and differences in inclusion or exclusion criteria between studies. In one systematic review of 21 community-based cohort studies of 6,500 older people, prevalence rates of frailty was between 4.0% and 59.1% [16].

| Year | Country | Participants [n] | Length of follow-up [years] | Falls, HR/OR [95%CI] | Worsening disability, HR/OR [95%CI] | Hospitalisation, HR/OR [95%CI] | Mortality, HR/OR [95%CI] |
|------|---------|------------------|----------------------------|----------------------|----------------------------------|--------------------------------|-------------------------|
| 2001 | USA     | 5317             | 7                          | 1.23* [1.50-2.21]    | 1.79* [1.47-2.17]               | 1.27* [1.11-1.46]            | 1.63* [1.27-2.08]        |
| 2004 | Canada  | 9008             | 5                          | NA                   | NA                               | NA                            | 3.69* [2.26-6.02]        |
| 2006 | USA     | 1438             | 3                          | 1.18* [0.63-2.19]    | NA                               | 0.67* [0.33-1.35]           | 6.03* [3.00-12.08]       |
| 2008 | USA     | 6701             | 4.5                        | 2.44* [1.95-3.04]    | 2.79* [2.31-3.37]               | NA                            | 2.75* [2.46-3.07]        |

*HR: Hazard ratio, NA: Not available, †OR: Odds ratio

The comparator for hazard ratios and odds ratios is people who are not frail.

Table 1: Covariate-adjusted associations between severe frailty and adverse outcomes from four large prospective studies.
The prevalence of sarcopenia has ranged between 5 and 13% [20-24]. In another study of nursing home residents aged ≥70 years in Italy, the prevalence of sarcopenia was 33% [11].

Despite this, there remain significant barriers in translating frailty and sarcopenia into clinical practice. Areas where these remained a challenge include the lack of standardized practical screening tools that could be used to identify and monitor the progress and a consistent approach to prevention and treatment of frailty and sarcopenia. Therefore effective tools to identify older people with frailty and sarcopenia at an early stage are important. In addition, effective interventions to treat these conditions are also needed so that adverse health-related outcomes can be prevented.

The comprehensive geriatric assessment (CGA) remains the gold standard for identifying frailty. However, CGA is time and resource-intensive to implement. Useful screening tests for frailty need to be quick and easy to administer, ideally utilizing data that are readily available to clinicians. The sensitivity should be high enough to make the exercise worthwhile while retaining the specificity to prevent indiscriminate use of resources. An effective population-based screening program has the potential to be a “warning system” for the impending “tsunami”.

A large study from the Toulouse Gerontopole Frailty Clinic has demonstrated positive results that general practitioners can use the Gerontopole Frailty Screening Tool to screen older people for frailty and those who are positive will be referred for a CGA [2,25]. In 200, Fried et al. created and validated a physical frailty phenotype [4]. Their definition included weight loss, exhaustion, weakness (grip strength), walking speed, and low physical activity. Based on this, a simple 5-point questionnaire (FRAIL scale – fatigue, resistance, aerobic, illness and loss of weight) was developed [26]. This scale has been validated by several studies and performed as well as the other more complex scales [27-29]. Of the five components of the FRAIL scale, both resistance (climbing a flight of stairs) and aerobic [walking one block] are also components of sarcopenia as defined by multiple groups [30,31]. This tool has been validated as a “rule in” test for frailty among community-dwelling older people in Hong Kong [32]. Recently, the FRAIL-NH scale has been proposed for use among nursing home residents but this scale has yet to be validated [33].

Another approach to frailty screening known as “frailty index” was developed by Rockwood et al. [5]. This consists of adding together all the deficits a person has and then mathematically designated a frailty score. While this is highly predictive of outcomes, some have argued that it is more of a comorbid score [34].

Single measurement such as gait speed and handgrip strength measured by a dynamometer has the potential to identify frailty in older people. A systematic review of nine prospective studies [3,485 participants] found that slow gait speed was associated with adverse outcomes in older people and had similar accuracy to complex multivariate models of assessment [35]. In a UK study of people aged between 64 and 74 years, grip strength was associated with more markers of frailty than chronological age [36]. Therefore, grip strength may prove a more useful single marker of frailty for older people of similar age than chronological age alone. Its validity in a clinical setting needs to be tested.

Five possible screening methods have been proposed for sarcopenia. The EWGSOP have used an algorithm to aid screening and diagnosis of sarcopenia [3]. Malmstrom and Morley have developed the SARC-F (Slowness, Assistance walking, Rising from chair, Climbing stairs and Falls) questionnaire as a rapid screening tool for sarcopenia [37]. This has been validated in several studies [38,39]. Others have developed prediction models for sarcopenia [40-42]. There is currently no consensus on a single screening tool.

Treatment interventions should be initiated as early as possible before the loss of skeletal muscle mass, strength and function lead to frailty. Strategies for treating frailty include physical exercise, nutrition (particularly protein supplementation), vitamin D, optimization of medical illness and reduction of polypharmacy. Exercise, including both aerobic and resistance has shown positive impact on both physical and functional abilities on patients with sarcopenia [43]. However the challenge lies in how exercises for older people can be individualized and maintained over a period of time because benefits were evident when therapy is structured, of longer duration (≥5 months) and performed regularly (3 times per week) for 30-45 minutes [44].

Nutrition plays an important role in preventing and reversing frailty. Increasing age is associated with reduced appetite and early satiety resulting in many older people failing to meet the recommended daily allowance (RDA) for protein that has important implications for skeletal muscles [45]. Evidence has shown that increased protein requirement is required for enhancement of muscle mass and quality [46]. Vitamin D supplementation has been found to improve muscle strength and balance [47]. Ensuring adequate replacement of vitamin D to minimize these outcomes is important.

A large multi-centre trial known as the Sarcopenia and Physical frailty in older people: A multi-component treatment strategy (SPRINT-T) is currently underway in Europe [48]. This trial involves multicomponent treatment strategies that combine exercise, nutritional advice and innovative technologies to prevent frail older people from becoming disabled and losing their mobility.

However, to what extent frailty can be influenced is unclear because instruments designed to assess frailty have not been validated as evaluative outcome instruments in clinical practice. Monitoring outcomes of interventions in sarcopenia and frail people need methods that are sensitive to change [49]. A 50-item evaluative frailty index for physical activity (EFIP) has been developed and found to be a reliable and valid instrument to evaluate the effect of physical activity on frailty in research and in clinical practice [50]. However, its use still needs to be tested in a larger population and the need to obtain data for 50 items may be cumbersome in a clinical setting.

One of the pressing needs in the research of frailty and sarcopenia is the standardization of method to screen, diagnose and grade the severity of these conditions. Standardization of measurement will enable studies to be compared and outcomes to be reassessed at different time points in longitudinal research. Then the long-term efficacy of multicomponent interventions to treat frailty and sarcopenia can also be examined. Parallel with the research into diagnostic and therapeutic aspects of frailty and sarcopenia, there is a need for translation of these findings into a community-based service to identify and manage older people with these conditions. Further work is required to determine the most effective way to introduce such services.

In conclusion, the clinical picture of frailty overlaps substantially with that of sarcopenia and both these conditions are reversible.
Sarcopenia may be considered the central element of frailty, which indicates that interventions specifically targeting the skeletal muscle may offer preventive and therapeutic benefits against these conditions [6]. The high prevalence of frailty and sarcopenia in the community can be viewed as an approaching “tsunami”. Therefore there is a need for reliable instruments to screen for these conditions in the general older population as well as effective preventive strategies. Further research is required to better define the appropriate multicomponent interventions that are effective in treating frailty and sarcopenia.

References

1. Kinsella KG, Phillips DR (2005) Global aging: The challenge of success: Population Reference Bureau Washington, DC, USA.
2. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K (2013) Frailty in elderly people. Lancet 381:752-762.
3. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, et al. (2010) Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age Ageing 39:412-423.
4. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, et al. (2001) Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci 56: M146-M156.
5. Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, et al. (2005) A global clinical measure of fitness and frailty in elderly people. CMAJ 173:489-495.
6. Cesari M, Landi F, Vellas B, Bernabei R, Marzetti E (2014) Sarcopenia and physical frailty: two sides of the same coin. Front Aging Neurosci 6:192.
7. Yu S, Umaphayasingh K, Visvanathan R (2014) Sarcopenia in older people. Int J Evid Based Healthc 12:227-243.
8. Rockwood K, Howlett SE, MacKnight C, Beattie BL, Bergman H, et al. (2004) Prevalence, attributes, and outcomes of fitness and frailty in community-dwelling older adults: report from the Canadian study of health and aging. J Gerontol A Biol Sci Med Sci 59:1310-1317.
9. Bandeiro-Roche K, Xue QL, Ferrucci L, Walston J, Guralnik JM, et al. (2006) Phenotype of frailty: characterization in the women's health and aging studies. J Gerontol A Biol Sci Med Sci 61:262-266.
10. Ensrud KE, Ewing SK, Taylor BC, Fink HA, Cawthon PM, et al. (2008) Comparison of 2 frailty indexes for prediction of falls, disability, fractures, and death in older women. Arch Intern Med 168:382-389.
11. Landi F, Liperoti R, Fusco D, Mastropaolo S, Quattricocchi D, et al. (2012) Sarcopenia and mortality among older nursing home residents. J Am Med Dir Assoc 13:121-126.
12. Landi F, Liperoti R, Russo A, Giovannini S, Tosato M, et al. (2012) Sarcopenia as a risk factor for falls in elderly individuals: results from the iSIRENTE study. Clin Nutr 31:652-658.
13. Cederholm T, Cruz-Jentoft AJ, Maggi S (2013) Sarcopenia and fragility fractures. Eur J Phys Rehabil Med 49:111-117.
14. Janssen I, Heymsfield SB, Ross R (2002) Low relative skeletal muscle mass (sarcopenia) in older persons is associated with functional impairment and physical disability. J Am Geriatr Soc 50:889-896.
15. Janssen I, Shepard DS, Katzmarzyk PT, Roubenoff R (2004) The healthcare costs of sarcopenia in the United States. J Am Geriatr Soc 52:80-85.
16. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC (2012) Prevalence of frailty in community-dwelling older persons: a systematic review. J Am Geriatr Soc 60:1487-1492.
17. Gonzalez-Vaca J, de la Rica Eseain M, Silva-Iglesias M, Arjonilla-Garcia MD, Varela-Perez R, et al. (2014) Frailty in Institutionalized older adults from ALbacete. The FINAL Study: rationale, design, methodology, prevalence and attributes. Maturitas 77:78-84.
18. Kanwar A, Singh M, Lennon R, Ghanta K, McNallan SM, et al. (2013) Frailty and health-related quality of life among residents of long-term care facilities. J Aging Health 25:792-802.
19. Matsuk P, Tomaszewski K, Chmielowska K, Nowak J, Nowak W, et al. (2012) Severe frailty and cognitive impairment are related to higher mortality in 12-month follow-up of nursing home residents. Arch Gerontol Geriatr 55:22-24.
20. Legrand D, Vaes B, Mathieu C, Swine C, Degryse JM (2013) The prevalence of sarcopenia in very old individuals according to the European consensus definition: insights from the BELFRAIL study. Age Ageing 42:727-734.
21. Patel HP, Syddall HE, Jameson K, Robinson S, Denison H, et al. (2013) Prevalence of sarcopenia in community-dwelling older people in the UK using the European Working Group on Sarcopenia in Older People (EWGSOP) definition: findings from the Hertfordshire Cohort Study (HCS). Age Ageing 62:378-384.
22. Patil R, Uusi-Rasi K, Pasanen M, Kannus P, Karinkanta S, et al. (2013) Sarcopenia and osteoporosis among 70-80-year-old home-dwelling Finnish women: prevalence and association with functional performance. Osteoporus Int 24:774-796.
23. Lin CC, Lin WY, Meng NH, Li CL, Liu CS, et al. (2013) Sarcopenia prevalence and associated factors in an elderly Taiwanese metropolitan population. J Am Geriatr Soc 61:459-462.
24. Subra J, Gillette-Guyonnet S, Cesari M, Oustreic S, Vellas B, Platform Team (2012) The integration of frailty into clinical practice: preliminary results from the Gérontopôle. J Nutr Health Aging 16:714-720.
25. Vellas B, Balardly L, Gillette-Guyonnet S, Abellan Van Kan G, Ghisolfi-Marque A, et al. (2013) Looking for frailty in community-dwelling older persons: the Gérontopôle Frailty Screening Tool (GFST). J Nutr Health Aging 17:629-631.
26. Abellan van Kan G, Rolland Y, Bergman H, Morley JE, Kritchevsky SB, et al. (2008) The I.A.N.A Task Force on frailty assessment of older people in clinical practice. J Nutr Health Aging 12:29-37.
27. Woo J, Leung J, Morley JE (2012) Comparison of frailty indicators based on clinical phenotype and the multiple deficit approach in predicting mortality and physical limitation. J Am Geriatr Soc 60:1478-1486.
28. Theou O, Brothers TD, Peña FG, Mitnitski A, Rockwood K (2014) Identifying common characteristics of frailty across seven scales. J Am Geriatr Soc 62:901-906.
29. Theou O, Brothers TD, Mitnitski A, Rockwood K (2013) Operationalization of frailty using eight commonly used scales and comparison of their ability to predict all-cause mortality. J Am Geriatr Soc 61:1537-1551.
30. Fielding RA, Vellas B, Evans WI, Bhaisin S, Morley JE, et al. (2011) Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. J Am Med Dir Assoc 12:249-256.
31. Muscaritoli M, Anker SD, Argiles J, Aversa Z, Bauer JM, et al. (2010) Consensus definition of sarcopenia, cachexia and pre-cachexia: joint document elaborated by Special Interest Groups (SIG) “cachexia-anorexia in chronic wasting diseases” and “nutrition in geriatrics”. Clin Nutr 29:154-159.
32. Woo J, Yu R, Wong M, Yeung F, Wong M, et al. (2015) Frailty Screening in the Community Using the FRAIL Scale. J Am Med Dir Assoc 16:412-419.
33. Kaehr E, Visvanathan R, Malmstrom TK, Morley JE (2015) Frailty in nursing homes: the FRAIL-NH Scale. J Am Med Dir Assoc 16:87-89.
34. Morley JE, von Haehling S, Anker SD, Vellas B (2014) From sarcopenia to frailty: a road less traveled. J Cachexia Sarcopenia Muscle 5:5-8.
35. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, et al. (2011) Gait speed and survival in older adults. JAMA 305:50-58.
36. Syddall H, Cooper C, Martin F, Briggs R, Aihie Sayer A (2003) Is grip strength a useful single marker of frailty? Age Ageing 32:650-656.
37. Malmstrom TK, Morley JE (2013) SARC-F: a simple questionnaire to rapidly diagnose sarcopenia. J Am Med Dir Assoc 14:531-532.
38. Cao L, Chen S, Zou C, Ding X, Gao L, et al. (2014) A pilot study of the SARC-F scale on screening sarcopenia and physical disability in the Chinese older people. J Nutr Health Aging 18: 277-283.

39. Woo J, Leung J, Morley JE (2014) Validating the SARC-F: a suitable community screening tool for sarcopenia? J Am Med Dir Assoc 15: 630-634.

40. Ishii S, Tanaka T, Shibasaki K, Ouchi Y, Kikutani T, et al. (2014) Development of a simple screening test for sarcopenia in older adults. Geriatr Gerontol Int 14 Suppl 1: 93-101.

41. Goodman MJ, G hate SR, Mavros P, Sen S, Marcus RL, et al. (2013) Development of a practical screening tool to predict low muscle mass using NHANES 1999-2004. J Cachexia Sarcopenia Muscle 4: 187-197.

42. Yu S, Appleton S, Chapman I, Adams R, Wittert G, et al. (2015) An anthropometric prediction equation for appendicular skeletal muscle mass in combination with a measure of muscle function to screen for sarcopenia in primary and aged care. J Am Med Dir Assoc 16: 25-30.

43. Montero-Fernández N, Serra-Rexach JA (2013) Role of exercise on sarcopenia in the elderly. Eur J Phys Rehabil Med 49: 131-143.

44. Theou O, Stathokostas L, Roland KP, Jakobi JM, Patterson C, et al. (2011) The effectiveness of exercise interventions for the management of frailty: a systematic review. J Aging Res 2011: 569194.

45. Visvanathan R, Chapman I (2010) Preventing sarcopaenia in older people. Maturitas 66: 383-388.

46. Bauer J, Biolo G, Cederholm T, Cesari M, Cruz-Jentoft AJ, et al. (2013) Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. J Am Med Dir Assoc 14: 542-559.

47. Muir SW, Montero-Odasso M (2011) Effect of vitamin D supplementation on muscle strength, gait and balance in older adults: a systematic review and meta-analysis. J Am Geriatr Soc 59: 2291-2300.

48. Bernabei R, Cesari M, Landi F (2014) Physical frailty and sarcopenia: background, rationale, and design of the SPRINT-T project. European Geriatric Medicine S33-S4.

49. de Vries NM, Staal JB, van Ravensberg CD, Hobbelen JS, Olde Rikkert MG, et al. (2011) Outcome instruments to measure frailty: a systematic review. Ageing Res Rev 10: 104-114.

50. de Vries NM, Staal JB, Olde Rikkert MG, Nijhuis-van der Sanden MW (2013) Evaluative frailty index for physical activity (EFIP): a reliable and valid instrument to measure changes in level of frailty. Phys Ther 93: 551-561.