



Frailty, Sarcopenia and Falls

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Research confirms that frailty, sarcopenia and falls are strongly correlated [1] and both are predictors of negative health outcomes such as falls, disability, hospitalisation and death [2]. Interventions are necessary to reverse frailty and treat sarcopenia [3] as it has been estimated that, by the year 2025, around 20% of the population in industrial countries will be aged 65 years and over. As the number of older people increases, their needs will become an increasingly important health issue. Reduction in physical function can lead to loss of independence, need for hospital and long-term nursing home care and premature death. The importance of physical, functional, psychological and social factors in realising a healthy old age is recognised by older people, health-care professionals, policy advisors and decision-makers.

This chapter will review the concepts of frailty, sarcopenia and falls as well as the interventions for older people, carried out by nurses and other health-care professionals, that have the potential to positively affect health and functional status and may promote independent functioning of older people with frailty and sarcopenia.

2.1 Learning Outcomes

At the end of the chapter, and following further study, the nurse will be able to:

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- Identify individuals with frailty, low muscle mass and depleted strength
- Promote health and prevent ill health in older people with frailty and sarcopenia
- Plan interventions for patients with frailty and sarcopenia
- Educate older people about frailty, sarcopenia and fall prevention
- Promote correct nutrition and physical exercise in frail and sarcopenic patients.

2.2 Frailty

Frailty is a complex societal challenge of an ageing population and has significant repercussions for patient outcomes and health-care utilisation [4]. There is no universally accepted definition [4, 5], but experts agree that it is a clinical syndrome characterised by increased vulnerability and diminished resistance to stressors that can cause functional impairment and increase risks [6, 7]; a minor stress or event such as an accidental fall or infection can worsen a person's health condition and increase dependency and/or mortality. Box 2.1 captures the main concepts in definitions of frailty.

Frailty can be physical or psychological or a combination of the two, with two common models used to explain it: (1) frailty is seen as a syndrome where sarcopenia (loss of muscle with ageing) is the main underlying concept [8] and individuals have at least three of a list of features including; unintentional weight loss, exhaustion, weakness, slowness and reduced physical activity and (2) frailty as the sum of an individual's deficits and non-specific disorders [9] that prevent individuals from launching an effective response to health stressors, leading to adverse health outcomes [6, 10].

Regardless of the perspective, frail patients are at increased risk of adverse health outcomes such as falls, hospitalisation, deterioration of mobility, disability, institutionalisation and death [5, 6, 8], and assessing patients for frailty is an important aspect of the assessment process with several tools available for this. Epidemiological studies [11] have estimated the prevalence of frailty at between 4% and 59%, depending on the population being studied [12], gender (higher in women than men) and age (the oldest have a higher prevalence) [13, 14].

Box 2.1: Frailty Definition

- Clinical syndrome
- Increased vulnerability
- Diminished resistance to stressors
- Can cause functional impairment
- Risk of adverse health outcomes

2.2.1 Assessment

Early diagnosis of frailty can improve care and has an important role in preventing fractures in older adults [15]. All individuals over 70 years of age and all persons with unintentional and significant weight loss should be assessed for frailty [6]. Box 2.2. provides an overview of the most commonly used tools.

A comprehensive review identified 67 instruments for the assessment of frailty. Of these, nine were highly cited: the Physical Frailty Phenotype (PFP—also known as the Fried or CHS Frailty Phenotype), the Deficit Accumulation Index (DAI; also known as Frailty Index), the Gill Frailty Measure, the Frailty/Vigour Assessment, the Clinical Frailty Scale, the Brief Frailty Instrument, the Vulnerable Elders Survey (VES-13), the FRAIL Scale and the Winograd Screening Instrument. The selection of a specific instrument to assess frailty should be based on its purpose, theoretical approach, the validity of the constructs used and its feasibility in the clinical context [16]. More recently, an umbrella review was performed to identify the most valid, reliable and diagnostically accurate frailty screening tools [11], concluding that only a few frailty measures demonstrate these characteristics. Among them, the Frailty Index appeared as the most useful in standard care and community settings. However, the review could not identify an appropriate tool for assessing frailty in EDs, concluding that there is no universally appropriate screening tool for identifying frailty that could be recommended. It is important, however, to provide an overview of the most commonly used tools.

The Physical Frailty Phenotype (PFP, Fried or CHS Frailty Phenotype) was developed following observations of 5000 men and women aged ≥ 65 years from the Cardiovascular Health Study [8]. This tool defines frailty as the presence of five criteria: weight loss ($\geq 5\%$ of body weight in the previous year), weakness (decreased grip strength), exhaustion (self-reported responses to questions about effort required for activity), slowness on walking (gait speed $\geq 6-7$ s to walk 15 feet) and decreased physical activity (Kcal spent per week: males expending < 383 Kcal and females < 270 Kcal) [8]. The assessment requires specialised equipment for grip strength measurement and involves patient participation to calculate gait speed. The PFP also facilitates identifying “pre-frailty”; one or two of the criteria for frailty are present.

The Deficit Accumulation or Frailty Index [9] is based on the individual’s accumulated burden of illnesses, functional and cognitive decline and other health related deficits that, together, provide a flexible measurement of frailty. Deficits are measured by answering medical and functional related questions, allowing a frailty index to be quantified; the higher the number of deficits, the higher the frailty score. An assessment that identifies a score of 30–40 deficits has been shown to be able to predict adverse health outcomes [9, 17]. One advantage of using this tool, versus PFP, is that it does not require a patient interview or exam, as the information can be retrieved from health records.

Some other instruments commonly used to assess frailty are quicker to use and, therefore, easier for nurses to apply; e.g. the Clinical Frailty Scale, FRAIL Scale

and Study of Osteoporotic Fractures (SOF) frailty tool. The Clinical Frailty Scale uses pictographs and descriptors to categorise between very fit (−1) and severely frail (−7). The assessment involves self-reporting (with no need for face-to-face examination) of comorbidities and the need for assistance with activities of daily living [18, 19]. The scale is composed of five questions with “FRAIL” as an acronym: F = fatigue, R = resistance, A = ambulation, I = illnesses and L = loss of weight [20, 21]; three or more positive answerers indicate frailty, and one or two positive answerers indicate pre-frailty. The Study of Osteoporotic Fractures (SOF) frailty tool assesses frailty according to three characteristics: loss of 5% of body weight in the last year, inability to stand up from a chair five times without the use of arms and feeling full of energy; two positive answers to the first and second items and/or a negative to the last one classifies the person as frail [22].

Box 2.2: Frailty Assessment

- Individuals older than 70 years
- Individuals with unintentional and substantial weight loss ($\geq 5\%$)
- The most common assessment tools are:
 - Physical Frailty Phenotype
 - Frailty Index
- Other instruments commonly used which are quicker and easier to adopt are:
 - Clinical Frailty Scale
 - FRAIL Scale
 - Study of Osteoporotic Fractures (SOF) frailty tool

2.2.2 Interventions

Health-care interventions can help to improve the degree of frailty over time [6]. Evidence relates to four possible interventions (Box 2.3): (1) exercise (aerobic and resistance), (2) calorie and protein supplementation, (3) vitamin D supplementation and (4) reduction of polypharmacy [6, 14, 21]:

- Planned exercise can develop muscle strength and improve physical performance and functionality [23] as well as decrease depression and fear of falling [6]. A mix of specifically prescribed aerobic and resistance exercises improves frailty and is effective in preventing its adverse outcomes [24, 25]. One systematic review found that an exercise programme, continued three times a week for 30–45 min per session for approximately 5 months, had positive impact [26].
- In frail older people with significant weight loss, it is essential to identify the cause (Chap. 8). Dietary calorific supplementation has been shown to be successful in achieving weight gain and reducing complications in malnourished individuals [27]. Protein supplementation of 15 g of protein twice a day over 24 weeks improves muscle strength and physical performance [28], while oral nutritional supplements provide additional protein and calories.

- Vitamin D supplementation can play a role in preventing or treating frailty by enhancing balance and maintaining muscle strength [29] but, while this is likely to be beneficial for frail older people, there have been no large-scale studies that have confirmed this to be the case on its own [6].
- Undertaking a medication review and considering side effects, interactions and consequences for frailty is essential. Medication review and reduction of polypharmacy have also been advocated as an option for improving outcomes, especially in reducing mortality, hospital admissions and falls [30].

These four interventions should be considered following frailty assessment so that they can be individually tailored to target specific identified problems and needs [31].

Box 2.3: Interventions

- Exercise (aerobic and resistance)
- Caloric and protein supplementation
- Vitamin D supplementation
- Reduction of polypharmacy

2.3 Sarcopenia

Changes in body composition occur with normal physiological ageing [32]; usually, body weight increases during adulthood and peaks at the age of 65 years in women and 54 years in men [33]. Muscle mass is lost at a rate of approximately 8% per decade between the ages 50 and 70 years; then weight loss is coupled with an accelerated loss of muscle mass, reaching a rate of 15% each decade [33]. The overall prevalence of sarcopenia is reported to be 10% [34]; with the continued increase in the older population, sarcopenia is becoming a serious global public health problem.

Sarcopenia is associated with the ageing process [35]; loss of muscle mass and strength, which in turn affects balance, gait and overall ability to perform tasks of daily living, are hallmarks of this disease that is also a powerful predictor of disability [36]. The risk of disability is 1.5–4.6 times higher in older people with sarcopenia than in those with normal muscle. These common age-related changes in skeletal muscle are major causes of impaired physical function in older adults, contributing to impaired mobility, falls and hospitalisation. The causes of sarcopenia are multifactorial and can include muscle disuse, changing endocrine function, chronic diseases, inflammation, insulin resistance and nutritional deficiencies [38]; reductions in testosterone and oestrogen that accompany ageing appear to accelerate its development [39].

2.3.1 Screening and Assessment for Sarcopenia

Sarcopenia, like many other health conditions, is asymptomatic in its initial stages, when interventions can best prevent the adverse health outcomes [40]. Screening is

currently not a routine aspect of clinical practice, partly because of the lack of appropriate screening strategies [41]. An ideal screening test should be cheap, acceptable and easily implementable without requiring additional training [42]. Several expert groups have convened with the goal of establishing a consensus about diagnostic criteria for sarcopenia [43–46]; a common theme is that diagnosis of sarcopenia should include identification of both low muscle mass and poor muscle function, indicated by either low muscle strength or impaired physical performance, such as slow gait speed. The European Working Group on Sarcopenia in Older People (EWGSOP) consensus outlined an algorithm to aid the screening and diagnosis of sarcopenia. Box 2.4 shows the diagnostic criteria. Patients with gait speeds of 0.8 m/s or less should then undergo a second performance assessment, such as grip strength. Those meeting the criteria for low grip strength should be assessed by DXA (Chap. 1) or bioelectrical impedance analysis (BIA) to confirm the presence or absence of sarcopenia [44].

Box 2.4: Diagnostic Criteria for Sarcopenia

Sarcopenia should be considered in patients with presence of criteria 1 plus criteria 2 or 3:

Criteria 1: Low muscle mass

DXA >2 SD below mean of the younger adults:

- Men <7.26 kg/m²
- Women <5.5 kg/m²

Lowest 20% of the distribution of appendicular skeletal mass (ASM) in a normative population (aged 65 years and older)

- Men <7.23 kg/m²
- Women <5.67 kg/m²

Lowest 20% distribution of the residual of ASM adjusting for height and fat mass

- Men <2.29
- Women: <1.73

BIA >2 SD below mean (SMI) of the younger adults

- Men <8.87 kg/m²
- Women <6.42 kg/m²

Criteria 2: Low grip strength

- Men: <30 kg
- Women: <20 kg

Criteria 3: Low physical performance

- Short Performance Battery (SPPB) ≤8
- Gait speed <0.8 m/s

2.3.2 The Clinical Consequences of Sarcopenia

Osteoporosis predicts the future risk of fracture; and sarcopenia is a powerful predictor of future disability [32]. Reduced muscle mass and strength are also associated with lower bone mineral density [47, 48], consistent with the “mechanostat” theory of bone loss due to reduced forces of muscle on bone [49]. In fact, sarcopenia may contribute to falls and, as a consequence, increase fracture risk [50, 51]. Hence, not surprisingly, there is evidence that low muscle mass and strength are associated with fractures [51]. Several studies have confirmed associations between low muscle mass, future functional decline and physical disability [2]. Physical inactivity or decreased physical activity is part of the underlying mechanisms of sarcopenia, so physical activity is important in reversing or modifying it. Several interventions have been proposed for the treatment of this loss of muscle and strength, but exercise is central. Sarcopenia has also been linked to higher hospitalisation rates, increased morbidity and mortality [52, 53]. Sarcopenia may also be associated with metabolic and cardiovascular diseases such as diabetes, dyslipidaemia and hypertension [32].

2.3.3 Interventions to Prevent Sarcopenia

It is better to prevent progressive loss of skeletal muscle mass, strength and function rather than try to restore it later, so preventive strategies should be initiated early, before loss of skeletal muscle mass and strength occurs.

Exercise interventions have the most significant improvement in sarcopenia. The benefits of physical activity in the elderly population include lower mortality and functional independence (Chap. 6). There are four specific categories of recommended exercise: (1) aerobic exercise, (2) progressive resistance exercise, (3) flexibility exercise and (4) balance training [3].

Nutrition is also important in preventing and reversing sarcopenia (Chap. 7). Increasing age is associated with reduced appetite and early satiety, resulting in many older people failing to meet the recommended daily dietary allowance (RDA) for protein, which has important implications for skeletal muscles [54]. Older adults will require higher dietary protein (up to 1.2 g/kg/day) to counteract age-related changes in protein metabolism and higher catabolic state associated with chronic or acute diseases [55].

It is the combination of exercise and nutrition interventions that is the key to preventing, treating and slowing down the progression of sarcopenia [54]. Pharmaceutical agents are under investigation but with no current proven benefit. Pharmacological agents such as myostatin inhibitors, testosterone, angiotensin-converting enzyme inhibitors and ghrelin-modulating agents are being investigated to treat sarcopenia, but there is inadequate evidence to support their use. Low serum vitamin D levels are associated with reduced muscle strength, and it has also been demonstrated that a dose-response relationship exists between serum levels and muscle health. If serum levels are low, vitamin D should be replaced with replenishment dosages ranging from 700 to 1000 IU/day [56].

Box 2.5: Multiple Factors That Contribute Collectively to Frailty, Sarcopenia and Falls

Potentially treatable:

- Social factors including social isolation, living alone
- Lack of access to transport
- Elder abuse
- Poverty and food insecurity
- Failure to provide for ethnic food preference
- Inability to prepare and cook meals or to feed self
- Inability to shop
- Alcoholism

Medical:

- Thyroid disease
- Cardiac failure
- Gastrointestinal disease affecting absorption: anorexia (antibiotics/digoxin), early satiety (anticholinergic drugs), reduced feeding ability (such as sedatives/psychotropics), dysphagia (NSAIDs), constipation (opiates/diuretics), diarrhoea (laxatives/antibiotics), hypermetabolism (thyroxin)
- Sensory impairment—vision/hearing
- Oral problem, e.g. poorly fitting dentures
- Swallowing problem/dysphagia, thickened diet
- Poorly managed pain or constipation

More difficult to treat:

- Medical factors
- Loss of taste and smell, restricted diets
- Cognition—dementia
- Catabolism
- Gastritis
- Cancer
- Mood—depression, paranoia
- Medications/polypharmacy

Implementing interventions for frailty and sarcopenia has several challenges and barriers. A systematic review demonstrated that older people believe that exercise is unnecessary or, even, potentially harmful [58]. Others recognise the benefits of exercise but report a range of barriers to participation in exercise interventions. Raising awareness is important to enhance exercise participation among older people and to prevent sarcopenia.

Another barrier that needs to be considered in planning long-term strategies to prevent and treat sarcopenia in older people is the financial ability to attend exercise programmes [59]. Factors such as access to food, finances and social isolation may all impact on an older person's ability to obtain optimal food intake.

2.4 The Link Between Frailty, Sarcopenia and Falls

Falls in older people are associated with multicomponent impairments, particularly of muscle function, balance and cognition, so are best understood as resulting from complex system failure as part of the frailty syndrome in the presence of sarcopenia [57]. Falls and fall prevention are considered in more detail in Chap. 3. Box 2.5 provides an overview of the multiple factors that contribute collectively to frailty, sarcopenia and falls, which include cellular and tissue changes, as well as environmental and behavioural factors.

2.5 Suggested Further Study

Search for information and online programmes on the impact of ageing on older people:

- <http://aginginmotion.org/>
- <https://nos.org.uk/for-health-professionals/>
- <https://www.cme.nof.org/>

Talk with patients, carers and other staff about the things they feel that lead to and prevent frailty, sarcopenia and falls. Reflect on what these conversations suggest about how practice might be developed to improve mobility outcomes by involving patients.

2.6 How to Self-Assess Learning

- Seek advice and mentorship from other expert clinicians.
- Meet with specialists and other members of the team to keep up to date on new evidence and disseminate it to colleagues.
- Search on a regular basis about recent new practices, guidance, knowledge or evidence.

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