Nutritional Management of Sarcopenia and Frailty—Shift from Metabolic Syndrome to Frailty

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Summary  Older adults have physical and metabolic characteristics, and there are many differences in nutritional outcomes from middle-aged adults. In addition, there are many factors that cause malnutrition peculiar to the older adults, which are not seen in middle-aged adults, and it is easy for them to lose weight and become malnourished. Therefore, nutritional management needs to take into account the age of each subject. Uniform nutritional management can even cause poor health outcomes. The concept of frailty, especially phenotype frailty, and sarcopenia, which have been advocated with the aging of the population and the extension of life expectancy around the world, is very important in considering the extension of healthy life expectancy. In other words, in the super-aged society, frailty and sarcopenia have been emphasized as factors of functional decline, physical dysfunction, and the need for long-term care in addition to the well-known diseases such as cardiovascular disease, malignant tumors, and infectious disease. In fact, these two conditions are strongly associated with the increased risk of new disease development, falls, fractures, disability, hospitalization and death in the older adults. These two conditions are primarily associated with malnutrition and decreased dietary protein intake, and may recover to robustness again with appropriate interventions such as nutritional therapy. Therefore, undernutrition measures are more important for prevention of frailty and sarcopenia than measures for obesity against metabolic syndrome in the older adults, especially in the late-stage older people.

Key Words  nutrition, frailty, sarcopenia, older adults

The nutritional status of older adults influences the processes leading to the development of new diseases, requiring long-term care, and is extremely important when considering the extension of healthy life expectancy. It is known that frailty and sarcopenia are more likely to appear with aging in older adults, who are at risk of becoming in need of long-term care. Furthermore, it is known that these two pathological conditions are closely related to nutritional status. This mini-review describes the relationship between these two pathologies to nutrition and the timing of gear change from metabolic syndrome.

Frailty

Frailty is conceptualized as a state of decreased physiological reserve and compromised capacity to maintain homeostasis as consequence of age-related, multiple, accumulated deficits. Frailty is clinically characterized by delayed and/or incomplete recovery from stressors such as infections, injuries, surgery, and psychosocial distress (1).

There is still a lack of consensus on the definition of frailty and several definitions and assessments of this symptom complex have been developed, of which the Fried Frailty Score (Phenotype Score) and the broader Frailty Index (Deficit Accumulation Index) are the most commonly used. Fried physical frailty (phenotype model) is assessed using the Cardiovascular Health Survey frailty scale that includes five components: weight loss/shrinking, exhaustion, low physical activity, slow gait speed, and weakness (Table 1) (2). Each component receives a point, and the scale ranges from 0 to 5. A participant is frail if three or more criteria are present, 1 or 2 for pre-frail (have some impairment but do not meet full criteria for frailty), and 0 for robust.

This phenotype frailty has been found to predict a variety of poor clinical outcomes, including falls, physical disability, hospitalization, and mortality. On the other hand, this frailty can be reversibly restored to robustness with appropriate intervention (Fig. 1) (1).

The recent Clinical Guide for Frailty suggested that regarding the relationship between frailty and nutritional status, there are multiple cross-sectional studies showing the relationship between undernutrition and frailty (3). In addition, frailty was associated with low intake or serum concentrations of micronutrients. A number of cross-sectional studies showed that low serum 25-hydroxyvitamin D level is associated with frailty. There have also been a number of studies of the relationship between frailty and diet quality. Adherence to a Mediterranean diet was found to reduce the risk of frailty in both a cross-sectional study and in longitudinal studies. From these results this guide proposed three statements: 1) nutritional status is associated with
frailty. 2) low levels of micronutrients (particularly low serum vitamin D) predicts frailty. 3) a balanced diet (such as a Mediterranean diet) might prevent frailty (3).

In addition, this guide proposed two additional statements based on the systematic review: 1) single nutritional interventions, such as nutrition education and nutritional supplementation, can be weakly recommended for frailty; 2) we recommend physical exercise therapy in combination with nutritional supplementation for frailty (3).

**Sarcopenia**

Sarcopenia is an age-related disease characterised by low muscle mass, muscle strength and physical performance, which has been associated with physical frailty, falls, and fractures in older populations, and remains a largely undiagnosed condition. Diagnostic methods for sarcopenia have been proposed by the European Working Group on Sarcopenia in Older People (EWGSOP) (4) or the Asian Working Group for Sarcopenia (AWGS) (5).

The Sarcopenia Clinical Guidelines, published in 2018, provide statements for individual clinical questions (CQs) based on a systematic review of previously reported papers on multiple CQs (6, 7). The guidelines include statements for three nutrition-related CQs: 1) CQ1: Can sarcopenia be prevented by diet and proper nutrition? Statement: Proper nutritional intake, especially protein intake of $\geq 1.0 \text{ g/kg of bodyweight per day}$ (assuming appropriate bodyweight), might be effective for preventing the development of sarcopenia, and is therefore recommended (evidence level: low; recommendation level: strong). 2) CQ2: Can nutritional intervention be effective for sarcopenia? Statement: Nutritional interventions focused on the intake of essential amino acids might improve knee extension muscle strength in patients with sarcopenia and are therefore recommended. However, the ability of this treatment approach to improve long-term outcomes is not yet clear (evidence level: very low; recommendation level: weak). 3) CQ3: Can combined interventions be effective for sarcopenia? Statement: Compared with singular interventions, combined interventions, including comprehensive exercise-based treatment interventions, such as resistance training and nutritional intervention, are effective for improving sarcopenia and are recommended. However, the ability of this approach to improve long-term outcomes is not yet clear (evidence level: very low; recommendation level: weak).

Thus, nutrition, especially protein, is very important for the prevention and treatment of sarcopenia, and it can be seen that the combination with exercise is more effective.

**Shift from metabolic syndrome to frailty**

Presence of metabolic syndrome is already established as a risk factor associated with all-cause and cardiovascular disease (CVD) deaths in middle-aged adults. Meta-analysis found that the presence of metabolic syndrome in older people ($\geq 60 \text{ y})$ is also a risk for all-cause and CVD deaths, but at a lower risk than in middle-aged adults (8). In addition, there are some reports that the presence of metabolic syndrome is not a risk for all-cause mortality or CVD death in older adults (9). Thus, the impact of metabolic syndrome on the life prognosis in the older adults is clearly reduced compared to that in middle-aged adults.

Therefore, regarding nutritional management, I would like to propose that the target of the concept of metabolic syndrome (measures against overnutrition) is adults under 65 y old, and the target of the concept of frailty (measures against undernutrition) is 75 y old or older. Among them, the older people aged 65–74 (younger-old) are designated as gray zones for individ-
ual support. This age group still has some subjects who should focus on metabolic syndrome, while others should shift to nutrition management for frailty earlier. If unconscious weight loss has already begun, they should be shifted to frailty intervention early. Subjects who are still obese or who are gaining more weight should still be responding to metabolic syndrome.

**Conclusion**

The relationship between undernutrition and frailty and sarcopenia is clear. However, there are still many unclear points about the causal relationship between nutrients and frailty/sarcopenia. There is no doubt that getting enough energy and nutrients will lead to prevention or treatment of these. However, further evidence from the accumulation of research is needed in the future as to whether nutrition therapy alone is sufficient or whether it is necessary to use it in combination with exercise. Furthermore, it can be said that the intervention effect of individual micronutrients on these pathological conditions is unknown. Intervention studies for building such evidence are desired in the future.

**Disclosure of state of COI**

No conflicts of interest to be declared.

**REFERENCES**


