SUMMARY

Maintaining functional capacity and mobility are cornerstones for older adults to actively participate in society. The progressive and insidious muscle loss during aging is closely related to impairments in physical function and mobility, which eventually can lead to disability and loss of independence. Loss in muscle mass, strength and physical function below a critical threshold is called sarcopenia (1). Sarcopenia is a strong driver of the physical frailty phenotype, and both conditions are strongly associated with inadequate dietary intake throughout the lifespan. Part I of this thesis, including chapter 2-4, provides insights into the nutritional status, physical and clinical characteristics of primarily community-dwelling older adults with sarcopenia and physical frailty. Part II, chapter 5-7, presents the effects of specific nutritional interventions on nutritional status and muscle measures in older adults with sarcopenia and/or obesity.

Part I
Nutritional assessment and malnutrition in sarcopenic and frail older adults

Although it is difficult to prospectively study the causal relationship between low nutritional intake and sarcopenia and/or frailty, the evidence from population studies for a relationship between malnutrition and sarcopenia or frailty among older adults is strong. Our systematic review and meta-analysis (chapter 2) showed that malnutrition and physical frailty in community-dwelling older adults are related, but not interchangeable geriatric syndromes. Two thirds of malnourished older adults with a mean age of 75-80 years were physically frail, whereas close to 10% of the physically frail older adults were identified as malnourished. The majority of the frail older adults are thus not identified as malnourished, but as at risk of malnutrition (43%) or with normal nutritional status (49%). Malnutrition, undernutrition or selective suboptimal intake of nutrients such as protein and micronutrients (2), may contribute to the development of sarcopenia and frailty and consequently to several negative health outcomes (3, 4).

Hospitalisation is a relevant example of the negative health outcomes. As examined in the EMPOWER study (chapter 3), muscle measures - greater muscle mass and muscle strength, self-reported ability to walk - and absence of malnutrition at hospital admission are positively associated with survival and independent living of older patients at three months after hospital discharge. Therefore, assessment of sarcopenia and nutritional status in hospitalized older populations should be recommended as part of routine care.

In chapter 4, we compared the nutritional intake and status of non-malnourished sarcopenic older adults with age and sex matched non-sarcopenic controls in the UK. The energy intake was similar, but the sarcopenic group consumed less protein and had lower intake of several micronutrients, such as vitamin D, compared to the non-sarcopenic controls. In addition to dietary insufficiencies and deficiencies, sarcopenic older adults may even have higher or specific nutritional needs in order to enhance muscle mass, strength and function (5-7).

Part II
Effects of nutritional supplementation on nutritional status and muscle measures in older adults with sarcopenia and/or obesity

To examine the effects of a nutritional intervention with a vitamin D and leucine-enriched whey protein medical nutritional drink on muscle measures we performed
the PROVIDE study among 380 sarcopenic participants in 18 European centers (chapter 5). The 13-week supplementation of the habitual diet improved the nutritional intake and status of these physically limited, primarily community-dwelling, older adults, without any indication for health concern. This nutritional intervention without associated physical exercise resulted in greater appendicular muscle mass. Furthermore, the test group improved more in chair-stand-test compared to the control group. This study shows proof-of-principle that specific nutritional Supplementation alone might benefit geriatric patients with sarcopenia, which is especially important for those who are unable to exercise.

In the post-hoc analysis of the PROVIDE study in chapter 6, we assessed whether serum 25-hydroxyvitamin D concentrations and dietary protein intake of PROVIDE participants at baseline modifies the intervention effect. Participants with serum 25(OH)D concentrations higher than 50 nmol/L and dietary protein intake higher than 1.0 g/kg/d at baseline showed greater gain in muscle mass in response to the nutritional intervention. There was no effect modification of baseline 25(OH)D status or protein intake on change in chair-stand-test. This suggest that sufficient baseline levels of 25(OH)D and protein intake may be required to increase muscle mass as a result of a nutritional intervention in sarcopenic older adults. The current cut-offs in the recommendations for vitamin D (8) and protein intake (9, 10) could be considered the “minimum” for adults with sarcopenia to respond adequately to nutrition strategies aimed at attenuating muscle loss.

Since the prevalence of obesity is on the rise among frail and sarcopenic older adults, we explored the effects of specific supplementation on muscle mass preservation in a weight loss program. Older adults with overweight consumed either a vitamin D and leucine-enriched whey protein supplement or isocaloric control product as part of a 13-week weight loss program including caloric restriction and resistance exercise (chapter 7). Both test and isocaloric control group decreased in body weight and fat mass, and improved muscle strength and function. The intervention with this specific supplement, however, preserved appendicular muscle mass in these overweight and obese older adults during a hypocaloric diet and resistance exercise program. It might, therefore, support the metabolic function of muscle regarding glucose handling and reduce the risk for developing sarcopenia in this at risk obese older population (11, 12).

In conclusion, malnutrition including suboptimal intake of nutrients such as protein and micronutrients may contribute to the development of sarcopenia and physical frailty. Specific nutritional supplementation can help older adults to preserve muscle mass, strength, and physical function. Targeted nutritional supplementation, especially during vulnerable periods, can be of added value to cope with catabolic stress and diseases, enhance recovery and maintain a mobile and active life.
REFERENCES

Summary - Samenvatting