Protein intake to support muscle health in a clinical setting

Food intake, physical activity and muscle mass maintenance

Adequate nutritional intake is essential to maintain nutritional status, support essential body functions, maintain quality of life, and lower disease burden. Food intake, with protein ingestion in particular, and physical activity are important regulators of muscle mass. Maintenance of skeletal muscle mass is of important clinical relevance in both health and disease. Having a low muscle mass at an older age increases the risk for hospitalization, impairs physical function, and results in a longer length of hospital stay, a worsened disease prognosis, and higher mortality rates during hospitalization.

Protein consumption

In **Chapter 2**, we assessed food provision and actual food consumption in 101 hospitalized, older patients admitted for elective orthopaedic surgery. We showed that 35-40% of the provided hospital food was not consumed, resulting in extremely low energy and protein intake levels. Protein intake averaged 0.6 $g \cdot kg^{-1} \cdot d^{-1}$ during short-term (6 day) hospitalization. As we showed that patients admitted for elective orthopaedic surgery were malnourished during their hospital stay, we were interested whether even more vulnerable patients showed similar (low) food intake levels during hospitalization. In **Chapter 3** we showed that patients at risk for malnutrition consumed ~0.7 g protein$\cdot kg^{-1} \cdot d^{-1}$. Malnourished patients are often provided with oral nutritional supplements to improve total energy and protein intake. Providing patients with oral nutritional supplements did not increase the protein density of the hospital diet. Our findings demonstrate that protein intake is insufficient in patients during hospitalization. We need to think of alternative strategies to increase the protein density of the hospital meals and, as such, increase daily energy and protein consumption.

Muscle loss and regain

Besides protein intake, physical activity is an important regulator of muscle mass maintenance. Short periods of physical inactivity, lead to significant loss of muscle mass and strength. Strategies should aim to preserve muscle mass during periods of disuse. Therefore, in **Chapter 4**, we assessed whether protein supplementation can attenuate muscle loss and/or augment muscle mass regain following one week of unilateral leg immobilisation. Healthy, young males were provided with either a peptide with proposed anabolic properties or milk protein concentrate. Participants ingested deuterium oxide daily with saliva and muscle biopsy samples being collected to measure myofibrillar protein synthesis rates during the immobilisation and recovery periods. We demonstrated that peptide supplementation does not preserve muscle mass or strength during short-term immobilization, or further augment muscle mass and strength regain during remobilization when compared to milk protein supplementation. In line, peptide supplementation did not differ from milk protein supplementation in modulating myofibrillar protein synthesis rates during immobilisation. Interestingly, we did observe higher rates of muscle protein synthesis following peptide when compared with milk protein supplementation during recovery.

Higher myofibrillar protein synthesis rates during the remobilization period may be indicative of more rapid skeletal muscle reconditioning.

Anabolic properties of protein intake

As postprandial protein handling plays an important role in the anabolic response to feeding, we assessed the protein digestion and amino acid absorption kinetics and the subsequent muscle protein synthetic response following the ingestion of intact protein and free amino acids in a group healthy, young volunteers (**Chapter 5**). Ingestion of a bolus of 30 g free amino acids led to more rapid amino acid absorption and greater postprandial plasma amino acid availability when compared to the ingestion of an equivalent amount of intact milk protein. The greater amino acid availability did not lead to measurable differences in the muscle protein synthetic response following ingestion of free amino acids versus intact milk protein. It could be speculated that the ingestion of a 30 g bolus of protein or free amino acids provided, prevented us from detecting differences in postprandial muscle protein synthesis rates between treatments. The effect of greater postprandial plasma amino acid release on stimulating muscle protein synthesis may become more evident in conditions where less than 20 g protein or free amino acids are ingested and/or assessed in more clinically compromised populations suffering from anabolic resistance. In **Chapter 6** we assessed protein digestion and amino acid absorption kinetics in critically ill patients following the ingestion of intact protein and an equivalent amount of free amino acids. Administration of free amino acids resulted in a more rapid and greater postprandial plasma amino acid availability when compared to the administration of intact protein. Future studies should assess whether the greater postprandial amino acid availability results in greater postprandial muscle protein synthesis rates in critically ill patients.

Future directions

In the final chapter of this dissertation, we elaborate on the implications of less than optimal nutritional intake in hospitalized patients and focus on future opportunities to improve muscle protein balance in the clinical setting. We present the proposed benefits of incorporating a pre-sleep snack to the hospital diet. The main benefit of providing a protein-rich snack prior to sleep is that it may attenuate overnight proteolysis. Furthermore, we discuss which characteristics (e.g. high-protein, small volume. etc.) such a product should have to be the ideal pre-sleep protein snack. Lastly, we give suggestions on how to improve the entire (hospital) food concept, rather than only limiting our focus on adding a pre-sleep protein snack.