Protein intake to support muscle health in a clinical setting

Impact

What is the main objective of the thesis, and what are the most important results and conclusions?

The number of individuals older than 65 y has grown rapidly over the last decades. The increased life-expectancy is a great achievement in biomedicine and healthcare. However, the rise of the aging population is associated with greater health care costs, with higher expenses for disease and injury prevention, treatment and rehabilitation. With increasing age, hospital admissions increase as well. The average hospital stay is 5 days, however, the length of stay increases with advancing age. During hospitalization, patients lose a substantial amount of muscle mass and strength. The amount of muscle tissue lost during hospitalization predicts mortality and clinical outcomes. Furthermore, the loss of muscle mass and strength results in physical and functional declines. As there is a trend starting that older individuals need to live at home for a longer period of time, it is important that they stay independent and self-reliant. Therefore, it is crucial that we develop strategies to prevent muscle mass, strength and function loss and augment recovery in older (clinical) populations.

Nutrition and physical activity are the two main anabolic stimuli for muscle mass maintenance. In order to develop strategies to prevent muscle mass, strength and function loss, it is essential to know the current nutritional and physical status of clinical populations. In **chapters 2 and 3** we assessed energy and protein intake in relatively healthy patients, as well as older patients at risk of malnutrition. We showed insufficient levels of protein and energy intake during hospitalization. This clearly demonstrates the urgent need to improve the patients' food intake throughout hospitalization. In addition, more studies are needed to further investigate the relation between protein intake and muscle loss during hospitalization.

To understand what is happening at a skeletal muscle level during disuse, we, in **chapter 4**, assessed muscle mass and strength loss during short-term immobilization. Disuse models are used to mimic a hospitalized setting without the disease-burden. A short period of muscle disuse already resulted in a significant amount of muscle being lost. We provided individuals with a designed peptide with proposed anabolic properties or a milk protein concentrate. Ingestion of the novel peptide did not attenuate muscle mass or strength loss during short-term limb immobilization when compared with milk protein concentrate supplementation. Furthermore, supplementation did not augment the regain of muscle mass and strength during recovery. Interestingly, we did observe higher rates of muscle protein synthesis following the peptide supplementation. Though this did not result in more rapid muscle mass and/or strength regain with a short recovery period, it may be of interest in a setting of more prolonged recovery.

To better understand the effect of protein type on muscle growth, we compared protein digestion and amino acid absorption kinetics of an intact protein supplement versus a free amino acid mixture in healthy, young adults (**chapters 5**). We demonstrated that a free amino acid mixture is more rapidly digested and absorbed, but this did not results in differences in muscle protein synthesis rates between supplements. This implies that a more rapid digestion and absorption does not necessarily result in higher rates of muscle protein synthesis. However, the difference in protein digestion and amino acid absorption kinetics may be relevant in conditions where anabolic resistance is attributed to impairments in protein digestion

and/or amino acid absorption. Therefore, in **chapter 6** we assessed protein digestion and amino acid absorption kinetics in intensive care unit patients. We showed that administration of free amino acids results in more rapid and greater post-prandial plasma amino acid availability when compared to intact protein administration. Future work will assess the health benefits of greater post-prandial amino acid availability in these patients.

What is the contribution of the research results to science and society?

The results presented in this thesis contribute to the scientific field of clinical nutrition and skeletal muscle metabolism. They help to better understand the relation between protein intake and muscle metabolism. With this knowledge, researchers can develop and investigate more effective strategies to increase protein intake and improve muscle health in clinical populations. Those strategies will be implemented in clinical practice to improve food intake and prevent muscle loss in clinical populations. If we can attenuate or prevent muscle mass, strength and function loss, we may reduce hospital stay and shorten the time needed to recover from hospital admission(s). Furthermore, when older individuals leave the hospital in a fitter state (e.g. well-fed and with better muscle health), they will more rapidly regain the capacity to live independently for a longer period. This can reduce the burden on our healthcare system, as less individuals require (additional) care (e.g. nurses at home, first-line dieticians and physical therapists) and will ultimately improve quality of life.

To whom are the research results relevant?

Besides the relevance for the scientific society, the results of this thesis are of considerable interest to dieticians. Dieticians need to have a good understanding of the current nutritional state of patients to prescribe a fitting diet. Ideally, patients should be informed about the importance of (sufficient) protein intake and muscle mass maintenance prior to hospital stay. Therefore, not only dieticians working in hospitals will benefit from the research results, our data are also relevant for dieticians who advise patients prior to and during recovery from hospital admission.

Furthermore, the presented results are relevant to (health care) policy makers. We clearly demonstrated that most patients are malnourished during their hospital stay. It is essential to implement strategies to make sure patients are able to meet their nutritional needs. To change the current logistical food concept, investments need to be made to change the infrastructure and evaluate the food concept. The presented work is also of interest to the general public, as every individual should recognize the importance of consuming sufficient protein and maintaining muscle mass prior to, during and after hospitalization. In addition, the research results are also relevant for physicians, nurses and food assistants, as they need to be educated on the importance of (the lack of appropriate) nutrition in a clinical setting.

Lastly, new insights into the relationship between protein intake and muscle health are of interest to the food industry. New strategies will be developed to prevent the loss of muscle mass, strength and function during hospital stay, which requires input from food companies to produce healthy, protein-rich snacks that can be effectively applied in novel food concept for patients.

Several communication strategies are applied to inform the various relevant stakeholders. The results are or will be published in international, peer-reviewed journals. The studies have been presented at several conferences and symposia, which increases the visibility of the results and contributes to new insights and ideas for future research. In addition, the results have been communicated during seminars for dieticians and during general lectures to increase public awareness of the importance of sufficient protein intake and the attenuating of muscle mass.