The BASES Expert Statement on optimising protein intake recommendations for skeletal muscle mass in older adults to support healthy ageing

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Introduction

The maintenance (and adaptation) of skeletal muscle mass across the lifespan is important for several health-related outcomes (e.g., cardio-metabolic health, functional capacity, fall risk) and represents an important prognostic marker in many clinical conditions. An area of particular clinical relevance is the importance of dietary protein to maintain muscle mass. We refer the reader to our previous expert statement (Issue 71) for a detailed discussion of how dietary protein principally regulates the synthesis of new, functional skeletal muscle tissue (termed muscle protein synthesis [MPS]). However, it is worthy of note that a blunted MPS response to each meal (termed 'anabolic resistance') as we age is a primary determinant of age-related muscle loss (termed 'sarcopenia'). In this statement we will discuss how current dietary protein recommendations could be optimised in an effort to combat anabolic resistance and therefore support healthy (muscle) ageing. We will focus on providing practically relevant and concise dietary protein intake recommendations for older adults.

Recommended Dietary Allowance (RDA)

Whilst the RDA for macronutrients somewhat differs across countries, its general purpose is to meet basic nutritional requirements and avoid deficiencies in the majority (~95%) of the population. It is therefore not intended, nor does it provide, an estimation of 'optimal' intakes. In the UK, the protein RDA is set at ~0.75g·kg BM[body mass]$^{-1}$·day^{-1}, which equates to ~60g·day^{-1} for a ~80kg individual. These recommendations are not delineated further on any other characteristic (e.g., age, sex etc.). However, accumulating evidence exists that the optimum daily protein intake for muscle mass maintenance in older adults markedly exceeds the current RDA, to at least 1.0-1.2g×kgBM^{-1}×day^{-1}. For the purpose of this statement, we define older adults as individuals ≥60 years of age given that sarcopenia typically accelerates beyond this timepoint, though we acknowledge that the recommendations may also be of value to individuals below this age.

Protein requirements and recommendations: healthy older adults

Sarcopenia manifests as early as the fourth decade of life and is underpinned by dysregulation in muscle protein turnover. Whilst no clear differences in postabsorptive MPS rates are observed between young and older adults, older muscle exhibits a blunted anabolic response at a typically consumed protein dose (<20g) (Wall *et al.*, 2015). However, increasing protein intake per meal (and as a result, on a daily basis beyond the RDA) in older adults is at least partially effective in mitigating anabolic resistance and thus eliciting an anabolic response more similar to younger muscle. Indeed, long-term studies consistently report declines in muscle mass of healthy older adults that are habitually consuming the protein RDA (Campbell *et al.*, 2001) and are more severe than those consuming >1.2g·kgBM^{-1}·day-1 (Houston *et al.*, 2008). With respect to optimising this process, on a per serving basis, the maximal effective dose of protein for stimulation of MPS, which increases with advancing age, is ~0.40g·kgBM^{-1}·meal^{-1} (vs. 0.25g in younger) in older adults (Moore *et al.*, 2015). However, >⅓ of older adults fail to consume even the RDA for protein, let alone the ~95g (for an 80kg individual) that 3 × meals at this dose would constitute. This protein deficiency is further exaggerated in frail older adults (discussed below), owing to issues such as reduced appetite, dysphagia, medications and/or psycho-social barriers. The consumption of high-quality protein (i.e., that contains a full complement of essential amino acids) foods and liquids, protein supplementation and/or fortification of foods increases the peripheral availability of dietary amino acids and thus represent practical strategies for more compromised older populations. In addition, older adults typically consume the majority of their daytime protein intake within a single meal (i.e., at dinner) and therefore may not benefit from repeated maximal acute stimulation of MPS at each meal /feeding opportunity. Accordingly, the notion that daily protein intake should be spread evenly between meals/servings (~3–4h apart) is intuitive and particularly promising in compromised individuals, but still requires confirmatory data from tightly controlled metabolic studies.

Are there sex-specific differences?

To date, there is relatively weak evidence suggesting sexual dimorphism in the postprandial MPS response to ingested protein and muscle adaptative responses in young adults. However, whilst sex differences remain relatively unexplored to support specific practical recommendations, sexual dimorphism to protein intake may exist in adults at a more advanced age. Specifically, older women exhibit higher postabsorptive MPS rates, but a blunted MPS response to protein feeding, compared with older men under resting conditions (Smith *et al.*, 2016), which suggests that older women may require more protein per meal than older men to achieve a comparable muscle anabolic response.

Special considerations

Aside from ('normal') ageing, muscle anabolic resistance is also a common feature of frailty, obesity and other catabolic states such as cancer cachexia, surgery, and periods of muscle disuse induced by limb immobilisation and/or bedrest. However, there is evidence that anabolic resistance can still be (partially) mitigated with ingestion of (sufficiently large doses of) protein even in frail and the 'oldest old' adults. Indeed, nutrition may represent a crucial intervention in these populations given that exercise training is typically less well adhered to and, importantly, seems far less effective under protein-deficient situations. Specifically, whilst protein supplementation per se is insufficient in improving muscle mass in frail older adults, when combined with a progressive resistance-type exercise training programme this increased protein intake facilitates hypertrophy (Tieland *et al.*, 2012). Accordingly, increasing protein intake to up to or even >1.6g·kgBM^{-1}·day^{-1} may benefit these populations, particularly when combined with some form of resistance-based exercise. Frail older adults, in particular, experience regular episodes of musculoskeletal disuse during illness that requires extended periods of bedrest/reduced ambulation. These episodes of disuse typically increase across the lifespan, not only in frail older adults, and can accelerate sarcopenia. Moreover, as we age, we generally become less physically active, even in the absence of injury/illness.

Accordingly, dietary protein recommendations should be increased to ≥1.6g·kgBM^{-1}·day^{-1} to combat the inactivity-induced decline in muscle mass. However, meeting this protein recommendation may be challenging, particularly during hospital stays, when protein intake tends to fall below recommendations. Nutrition strategies to achieve higher protein intakes (e.g., parenteral nutrition) in older patients during hospitalisation/disuse are warranted, particularly during severe catabolic states (e.g., burns, cancer cachexia, sepsis patients). However, protein requirements for critically ill older patients are not well understood and will likely vary with the phase of illness and recovery. It should be acknowledged that, even in the event of achieving higher protein intakes during disuse, evidence exists that this can be ineffective in the absence of muscle contraction, and therefore every effort should be made to introduce some form of physical activity as soon as reasonable.

Role of Exercise Training: Master athletes

Highly active older adults who have maintained structured exercise training habits (referred to as 'Master Athletes') display superior indices of physiological function (aerobic capacity and strength) and body composition compared with their untrained age-matched counterparts (McKendry *et al.*, 2019). Hence, as opposed to a focus on muscle maintenance, Master Athletes' goals are centred on optimising muscle remodelling and, potentially, promoting muscle hypertrophy. Despite higher physical activity levels, a superior biological profile, and the suggestion that the muscle anabolic response to protein may be better maintained in Master Athletes compared with untrained older adults, higher dietary protein intake of >1.6g·kgBM^{-1}·day^{-1} is required to support optimal muscle recovery and remodelling around training and competition. Importantly, regardless of training history, older adults maintain the capacity for robust MPS responsiveness to exercise training when coupled with sufficient dietary protein intake. It's never too late to start exercising!


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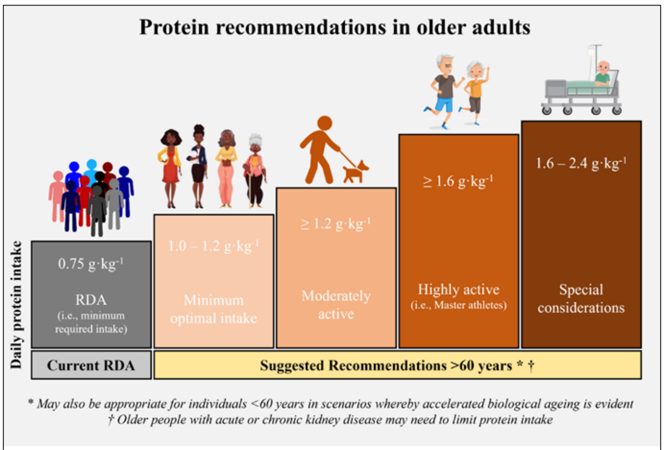

Figure 1. Summary of protein recommendations for older adults.

Protein, kidney failure and bone health: is there any evidence to support a link?

Although a protein intake higher than the RDA and up to 2.4g·kgBM^{-1}·day^{-1} has been associated with benefits to muscle, no adverse effects to health appear to be a consequence in the majority of populations. The habitual consumption of higher (i.e., >RDA) dietary protein fwas originally suggested to negatively impact kidney function due to a sustained increase in kidney workload. However, in otherwise healthy individuals, there is no evidence that links a higher protein intake with reduced kidney function. Interestingly, a higher relative protein intake in adults with normal kidney function is associated with a lower incidence of end-stage/chronic kidney disease (Park *et al.*, 2021). Another suggestion has been that high(er) protein intakes could lead to an acidic environment and cause leaking of calcium from bones (termed the 'acid-ash hypothesis'). In contrast, high(er) dietary protein intakes are associated with bone-supporting mechanisms, assuming sufficient provision of calcium and vitamin D.

Conclusions

Numerous factors (e.g., anabolic resistance, disuse, hospitalisation, activity levels) warrant consideration when devising protein recommendations across the lifespan. A summary of our daily protein intake recommendations for older adults is illustrated in Figure 1. ■

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