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Supplementing a normal diet with protein yields a moderate improvement in the robust gains in muscle mass and strength induced by resistance training in older individuals

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From midlife, a progressive decline in muscle mass occurs, which is an independent risk factor for disability among elderly people (1). This natural process of biological aging can be either worsened or diminished by environmental, pathological, and pharmacologic conditions as well as daily living habits. Two basic prerequisites for the maintenance of skeletal muscle mass among older people are adequate energy and protein intakes as well as physical activity and muscular training. In this issue of the Journal, Liao et al. (2) present a systematic review and meta-analysis that shows that overweight older persons [age >60 y; BMI (in kg/m^2) >25] benefit from protein supplementation when aiming for resistance training–induced hypertrophy and strength gains. This finding is important and timely. Conflicting reports have questioned the importance of protein supplementation both as a stand-alone "treatment" to preserve muscle mass (3) as well as a crucial prerequisite for gains in muscle mass and strength during periods of muscular training (4, 5).

It is evident that dietary protein is crucial for providing amino acids to balance the constant net loss due to metabolism and excretion. However, the fate, utilization, and recirculation of amino acids are adaptive and, hence, the range of adequate and safe protein intakes is highly individual, ranging from ~0.66 g · kg^{-1} · d^{-1}, in which 50% of adults are in zero net protein balance (6), to intakes that are ≤2- to 3-fold higher (7). Various conditions (disease, inflammation, sepsis, energy intake, and level of physical activity) affect the requirement, but once metabolic and synthetic processes are saturated with amino acids, an increase in availability will be directed toward energy metabolism and will not further benefit growth. Therefore, we emphasize that protein supplementation cannot be expected to "never" or "always" benefit skeletal muscle hypertrophy. Basically, only individuals who ingest inadequate amounts of protein through their daily diet are likely to benefit from protein supplementation in terms of enhancing muscle growth during periods of resistance training, for example.

Regular resistance training has the potential to preserve and to add muscle mass and function in the elderly (8). In the quest to identify evidence-based, efficient strategies for maintaining muscle mass and function in the general population as well as in overweight and obese persons, it must be noted that almost all studies of resistance training in an elderly population found increases in strength of ~24–33% (9) and of ~1–21% in muscle mass (10). Thus, strength training without protein supplementation is a strong intervention for preserving muscle function and mass. However, one specific situation in which the combination of strength training and protein supplementation may be of special interest is with the simultaneous presence of sarcopenia and obesity (11). In the systematic review by Liao et al. (2), the additional effect of protein supplementation for resistance training–induced gain in lean body mass normalized to the SD of the measurement [standard mean difference (SMD) or effect size] was 0.58 and highly significant. For lower-extremity strength gain, the SMD was 0.69. To put the effect sizes into context, in one of the larger included studies the significant increase in lean body mass after resistance training was ~0.8 ± 1.3 kg and lower-extremity strength increased by ~55 ± 55 newtons (N) in a group of 161 participants; no significant differences between the investigated groups were evident (12). With these SDs of the change, the expected additional effect with protein supplementation on lean mass and leg strength is ~0.8 kg and 38 N, respectively. However, the observed nonsignificant differences were ~0.2 kg and ~3 N, respectively, corresponding to a study-specific SMD of −0.15 and 0.07, which shows that protein supplementation cannot be expected to induce large effects on gains in muscle mass and strength in all settings. Clearly, other studies have shown rather large effects of supplementation to reach the SMDs reported in the meta-analysis. One example is an SMD of 1.81 as a result of a modest effect of ~3% on strength, which corresponds to ~18 N in the supplemented group, whereas no training effect was evident in the nonsupplemented group (13). These examples highlight that the results of systematic meta-analyses need to be interpreted with the differences in methodology and observed gains of muscle mass between the included studies in

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mind, and we argue that the additional effect of protein supplementation in overweight elderly individuals is modest compared with strength training alone when analyzing well-designed studies in well-nourished individuals.

In a subgroup of obese (BMI >30) elderly individuals, an additive effect of protein supplementation on strength training outcomes could not be shown (2). Importantly, only 5 studies ($n = 221$) were included for this analysis, and although the group-average BMI was >30, the participants were within a wide range of BMIs and percentages of body fat. Such lack of homogeneity is likely to result in larger variations and, hence, smaller chances of detecting effects. One rather large cohort and intervention study conducted in obese older women concluded that a diet that was moderately high in protein was able to preserve muscle mass (14). Therefore, the conflicting significance of the impact of protein intake on muscle mass in obese older adults prevents a clear conclusion, and more studies are required in this specific target group.

More generally, it has to be acknowledged that, of the 17 studies included in the study by Liao et al. (2), only 6 had a duration of >24 wk and ranged from 48 to 72 training sessions. Thus, the importance of protein supplementation for adaptations in skeletal muscle beyond this time frame remains unclear.

Finally, future research in this important area should focus more narrowly on certain characteristics among older people (e.g., obesity) or include sufficient numbers of participants to allow post hoc exploration of the impact of body composition, sex, and various other confounders on muscle-specific outcomes as well as the application of sufficient follow-up periods to evaluate more-prolonged health benefits. Such endeavors also call for an interdisciplinary research approach.

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