A meta-analysis to interrogate skeletal muscle anabolic response to resistance exercise protocol

Ikufumi Takahashi, PhD, PT[1,2], Moeka Yokoyama, PhD, PT[3], Nana Takenaka-Ninagawa PhD, PT[4,5], Fabrisia Ambrosio, PhD, MPT[6,7,8], Hirotaka Iijima, PhD, PT[6,7,8]

[1]Section of Rehabilitation, Kanazawa University Hospital, Ishikawa, Japan.
[2]Department of Motor Function Analysis, Human Health Sciences, Graduate School of Medicine, Kyoto University, Kyoto, Japan.
[3]Department of Physical Therapy, Faculty of Health Science, Juntendo University, Tokyo, Japan
[4]Department of Clinical Application, Center for iPS Cell Research and Application (CiRA), Kyoto University, Kyoto, Japan.
[5]Department of Rehabilitation Medicine, Nagoya City University Graduate School of Medical Sciences, Nagoya, Japan.
[6]Discovery Center for Musculoskeletal Recovery, Schoen Adams Research Institute at Spaulding, Charlestown, MA
[7]Department of Physical Medicine & Rehabilitation, Harvard Medical School, Boston, MA
[8]Department of Physical Medicine & Rehabilitation, Spaulding Rehabilitation Hospital, Charlestown, MA

DISCLOSURE: The authors declare nothing to disclose

ABSTRACT:
INTRODUCTION: Aging is associated with sarcopenia, the progressive loss of skeletal muscle mass and function, leading to decreased mobility, increased risk of falls and fractures, and reduced quality of life in older adults.[1] While resistance exercise is effective in counteracting muscle loss by promoting muscle protein synthesis and hypertrophy, aging often impairs this anabolic response, a condition known as "anabolic resistance."[2] This phenomenon results in reduced muscle protein synthesis and attenuated muscle gains in older adults in response to resistance training. The underlying mechanisms of anabolic resistance remain unclear, and existing studies show inconsistent findings due to varying study designs, exercise protocols, and small sample sizes. To address this critical knowledge gap, this study employed a series of computational approaches to examine the current state of the field regarding anabolic resistance of aged skeletal muscle in response to resistance exercise.

METHODS: We searched peer-reviewed literature published up to July 2024 for studies reporting skeletal muscle response to a resistance exercise protocol in young and older adults. Summary estimates were computed using random-effects meta-analysis, and outcomes were stratified by sex.

RESULTS: A preliminary implementation of literature search identified 12 studies (273 young adults versus 290 older adults). Comprehensive clinical and functional characterization of skeletal muscle response to acute and/or chronic resistance exercise protocols revealed that aged lower limb skeletal muscle displayed blunted strength gains compared to young counterparts. Moreover, we discovered that the age-related decline in skeletal muscle anabolic response is sex-specific, with aged females displaying blunted muscle strength gains compared to male counterparts.

DISCUSSION: While individual studies lacked a statistical power to draw confident conclusions, meta-analysis of the integrated data across the available studies demonstrated that skeletal muscle displayed muscle strength gains to resistance exercise protocol in age- and sex-dependent manner. The findings from this study suggest the development of sex-specific intervention strategies to promote skeletal muscle health in an older population.

SIGNIFICANCE/CLINICAL RELEVANCE:
- By employing a meta-analysis approach, this study enhances our understanding of age-related decline in skeletal muscle anabolic responses to resistance exercise protocols.
- The findings highlight the need for sex-specific intervention strategies to effectively counteract anabolic resistance in aged skeletal muscle, improving overall mobility and quality of life in older adults.

REFERENCES:
1. Larsson L, et al. Sarcopenia: Aging-Related Loss of Muscle Mass and Function. Physiol Rev 2019;99(1):427-511.
2. Endo Y, et al. Optimizing Skeletal Muscle Anabolic Response to Resistance Training in Aging. Front Physiol 2020;11:874.

ACKNOWLEDGEMENTS: Not applicable.