



Comparative ultrasonographic assessment of supraspinatus, infraspinatus, and biceps tendon thickness in bodybuilders and non-sportsperson

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Received: 27 July 2024 / Accepted: 2 December 2024

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Abstract

Background Healthy tendons are crucial for sportspersons to prevent injuries. While resistance exercise is known to increase muscle size and composition, its impact on tendon thickness remains unclear. This study investigated potential differences in tendon thickness between bodybuilders and non-sportsperson control group and their association with training intensity/duration in bodybuilders.

Methods Forty men in the age range 18 to 40 were included in the study. Fifteen bodybuilders (2–3 weekly upper body resistance training sessions, moderate-to-high intensity, > 6 months) and 25 non-sportsperson controls participated. All were free of tendon injuries in the studied muscles (biceps, supraspinatus, infraspinatus). Two independent physiatrists measured tendon thickness using ultrasound.

Results No significant differences in tendon thickness were found between bodybuilders and non-sportsperson controls (dominant/non-dominant sides). However, within the bodybuilding group, tendon thickness showed strong positive correlations with both training intensity ($r=0.59–0.84$) and exercise duration ($r=0.71–0.88$).

Conclusion This study found no overall group differences in tendon thickness between bodybuilders and non-sportsperson controls. However, for bodybuilders, increased training intensity and duration were associated with thicker tendons. Further research with larger samples and advanced techniques is warranted to understand the complex relationship between resistance training and tendon adaptations.

Keywords Exercise · Tendons thickness · Bodybuilders · Ultrasound · Supraspinatus · Infraspinatus · Biceps

Abbreviations

EMS	Eclectic muscle stimulation
1RM	One repetition maximum
LHBT	Long head of the biceps tendon
SST	Supraspinatus tendon
SPSS	Statistical Package for Social Sciences

Introduction

In recent years, new sports like functional fitness, jumping fitness, and wearable technologies such as electrical muscle stimulation (EMS) have emerged. However, bodybuilding has remained popular and has become one of the most prominent fitness activities, especially through its presence on social media platforms. This has resulted in more people engaging in bodybuilding to improve their self-perception and body image [1, 2]. Bodybuilding primarily involves systematic resistance training exercises targeting most major muscle groups. These exercises are performed over an extended period, with varying frequency and intensity, aiming to induce muscle hypertrophy [3]. It is noteworthy that some bodybuilders employ anabolic hormones and rigorous dietary regimens to optimize muscle growth [4]. Supraspinatus and infraspinatus, as a part of rotator cuff muscles, assist in the abduction and external rotation of the arm, stabilizing the glenohumeral joint by compressing the

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To our knowledge, this study is the first to examine the effects of bodybuilding on biceps, supraspinatus, and infraspinatus tendon thickness, limiting direct comparisons with existing literature. In contrast to our findings, Wang et al. reported significant differences in biceps and supraspinatus tendon thickness between baseball athletes and non-athlete controls [19]. The absence of significant differences in our study may be attributed to sport-specific adaptations, training duration, sample size limitations, or variations in measurement techniques. Bodybuilding, unlike baseball, may not induce the same degree of tendon hypertrophy due to differences in mechanical loading patterns. Additionally, our participants' training history (duration) may not have been sufficient to elicit measurable tendon adaptations, or our sample size may have limited statistical power to detect subtle differences. Further research with larger samples and longitudinal designs is needed to clarify the potential effects of bodybuilding on tendon morphology.

Malanga et al. investigated supraspinatus tendon thickness differences between dominant and non-dominant arms in young baseball players [20]. Their study, involving twelve asymptomatic players, utilized ultrasound measurements. Results revealed significant differences in supraspinatus tendon thickness (in both long-axis and short-axis views) for the dominant side of right-handed players, but not for left-handed players. The discrepancy between these findings and our results may be attributed to the nature of the sports examined. Baseball pitching predominantly involves unilateral arm use, whereas bodybuilding typically requires bilateral, symmetrical muscle contractions. This fundamental difference in movement patterns and force distribution likely accounts for the contrasting outcomes observed in tendon adaptations between the two sports.

In our study, high-intensity resistance exercise performed for more than 3 years demonstrated a significant correlation with tendon thickness of the biceps, supraspinatus, and infraspinatus muscles in both dominant and non-dominant shoulders of bodybuilders. This finding aligns with research by Seynnes et al., who observed increased patellar tendon cross-sectional area after just 9 weeks of resistance training [21]. They attributed these rapid changes to the high mechanical loads associated with resistance exercise, which stimulate tendon adaptation. The longer duration of our study (> 3 years) compared to Seynnes et al.'s 9-week intervention may explain the more pronounced tendon adaptations observed in our participants. These results suggest that long-term, high-intensity resistance training can induce significant structural changes in shoulder tendons, potentially as an adaptive response to increased mechanical loads over time.

This study had several limitations, primarily due to the COVID-19 pandemic, which restricted participant recruitment and follow-up assessments. The resulting small sample

size and cross-sectional design limited our ability to assess longitudinal changes in tendon thickness among bodybuilders. Additionally, ultrasound was not performed before the exercise program, preventing comparisons of tendon thickness before and after training. Future research should aim to include larger cohorts of professional athletes with extended training histories and utilize advanced imaging techniques such as MRI. Incorporating tendon elastography could also provide a more comprehensive evaluation of training-induced adaptations.

Future studies should implement longitudinal designs with baseline measurements to better understand the temporal dynamics of tendon adaptation. These studies could explore the optimal timing, dosage, and duration of exercise protocols to maximize tendon healing and recovery. Additionally, examining the cellular and molecular mechanisms underlying tendon adaptations to resistance training would provide valuable insights. Such research would enhance our understanding of the relationship between resistance training and tendon morphology, as well as identify potential factors influencing tendon thickness changes over time.

Conclusion

This study provides novel insights into the effects of long-term, high-intensity bodybuilding on tendon morphology in the shoulder region. While no significant differences in overall tendon thickness were observed between bodybuilders and non-athlete controls, our findings reveal a positive correlation between exercise intensity and duration with increased tendon thickness within the bodybuilding group. This suggests that prolonged, vigorous resistance training may induce adaptive changes in tendon structure, potentially as a response to increased mechanical loading. However, the complex relationship between resistance training and tendon morphology warrants further investigation. Future longitudinal studies with larger sample sizes, advanced imaging techniques, and consideration of molecular mechanisms are necessary to elucidate the full extent of tendon adaptations in response to bodybuilding.

Acknowledgements This manuscript was the subject of the dissertation of Najmeh Pirasteh (NO.23420), which was approved by the vice-chancellor of research at Shiraz University of Medical Sciences, Shiraz, Iran. The authors would like to thank the center for developing clinical research at Nemazi hospital and Dr. Nasrin Shokrpour for editorial assistance. The authors would also thank Mr. Ali Kamali for arrangement of cases.

Authors' contributions All authors contributed equally to the manuscript preparation and read and approved the final manuscript.

Funding No financial support was received for this report.