Relationships between Vertical Jump Height and Muscle Size and Quality of the Rectus Femoris and Vastus Lateralis

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ABSTRACT

Ultrasound assessments of muscle cross-sectional area (CSA) and echo intensity (EI) are commonly used to examine muscle size and quality in younger adults. Greater muscle CSA and lower EI values of the rectus femoris (RF) and vastus lateralis (VL) have been associated with improvements in lower-body muscle power and consequently, may play a significant role in the maximum height achieved during a vertical jump test. **PURPOSE**: To examine the relationships between vertical jump height and CSA and EI of the RF and VL muscles in healthy, young females. **METHODS**: Seventeen young females (age = 22 ± 3 years; mass = 61 ± 8 kg; height= 162 ± 6 cm) volunteered for this study. Participants visited the laboratory two times, separated by 7 days, at approximately the same time of day (±2 hours). During the first visit, participants were familiarized with the jumping procedures and underwent 2 diagnostic ultrasound assessments of the RF and VL muscles using a portable B-mode ultrasound imaging device and linear-array probe. During the second visit, participants performed 3 countermovement vertical jumps using a jump mat, which measured jump height (cm) based on flight time. All ultrasound images were scanned on the right leg with the probe oriented in the transverse plane. RF images were taken at 50% of the distance between the anterior superior iliac spine and the proximal border of the patella. VL images were taken at the midpoint between the greater trochanter and lateral epicondyle of the femur. For each scan, participants laid supine with the knee resting comfortably in extension, while the investigator (A.C.C.) moved the probe manually at a slow and continuous rate along the surface of the skin from the lateral to the medial sides of the muscle using a panoramic ultrasound imaging technique. Images were analyzed by determining a region of interest consisting of as much of the muscle as possible without any surrounding bone or fascia. CSA (cm^2) and EI (AU) were measured from the same region of interest using a quantitative gray-scale analysis (black = 0, white = 255). Pearson product-moment correlation coefficients (r) were used to examine the relationships between RF and VL CSA and EI and vertical jump height. **RESULTS**: CSA and EI values (mean ± SD) were 9.61 ± 2.60 cm^2 and 70.89 ± 8.12 AU for the RF and 21.85 ± 4.71 cm^2 and 68.59 ± 6.69 AU for the VL, respectively. Jump height was 34.90 ± 4.14 cm. There was a significant positive relationship between jump height and VL CSA (r = 0.525, P = 0.030); however, there were no relationships between jump height and VL EI (r = -0.140, P = 0.592), RF CSA (r = 0.324, P = 0.204), and RF EI (r = -0.126, P = 0.629). **CONCLUSION**: The present findings of a significant positive relationship between jump height and VL CSA suggest that muscle size of the VL may play an important role in vertical jump performance. These findings highlight the need for training programs aimed to increase the size of the VL, as this may be beneficial for improving vertical jump height in younger adults.