

Relationships among Maximal and Explosive Strength Production of the Leg Extensors and Vertical Jump Peak Power Output in Female Youth Volleyball Athletes

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ABSTRACT

Architectural and physical performance measurements are commonly implemented to identify various physical capacities in many populations. However, previous research has suggested architectural measures, notably in the leg extensors, are ineffective predictors of vertical jumping (VJ) performance. Given the functional relevance of rapid strength development on explosive dynamic tasks, further research is warranted examining, a) the presence of associations of maximal (e.g., peak torque; PT) and, in particular, explosive (e.g., rate of torque development; RTD) strength-related characteristics with jumping performance in the leg extensors, and b) the extent to which PT and RTD either uniquely, or synergistically contribute to VJ performance. The purpose of this study was to examine the relationships between isometric maximal and explosive strength measures of the leg extensors and VJ peak power (PP) output in female youth volleyball athletes. Thirty (mean \pm SD, range: age= 13.73 \pm 1.11, 12-17 years, height=162.53 \pm 6.39 cm, body mass=57.84 \pm 12.05 kg) female youth competitive volleyball players reported to the laboratory on two occasions, with the first visit being a familiarization session. The second visit involved experimental testing, in which participants performed two isometric maximal voluntary contractions of the leg extensors on a dynamometer at a leg angle of 60°, followed by three countermovement VJ trials. Subjects performed countermovement jumps, starting in a standing position and feet firmly on the ground. Following the descent to the midpoint position and without pause, the subjects exploded upward as hard and fast as possible. PT and RTD were calculated as the highest 500ms epoch and the slope of the rise in torque in the first 200ms from onset, respectively. Lower-body PP was assessed using a linear velocity transducer, which was attached to the posterior side of a belt that was securely fastened to the subjects' waistline. Pearson correlation (r) and stepwise linear regression analyses were performed to examine the relationships. Results indicated that both PT ($r=0.71$) and late RTD ($r=0.62$) were significantly correlated to PP ($p\leq 0.01$). However, linear regression analysis revealed that PT was the only variable entered into the stepwise regression model ($R=0.71$; $R^2=0.50$). These findings showed that while both maximal and explosive strength variables correlated with VJ performance, only PT was necessary to effectively predict PP output with no additional explained variance from RTD. Thus, training regimens aimed at development of high force production of the leg extensors may enhance PP production during explosive vertical jump tasks more so than enhancing early rapid force production.