THE RELATIONSHIP BETWEEN KNEE EXTENSOR MUSCLE STRENGTH AND VERTICAL JUMP PERFORMANCE: EFFECT OF LOAD

Vuk, S.1, Markovic, G.1
1: School of Kinesiology, University of Zagreb (Zagreb, Croatia)

Introduction

One of the fundamental mechanical properties of skeletal muscles is the force-velocity-power (FVP) relationship. Power output of a skeletal muscle depends on both muscle force and a velocity of shortening. Since they are inversely related, power output at higher external loads should be dependent on muscle strength and *vice versa*. Accordingly, the heavier the load that has to be overcome during movement, the more important is muscle strength for power production and performance.
In this study we examined the relationship between knee extensor muscle strength and vertical jump performance with different loads.

Methods

Sixty-six young and healthy men volunteered in the study. After standardized warm up, each subject performed countermovement jumps (CMJ) under 5 loading conditions: no load (1BW), negative loads (0.85 and 0.7BW), and positive loads (1.15 and 1.3BW) on a force plate. CMJ was followed by the measurement of subject's maximal concentric knee extension torque at 60 deg/sec on an isokinetic dynamometer. The relationship between strength and jumping performance with various loads was assessed by Pearson's correlation coefficients (CC) and partial CC after controlling for body mass.

Results

Knee extensor muscle strength correlated significantly (r=0.78-0.79; all p<0.01) with peak power output during CMJ at all loading conditions. When controlled for body mass, the corresponding CC were reduced but still remained highly significant (r=0.62-0.65; all p<0.01). Considerably lower CC (r=0.18-0.43; p=0.01-0.15) were observed between knee extensor muscle strength and CMJ height at all loading conditions. Removing the effect of body mass increased the CC at all loading conditions (r=0.37-0.51; all p<0.01). We have also observed that subjects changed their depth of countermovement during performance of CMJ with different loads.

Discussion

The first main finding is that there are no significant changes in CC between knee extensor muscle strength and CMJ peak power under different loads applied. The lower body power output during CMJ with various loads depends not only on the FV relationship, but also on changes in leverage of leg extensors and muscle's force-length relation. As subjects changed their movement kinematic pattern during CMJ with different loads, the relationship between leg extensors muscle strength and power output during CMJ didn't behave as expected from FVP relationship.
The second main finding is an increase of the CC between knee extensor muscle strength and jump height after removing the effect of body size. This is in line with our previous study (1) which suggests that CMJ height could be a body size independent measure of a muscle power.

References

1 Markovic G, Jaric S (2007) J Sport Sci 25(12) 1355-63