

A COMPARISON OF LOWER EXTREMITY POWER BETWEEN GENDER FOR MAXIMAL VERTICAL SQUAT JUMPING AND HANG POWER CLEANS

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INTRODUCTION

An outcome that has steadily increased, since the inception of Title IX in 1972, is the amount of knee injuries that have occurred in female athletics. It is well documented in research that women are more susceptible to knee injuries when compared to men, some reporting two to eight times greater (Rochman, 1996). There are several theories attempting to explain this phenomena ranging from a woman's Q-angle to hormonal effects on ligamental laxity. One such theory is the difference in lower extremity mechanics for males versus females during jumping movements. Also, Olympic-style lifting considered by many to be the "gold-standard" in training an athlete to become more ballistic in a vertical direction (NSCA, 1985). Power production at the major joints of the lower body assist in lifting an athlete from the ground into the air. An athlete with the greatest amount of power production in the shortest amount of time will create the largest impulse, therefore reaching a greater height. Power at a joint is a product of net joint moment and angular velocity. Therefore, the purpose of this study was to compare average and peak power outputs of the three major joints of the lower extremity between gender for three conditions during the propulsion phase: Maximal Vertical Squat Jump (MVSJ), 50% Hang Power Clean (50HPC), and 75% Hang Power Clean (75HPC). Also, the time to peak power and total time of the condition were investigated across gender for the three conditions.

METHODS

Ten highly trained and competitive Olympic-style lifters (five males average age = 27.4 ± 4.5 years and training years = 5.8 ± 3.1 years, and five females average age = 31.6 ± 5.7 years and training years = 9.6 ± 6.7 years) volunteered for the study. Each lifter performed each of the three conditions with his/her right foot on a single AMTI force plate recording at 600 Hz. Digital video recorded the movements from the right sagittal plane at 120 Hz. During the movement, reflective markers were placed on the right side of the body: mid-thoracic (inferior to the 12th rib), the greater trochanter, knee joint line superior to the fibular head, lateral malleolus, and styloid process of the 5th metatarsal. Digital video data were smoothed using a 4th order, zero lag, Butterworth filter. Every fifth sample of the AMTI force plate data were exported and synchronized with the data from the digital video. Ankle, knee and hip power were calculated using an inverse dynamics model. Prior to analysis moments and power were normalized by body mass. Dependent variables included average and peak power for ankle, knee and hip, and time to peak power compared to total time to complete the condition. A two-way ANOVA was used to compare males versus females for the three conditions MVSJ, 50HPC and 75HPC for variables related to power at the ankle, knee and hip ($p < 0.05$).

RESULTS AND DISCUSSION

No significant differences were found between power or time variables related to

the ankle and hip. However, average (Fig. 1) and peak power (Fig.2) and time to peak power variables associated with the knee differed significantly between gender for MVSJ, but not for the 50HPC and 75 HPC conditions ($P < 0.05$).

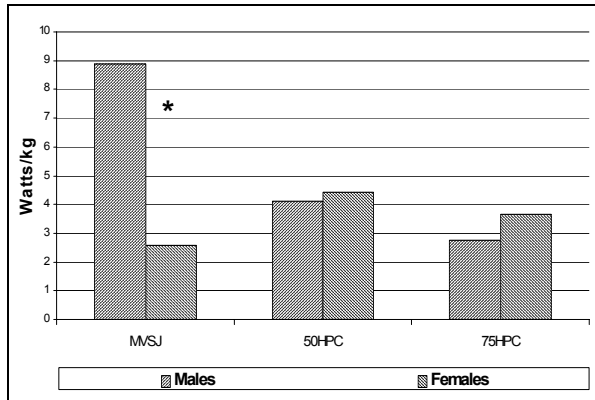


Figure 1: Average Knee Power. Conditions from left to right are MVSJ, 50 HPC, and 75HPC for males versus females.

There appears to be a different strategy being employed for females when compared to their male counterparts for MVSJ. Although, average and peak power outputs appear similar for 50HPC and 75HPC, female MVSJ power outputs are 29.1 and 31.2 percent to that of male average and peak power outputs, respectively.

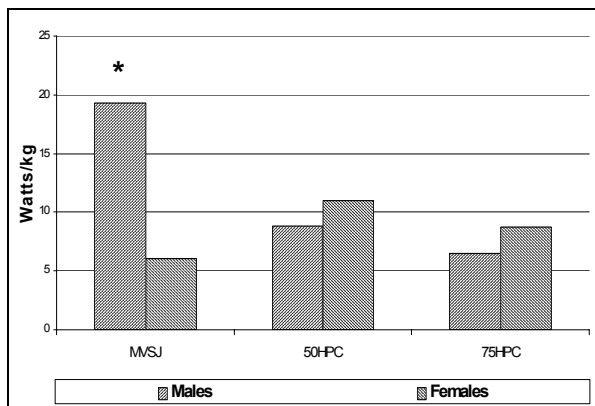


Figure 2: Peak Knee Power. Conditions from left to right are MVSJ, 50 HPC, and 75HPC for males versus females.

Females time to peak (Fig. 3) and total time (Fig. 3) to complete the condition were greater when compared to males. There was a significant difference between time to peak power and total time to completion for MVSJ when comparing males to females. * indicates significance ($p < 0.05$)

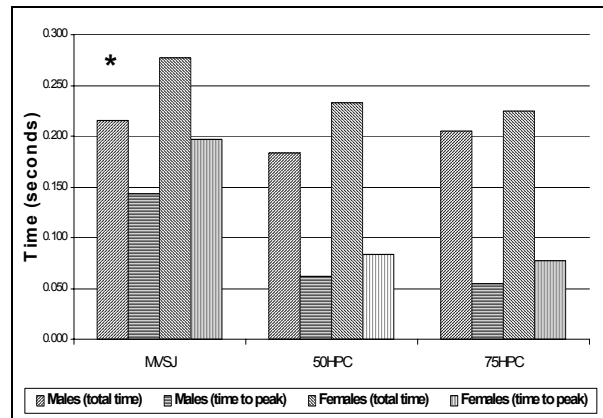


Figure 3: Time to Peak and Total to Time to complete the condition. Conditions from left to right are MVSJ, 50HPC, and 75 HPC for males versus females.

SUMMARY

All subjects were considered highly trained and competitive Olympic-style lifters; therefore no difference in MVSJ performance should have been evident, yet female subject produced significantly different power outputs at the knee. Thereby, lending some credibility to the argument that lower body mechanics for females may be a contributing factor to knee injuries in athletics. Also, the difference in MVSJ time to peak power and total time to completion indicates an increased ramping strategy is needed for the female subject's vertical impulse.

REFERENCES

- NSCA (1985). Power clean. *NSCA Journal*, 7(2), 10-25.
- Rochman, S. (1996). Gender Inequity. *Training and Conditioning*. VI, 5, 10-20.