INFLUENCE OF POWER AND STRENGTH-POWER TRAINING ON LOAD-VELOCITY PERFORMANCE

James L. Nuzzo, Grant O. McCaulley, Prue Cormie, and Jeffrey M. McBride

Neuromuscular Laboratory, Appalachian State University, Boone, NC

Appalachian STATE UNIVERSITY

Introduction

•The purpose of this study was to compare the impact of power and strength-power training on the load-velocity, load-force, load-power, and load-jump height relationships in the jump squat.

•Power training with loads equal to body mass has been shown to improve tests of athletic performance (Wilson 1993).

•Combined strength-power training programs have also been proven effective in improving tests of athletic performance (Harris et al., 2000) and the force-velocity relationship (Toji et al. 1997).

•A limited number of investigations have compared power and strength-power training programs. Toji et al. (1997) demonstrated that strength-power training of the biceps brachii improved both maximal velocity and force production during elbow flexion whereas power training only improved maximal velocity. Harris et al. (2000) demonstrated that both power and strength-power groups improved vertical jump peak power and jump height; however, the strength-power group also improved 10 and 30-yard sprint times and squat one-repetition maximum (1RM). Thus, the results of these studies indicate that strength-power training may be more effective than power training for improving measures of athletic performance. However, the amount of work completed by the training groups in these studies may not have been equivalent; subsequently, the changes in athletic performance may have been the result of the amount of work completed and not the method of training.

•No previous study has attempted to equate work while measuring the impact of power and strength-power training on jump squat performance.

Methods

•Subjects
- •Recreationally- trained males (n=26)
- •3 groups: power training (n=10); strength-power training (n=8); control (n=8)

•Training Program (12-wks with equal work (Table 1))
- •Power training group (7 sets of 6 jump squats at body mass)
- •Strength-power training group (5 sets of 6 jump squats at body mass + 3 sets of 3 squats at 90% of 1RM)
- •Control group (no training)

•Outcome Measures
- •Baseline, mid- (6-wk), and post-training (12-wk)
- •Jump Squat: Peak Power (PP), Peak Force (PF), Jump Height (JH), Peak Velocity (PV)
  - •Measured with loads equal to body mass, 20kg, 40kg, 60kg, and 80kg (Figures 1-4)
- •Anthropometric and Strength Assessments (Table 2)
  - •Body Mass and Body Fat %
  - •Squat 1RM, Squat 1RM/Body Mass Ratio, and Isometric Squat Peak Force

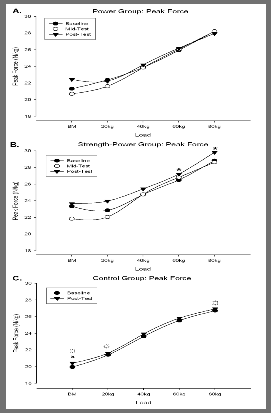
Table 1. Total Work

	Eccentric Work (J)			Concentric Work (J)			Total Work (J)		
	Power	Strength-Power	p-value	Power	Strength-Power	p-value	Power	Strength-Power	p-value
Week 1	43768 ± 12573	38384 ± 10085	0.34	40992 ± 10802	38964 ± 8475	0.40	84760 ± 23179	75347 ± 18549	0.40
Week 6	43563 ± 13887	40755 ± 10448	0.64	41914 ± 11130	38121 ± 9073	0.45	85478 ± 24586	78876 ± 19250	0.54
Week 12	47781 ± 14250	44575 ± 11483	0.61	45883 ± 10898	41545 ± 8847	0.38	93664 ± 21834	86120 ± 20257	0.46
Sum	135112 ± 37941	123714 ± 31491	0.51	128790 ± 32445	116630 ± 26017	0.40	263902 ± 68229	240344 ± 57306	0.45

Comparison of eccentric, concentric and total (total work = eccentric work + concentric work) work completed during week 1, 6 and 12. 'Sum' represents the cumulative work over week 1, week 6 and week 12. The p-values comparing work between power and strength-power groups indicate that no significant differences in work existed between the training programs.

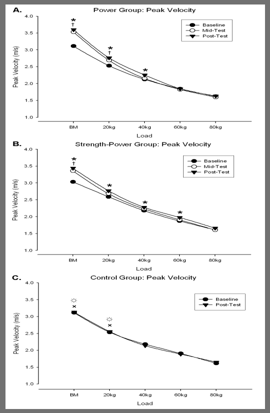
Results

Figure 1. Load-Force Relationship



Peak force achieved by the power (A), strength-power (B) and control (C) groups across the loading spectrum at baseline, mid and post tests. Peak force expressed relative to body mass. * Significant difference between baseline and post-testing. × Significant difference between power and control groups at post-test. ☼ Significant difference between strength power and control groups at post-test.

Figure 2. Load-Velocity Relationship



Peak velocity achieved by the power (A), strength-power (B) and control (C) groups across the loading spectrum at baseline, mid and post tests. * Significant difference between baseline and post-testing; † Significant difference between baseline and mid-testing. × Significant difference between power and control groups at post-test. ☼ Significant difference between strength power and control groups at post-test.

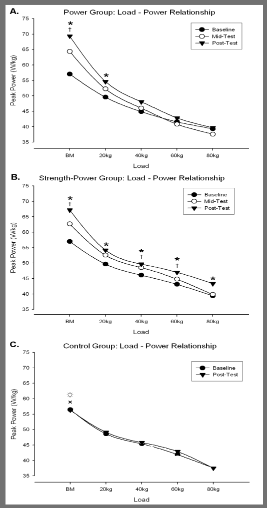
Table 2. Anthropometric and Strength Variables

	Baseline (week 0)	Mid-Test (week 6)	Post-Test (week 12)
Weight (kg)			
Power Group	81.6±18.8	81.0±19.5	80.9±19.1
Strength-Power Group	79.8±15.4	79.3±15.3	80.0±14.4
Control Group	85.5±24.0	-	85.7±22.9
Body Composition (% Fat)			
Power Group	16.7±8.1	15.6±6.9	15.7±8.2
Strength-Power Group	15.2±3.4	14.8±3.4	14.8±3.8
Control Group	15.7±7.3	-	16.1±8.1
1RM (kg)			
Power Group	107.5±21.8	107.3±22.0	109.3±16.3
Strength-Power Group	119.4±25.0	128.8±25.1	136.3±24.5 † × *
Control Group	116.3±30.3	-	117.5±28.7
1RM-to-BM Ratio			
Power Group	1.4±0.3	1.4±0.3	1.4±0.3
Strength-Power Group	1.5±0.2	1.6±0.3	1.7±0.3 † × *
Control Group	1.4±0.3	-	1.4±0.3

Comparison of weight, body composition and measures of strength across baseline, mid (week 6), and post (week 12) testing sessions. * Significant difference from baseline ($p < 0.05$); † Significant difference from Power Group ($p < 0.05$); × Significant difference from Control Group ($p < 0.05$). Values expressed as mean ± standard deviation.

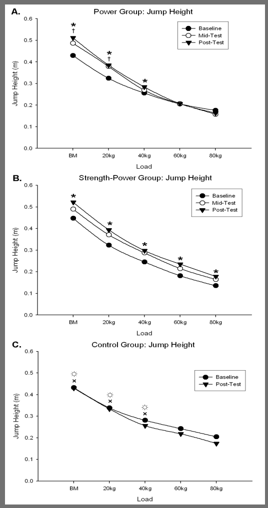
Results (cont.)

Figure 3. Load-Power Relationship



The load-power relationship of the power (A), strength-power (B) and control (C) groups at baseline, mid and post tests. Peak power expressed relative to body mass. * Significant difference between baseline and post-testing; † Significant difference between baseline and mid-testing. × Significant difference between power and control groups at post-test. ☼ Significant difference between strength-power and control groups at post-test.

Figure 4. Load-Jump Height Relationship



Maximal jump height achieved by the power (A), strength-power (B) and control (C) groups across the loading spectrum at baseline, mid and post tests. * Significant difference between baseline and post-testing; † Significant difference between baseline and mid-testing. × Significant difference between power and control groups at post-test. ☼ Significant difference between strength power and control groups at post-test.

Conclusion

•Combined strength and power training resulted in increased power output over a greater portion of the load-power relationship than power training alone. While both types of training allowed for marked improvements in maximal jump height and maximal power output in the jump squat, the overall impact of strength-power training on the load-force, load-velocity, load-power, and load-jump height relationships indicate its superior transference to a wide variety of on-field demands associated with strength-power sports.

•Strength and conditioning coaches should implement both strength and power exercises in training programs designed to improve both maximal strength and peak power.