THE EFFECT OF LOAD ON ACCENTUATED ECCENTRIC LOADED BACK SQUAT PERFORMANCE IN RESISTANCE-TRAINED WOMEN

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Introduction

Accentuated eccentric loading (AEL) is form of eccentric training that involves overloading the the eccentric action during exercises involving the complete stretch-shortening cycle: both eccentric and concentric movement (4). If programmed at the proper load, this can give a more advanced athlete a novel training stimulus.

Researchers have examined supramaximal loading of a one repetition maximum (1RM) eccentrically but have not examined multiple loading combinations for the concentric phase. Wagle et al. (3) investigated back squat differences in traditionally loaded cluster sets and straight sets as well as AEL with cluster sets by using 105% 1RM eccentrically and 80% 1RM concentrically. It was found that overloading the braking phase caused rate of force development to remain elevated through at least three repetitions of a set. A study showing a supramaximal loading of 105% 1RM was applied to the eccentric phase and 100% 1RM on concentric. This was compared to a traditional loading of 100% 1RM throughout. Results demonstrated a statistically significant increase in concentric 1RM performance in AEL condition, indicating AEL can acutely enhance force production (1). Another recent study assessed the impact of 3 supramaximal eccentric loading magnitudes (105%, 110% and 120% 1RM; 90% 1RM on concentric phase) on front squat using weight releasers. They found that heavier eccentric loads elicited greater improvements in concentric performance than lighter eccentric loads (2). While these studies may provide a starting point, further research is needed to indicate how the load can affect force production and impulse during both the braking phase and propulsion phase of an AEL back squat in women.

The purpose of this study examine the effect of load on force production characteristics during the braking and propulsion phases of AEL back squats in resistance-trained women. It was hypothesized that lighter loads would allow female athletes to develop greater rate of rapid force production, while heavier loads may provide a greater strength stimulus.

Results

Table 1. Braking and propulsion mean force, duration, and impulse characteristics of each load.

Load	Braking Phase Mean Force (N/kg)	Braking Phase Duration (s)	Braking Phase Impulse (Ns)	Propulsion Phase Mean Force (N/kg)	Propulsion Phase Duration (s)	Propulsion Phase Impulse (Ns)
50%	5.3 ± 1.2^{a,b}	0.49 ± 0.11^{a,b}	178.3 ± 19.3	3.8 ± 0.6^{a,b,c}	0.60 ± 0.06^{a,b,c}	157.2 ± 27.9^{a,b}
60%	5.0 ± 1.1^{a,b}	0.53 ± 0.09^{a}	184.0 ± 22.0^{a}	3.4 ± 0.5^{a,b}	0.68 ± 0.08^{a,b}	162.8 ± 22.1^{a}
70%	4.4 ± 1.2^{a,c}	0.58 ± 0.09^{a}	172.1 ± 19.0	2.9 ± 0.4^{a}	0.86 ± 0.14^{a}	176.0 ± 30.2
80%	3.7 ± 1.1	0.64 ± 0.09	159.5 ± 25.8	2.3 ± 0.3	1.14 ± 0.15	182.4 ± 21.0
g	0.25 – 1.35	0.39 – 1.45	0.27 – 0.99	0.70 - 3.06	1.10 – 4.58	0.22 – 0.99

Note: Loads listed are those performed during the concentric phase of the back squat and are based on percent of 1RM back squat; g = Hedge's g effect size range between loads; a = significantly different than 80% 1RM ($p < 0.05$); b = significantly different than 70% 1RM *($p < 0.05$)*; c = significantly different than 60% 1RM *($p < 0.05$)*

Methods

- Seven resistance-trained men (age: 22.9 ± 0.9 body mass: 89.0 ±12.9 kg, height: 180.0 ± 9.0 cm, relative one repetition maximum [1RM] back squat: 1.92 ± 0.22 kg/BM) and eight resistance-trained women (age: 24.1 ± 2.9, body mass: 68.1 ± 9.0 kg, height: 162.4 ± 3.3cm, relative 1RM back squat: 1.49 ± 0.13kg/BM) participated in this study.
- All subjects completed four testing sessions. During the first session, participants completed a 1RM back squat and were familiarized with the weight releasers.
- In sessions 2-4, subjects completed the following conditions in a randomized order: 1) traditional loading scheme with 50, 60, 70, and 80% of 1RM (TRAD); 2) 100% of 1RM eccentrically (AEL100) and 50, 60, 70, and 80% of 1RM concentrically; 3) 110% of 1RM eccentrically (AEL110) and 50, 60, 70, and 80% of 1RM concentrically. All testing sessions were performed on force plates.
- Mean force, duration, and impulse were recorded during the braking phase of the squat, which was identified as the point where force was produced above the system mass to the lowest position of the squat (identified by a linear position transducer) and where peak braking force was produced.
- A series of 3x4 repeated measures ANOVA were used to compare braking mean force, duration, and impulse characteristics.
- Hedge's *g* effect sizes were calculated to determine the magnitude of the differences between loads.

Figure 1. Starting position of the subject on the force platform.

Figure 2. Bottom position of the subject during the squat.

Conclusions

- There were small-large, small-moderate, and moderate-very large differences between loads for BMF and BDur, BImp and Pimp, and PMF and PDur, respectively.
- The load added to the barbell significantly impacted braking and propulsion characteristics during AEL back squats. BMF and BImp decreased while BDur increased as heavier loads were used. PMF decreased while both PDur and PImp increased as loads increased.

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Practical Applications

- Using lighter concentric loads (50-60% 1RM) during AEL back squats may allow individuals to develop greater rapid force production characteristics.
- Prescribing heavier loads (70-80% 1RM) may provide a greater strength stimulus.

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