Acute effect of L-citrulline supplementation on resistance exercise performance

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Abstract

L-citrulline is a nitric oxide precursor suggested to increase blood flow and augment resistance exercise performance, yet most studies have provided L-citrulline in the form of 8 g citrulline malate providing 4-5.3 g L-citrulline. **PURPOSE:** The purpose of this study was to examine the effect of supplementing with a higher dose of L-citrulline on resistance exercise performance and subjective measures of perceived effort, energy, focus, fatigue, and muscle pump. **METHODS:** In a cross-over design fashion, eighteen recreationally resistance trained men (n=11) and women (n=7) (21.4±1.8 years; 172.3±7.5 cm; 76.9±10.8 kg) were randomly assigned to supplement with a placebo or 8 grams of L-citrulline one hour prior to completing assessments consisting of an isometric mid-thigh pull test (IMTP), a ballistic bench press protocol [2 sets of 2 repetitions at 75% 1-repetition maximum with maximum ballistic intent], and a strength-endurance bench press protocol [5 repetition-maximum sets at 75% 1RM]. Barbell velocity and power were measured via linear position transducer during the ballistic protocol, while repetitions completed and volume load were quantified during the strength-endurance protocol. Subjective measures were assessed at baseline and immediately pre- and post-exercise. **RESULTS:** No differences were observed between conditions for peak force during the IMTP (p=0.523), ballistic bench press power and velocity (p=0.151-0.455), or total repetitions (p=0.746) and volume load (p=0.914) during the strength-endurance bench press protocol. Additionally, no differences were seen between conditions for measures of perception. **CONCLUSION:** An acute 8 g dose of L-citrulline did not enhance isometric force production or bench press performance in recreationally resistance trained men and women. **PRATICAL APPLICATION:** These data suggest that acute L-citrulline supplementation did not provide ergogenic benefits to the protocol implemented in this study.

Methods

Table 1. Participant characteristics (N=18)

Characteristic	Men	Women
Age (y)	21.4 ± 2.0	21.4 ± 1.9
Height (cm)	176.4 ± 6.3	165.9 ± 3.7
Body mass (kg)	83.0 ± 8.4	67.3 ± 6.1
Resistance training experience (y)	5.1 ± 2.5	4.6 ± 2.1
Bench press 1RM (kg)	98.7 ± 16.9	58.6 ± 14.3
Relative strength (1RM/Body mass)	1.2 ± 0.2	0.9 ± 0.2

Data are presented mean ± standard deviation (SD)

Familiarization

- Participants were familiarized with the IMTP test and assessed for barbell bench press 1RM during a familiarization session.

Main Findings

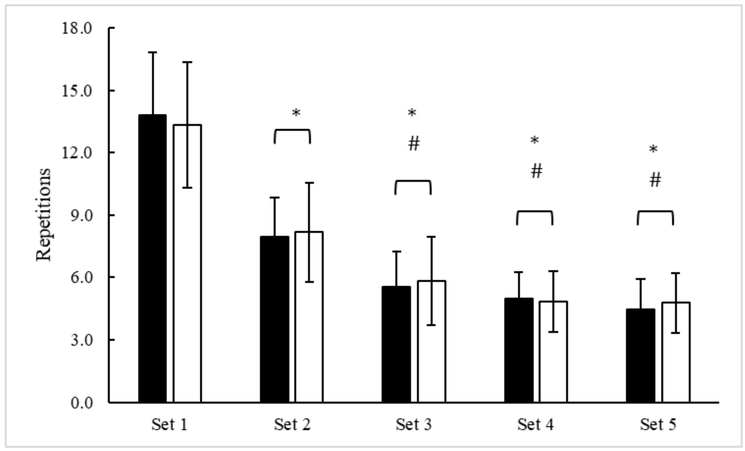
An acute 8 g dose of L-citrulline did not enhance isometric force production or bench press performance in recreationally resistance trained men and women.

Results

Table 2. Strength and power differences between sexes and conditions (mean ± SD)

				Sex		Condition		Sex × Condition	
		PL	CIT	p	BF_{10}	p	BF_{10}	p	BF_{10}
Isometric mid-thigh pull									
Peak force (N)	Women	366 ± 44	362 ± 54	< 0.001	1.0	0.523	0.0	0.894	0.2
	Men	581 ± 97	576 ± 85						
Ballistic bench press									
Peak Power (W)	Women	359 ± 84	359 ± 75	< 0.001	1.0	0.151	0.0	0.161	0.8
	Men	625 ± 168	689 ± 204						
Mean Power (W)	Women	241 ± 39	234 ± 36	< 0.001	1.0	0.382	0.0	0.144	0.5
	Men	413 ± 100	438 ± 106						
Mean Velocity ($m \cdot sec^{-1}$)	Women	0.58 ± 0.11	0.56 ± 0.08	0.602	0.6	0.455	0.5	0.085	0.4
	Men	0.58 ± 0.11	0.62 ± 0.14						

Table 3. Effect of L-citrulline on five sets of bench press (75% 1RM; 2 min rest intervals)



PL = black bars; CIT = open bars; * = Significantly (p < 0.001) different from set 1; # = Significantly (p < 0.001) different from set 2.

Methods (Cont.)

Supplementation

One hour prior to resistance exercise, participants ingested a 500 mL beverage containing either:

- **CIT:** 8 g of pure L-citrulline powder (Nutricost, Vineyard, UT, USA) mixed with a non-caloric lemonade flavoring
- **PL**: Non-caloric lemonade flavoring only

Isometric Mid-thigh Pull

- Three 4-sec IMTP using force plate software (Vernier Software and Technology, Beaverton, OR, USA).
- Highest peak force (N) value among the three sets was used for analysis.

Ballistic Bench Press Protocol

- 2 sets of 2 repetitions at 75% 1RM with maximum ballistic intent separated with a 3-minute rest period.
- Concentric barbell velocity ($m \cdot sec^{-1}$) and power (W) were measured via a linear position transducer (Tendo Power Output Unit, Trencin, Slovak Republic).

Strength-endurance Bench Press Protocol

- 5 repetition-maximum sets at 75% 1-RM with 2 minutes of rest between each set

Subjective Measures

- Questionnaires were provided at baseline, prior to exercise, and immediately following exercise to assess subjective feelings of focus, energy, and fatigue using a 15-cm visual analog scale.

Statistical Analysis

The frequentist and Bayesian approach involved two-tailed, three-way (Sex x Condition x Time) analyses of variance conducted to assess the main effects and interactions of condition and time of performance measures across time and within conditions. Significance was accepted at an alpha level $p \leq 0.05$.

Summary and Practical Applications

- CIT supplementation did not enhance isometric force production, bench press performance, or subjective measures in recreationally resistance trained men and women.
- Future research should continue to examine the efficacy of different acute and chronic doses of L-citrulline on strength and power performance and other forms of high-intensity training.