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## Comparing Mean & Peak Barbell Velocity During Traditional and Accentuated Eccentric Loaded Back Squats

Zach S. Schroeder  
*Carroll University*

Lauren K. Marshall  
*Carroll University*

Lea C. Katanick  
*Carroll University*

Brookelyn A. Campbell  
*Carroll University*

Conor J. Cantwell  
*Carroll University*

*See next page for additional authors*

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**Authors**

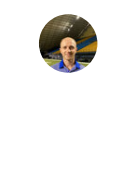
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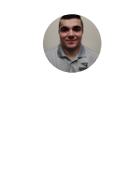
**Author(s)**  
 Joshua D. Stewart  
Cardiff University  
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 Daniel J. Cardwell  
Cardiff University  
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# COMPARING MEAN AND PEAK BARBELL VELOCITY DURING TRADITIONAL AND ACCENTUATED ECCENTRIC LOADED BACK SQUATS

Zach S. Schroeder<sup>1</sup>, Lauren K. Marshall<sup>1</sup>, Lea C. Katanick<sup>1</sup>, Brookelyn A. Campbell<sup>1</sup>, Conor J. Cantwell<sup>1</sup>, Christopher B. Taber<sup>2</sup>, and Timothy J. Suchomei<sup>1</sup>

<sup>1</sup>Department of Human Movement Sciences, Carroll University, Waukesha, WI, USA

<sup>2</sup>Department of Exercise Science, Sacred Heart University, Fairfield, CT, USA

## Introduction

Accentuated eccentric loading (AEL) is a form of eccentric training that has become more popular with athletes and has been shown to be effective if implemented correctly. The purpose of AEL is to overload the eccentric phase of a movement in order to enhance the concentric phase of that same movement while causing minimal disruption to the natural mechanics of that exercise (4). Previous studies have incorporated AEL with exercises including the back squat (2), front squat, bench press (1), countermovement jump, and drop jump, with a variety of releasers such as bands, dumbbells, plates, or hooks (1,2).

Currently, there is limited research looking at the use of AEL with back squats. Previous researchers have looked at both submaximal and supramaximal percentages of one repetition maximum (1RM) eccentrically but have not examined multiple loading combinations for the concentric phase. Wagle et al. (4) 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 eccentric overload caused eccentric RFD to remain elevated through at least three repetitions of a set. However, none of the loading configurations examined were found to potentiate the concentric portion of the movement (3). Yarrow et al. (5) used AEL back squats with an eccentric load of 100%1RM and a concentric load of 40% while observing blood lactate and testosterone levels and found that the AEL and traditional conditions resulted in similar muscular strength adaptations. Due to these mixed findings, further research is required to identify an optimal loading range for maximizing barbell velocity during AEL back squats. The purpose of this study was to compare the mean (MV) and peak barbell velocity (PV) characteristics of back squats using traditional and AEL methods. It was hypothesized that the traditional condition would produce significantly higher MV and PV compared to the 100% and 110% AEL conditions across all loads. It was also hypothesized that MV and PV would decrease as load increased.

## Methods

- 7 resistance-trained men (age: 22.9 ± 0.9 y, body mass: 89.0 ± 12.9 kg, height: 180.0 ± 9.0 cm, relative 1RM back squat: 1.92 ± 0.22 kg/kg) and 8 resistance-trained women (age: 24.1 ± 2.9, body mass: 68.1 ± 9.0 kg, height: 162.4 ± 3.3, relative 1RM back squat: 1.49 ± 0.13 kg/kg) participated in this study.
- The subjects completed 4 separate testing sessions:
  - 1RM back squat and weight releaser familiarization
  - Three randomized testing sessions with various squat conditions including 1) Traditional loading scheme, 2) 100% of 1RM eccentrically and 50, 60, 70, and 80% of 1RM concentrically, and 3) 110% of 1RM eccentrically and 50, 60, 70, and 80% of 1RM concentrically.
- Three repetitions were performed during each testing set for all conditions and 3-5 minutes of rest were given between each set.
- A GymAware device was used to assess MV and PV.
- The start of the propulsive phase of the back squat was identified by the GymAware device as the lowest point reached during the movement and ended when the subject reached a standing position.
- A series of 3 (condition) x 4 (load) repeated measures ANOVA were used to compare the differences in MV and PV between conditions and loads.
- Hedge's g effect sizes were used to determine the practical differences between conditions and loads.

## Methods



**Figure 1.** AEL squat sequence performed on the force platform. Subject is in the ready position (Left), end of the braking phase and start of the propulsion phase (Center), and end of the propulsion phase (Right).

## Results

**Table 1.** Mean and peak barbell velocities during different loading conditions.

Load	Traditional		100% ECC		110% ECC	
	MV (m/s)	PV (m/s)	MV (m/s)	PV (m/s)	MV (m/s)	PV (m/s)
50% CON	0.83 ± 0.08	1.32 ± 0.16	0.79 ± 0.09	1.25 ± 0.20	0.79 ± 0.08	1.26 ± 0.22
60% CON	0.74 ± 0.06	1.21 ± 0.15	0.72 ± 0.07	1.19 ± 0.17	0.73 ± 0.07	1.19 ± 0.19
70% CON	0.64 ± 0.06	1.09 ± 0.15	0.60 ± 0.08	1.04 ± 0.16	0.63 ± 0.06	1.09 ± 0.16
80% CON	0.52 ± 0.05	1.00 ± 0.14	0.48 ± 0.06	0.97 ± 0.16	0.51 ± 0.07	1.00 ± 0.15

Note: MV = mean barbell velocity; PV = peak barbell velocity; CON = concentric; ECC = eccentric.

- MV: There were statistically significant main effects present for both condition ( $p = 0.002$ ;  $g = 0.10 - 0.23$ ) and load ( $p < 0.001$ ;  $g = 0.95 - 3.93$ ). However, the condition x time interaction effect was not statistically significant ( $p = 0.259$ ).
- PV: There were statistically significant main effects present for both condition ( $p = 0.016$ ;  $g = 0.11 - 0.23$ ) and load ( $p < 0.001$ ;  $g = 0.42 - 1.6$ ), but there was no statistically significant condition x time interaction effect ( $p = 0.101$ ).
- Post hoc analysis indicated that there was a significant difference between MV ( $p = 0.006$ ) and PV ( $p = 0.032$ ) between the traditional and 100% AEL conditions.
  - Moderate effect sizes were found with MV between the traditional and 100% AEL conditions at both 70% CON ( $g = 0.55$ ) and 80% CON ( $g = 0.70$ ).
  - No practically significant differences were found for PV.

## Conclusions

- The traditional condition produced significantly higher MV ( $p = 0.006$ ) and PV ( $p = 0.032$ ) compared to the 100% AEL condition but no differences existed when compared to the 110% condition ( $p = 0.406$ ,  $p = 0.701$ ).
- There were no statistically significant differences in either MV ( $p = 0.051$ ) or PV ( $p = 0.125$ ) barbell velocity between 100% and 110% AEL conditions.
- As load increased, MV and PV decreased. Moderate to very large effects and small to large effects were present between loads for MV and PV, respectively.

## Practical Applications

- MV and PV may be maintained while incorporating AEL conditions during back squats.
- Practitioners may be able to prescribe back squats with maximal (100%) or supramaximal (110%) loads to overload the eccentric phase while maintaining the concentric velocity of the movement. This in turn may allow athletes to improve their strength-power characteristics.

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@ZachSchroeder98



@zsschroeder98



zschroed@carrollu.edu



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