

The Effects of Training Near Volitional Fatigue on Motor Unit Properties in Trained Adults

Jonathan P. Beausejour, Jason I. Pagan, Juan P. Rodriguez,
Daniel Sheldon, Kevan S. Knowles, Bradley A. Ruple,
Daniel Plotkin, Kaelin C. Young, Michael D. Roberts, Matt S. Stock



UCF Institute of Exercise Physiology and Rehabilitation Science

Background

- Whether resistance training sets should be performed until volitional failure versus leaving repetitions in reserve (RIR) has recently received significant attention in the literature.
- Little is known about the underlying motor unit adaptations following different training paradigms.

Research Aims

Using multiple two-way mixed factorial ANOVAs, our research aims were to:

- Examine differences in lift-specific strength following six weeks of low- versus high-RIR powerlifting training.
- Document changes in motor unit firing characteristics within each condition.



Methods

- 19 resistance trained adults (11 males, 8 females) were randomly assigned to Low-RIR and high RIR groups, and completed a six-week powerlifting-based training program
- Before and after training, one repetition-maximum (1RM) testing of barbell back squat, bench press and deadlift exercises were conducted
- Isometric peak torque and vastus lateralis motor unit firing rates during an 80% maximal voluntary contraction (MVC) were measured

Powerlifting Training Program

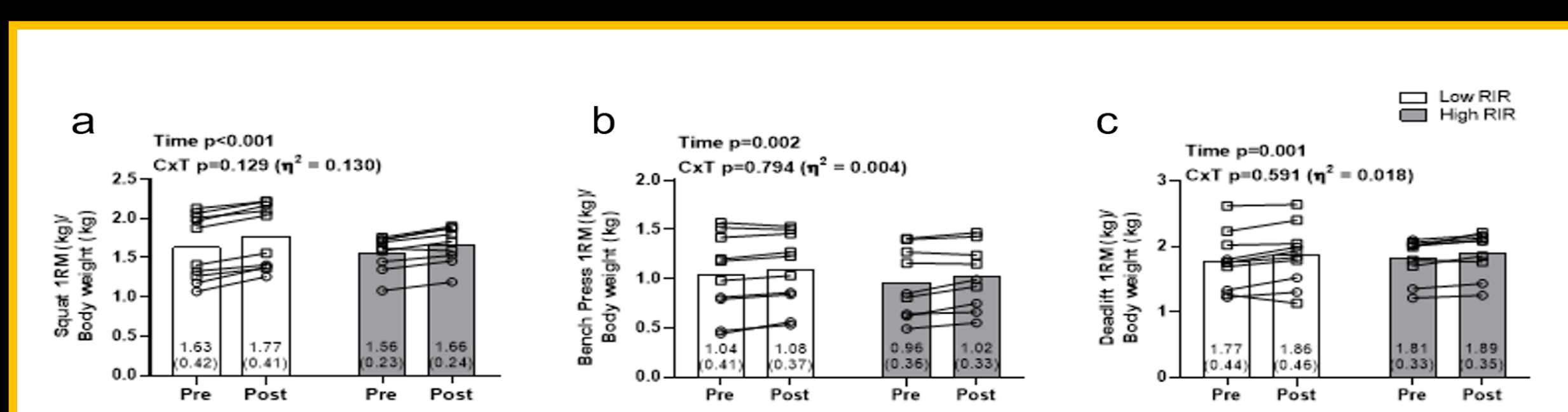
Week 1								
Day 1			Day 2			Day 3		
Exercise	Weight	SxR	Exercise	Weight	SxR	Exercise	Weight	SxR
Squat*	70%	3x6	Bench*	70%	3x6	Deadlift*	70%	3x6
Deadlift*	65%	3x6	Squat*	65%	3x6	Bench*	65%	3x6
RFESS	60%	3x15	Low-incline Bench	60%	3x15	OHP	60%	3x15
RDL	60%	3x15	Lat Pulldown	60%	3x15	BB Row	60%	3x15
Face-pull	60%	3x15	Goblet Squat	60%	3x15	BB curl	60%	3x15
Skull Crushers	60%	3x15				Lat Raises	60%	3x15
Week 2								
Day 4			Day 5			Day 6		
Exercise	Weight	SxR	Exercise	Weight	SxR	Exercise	Weight	SxR
Squat*	77.5%	5x5	Bench*	77.5%	5x5	Deadlift*	77.5%	5x5
Deadlift*	70%	3x6	Squat*	70%	3x6	Bench*	70%	3x6
RFESS	65%	3x12	Low-incline Bench	65%	3x12	OHP	65%	3x12
RDL	65%	3x12	Lat Pulldown	65%	3x12	BB Row	65%	3x12
Face-pull	65%	3x12	Goblet Squat	65%	3x12	BB curl	65%	3x12
Skull Crushers	65%	3x12				Lat Raises	65%	3x12
Week 3								
Day 7			Day 8			Day 9		
Exercise	Weight	SxR	Exercise	Weight	SxR	Exercise	Weight	SxR
Squat*	85%	4x4	Bench*	85%	4x4	Deadlift*	85%	4x4
Deadlift*	75%	3x6	Squat*	75%	3x6	Bench*	75%	3x6

Low RIR Group: Completed each set close to failure (RIR of 0-1).

High RIR Group: Completed each set within several repetitions from failure (RIR of 4-6).

Aim #1 Results

Strength increased **similarly within both groups** following training.



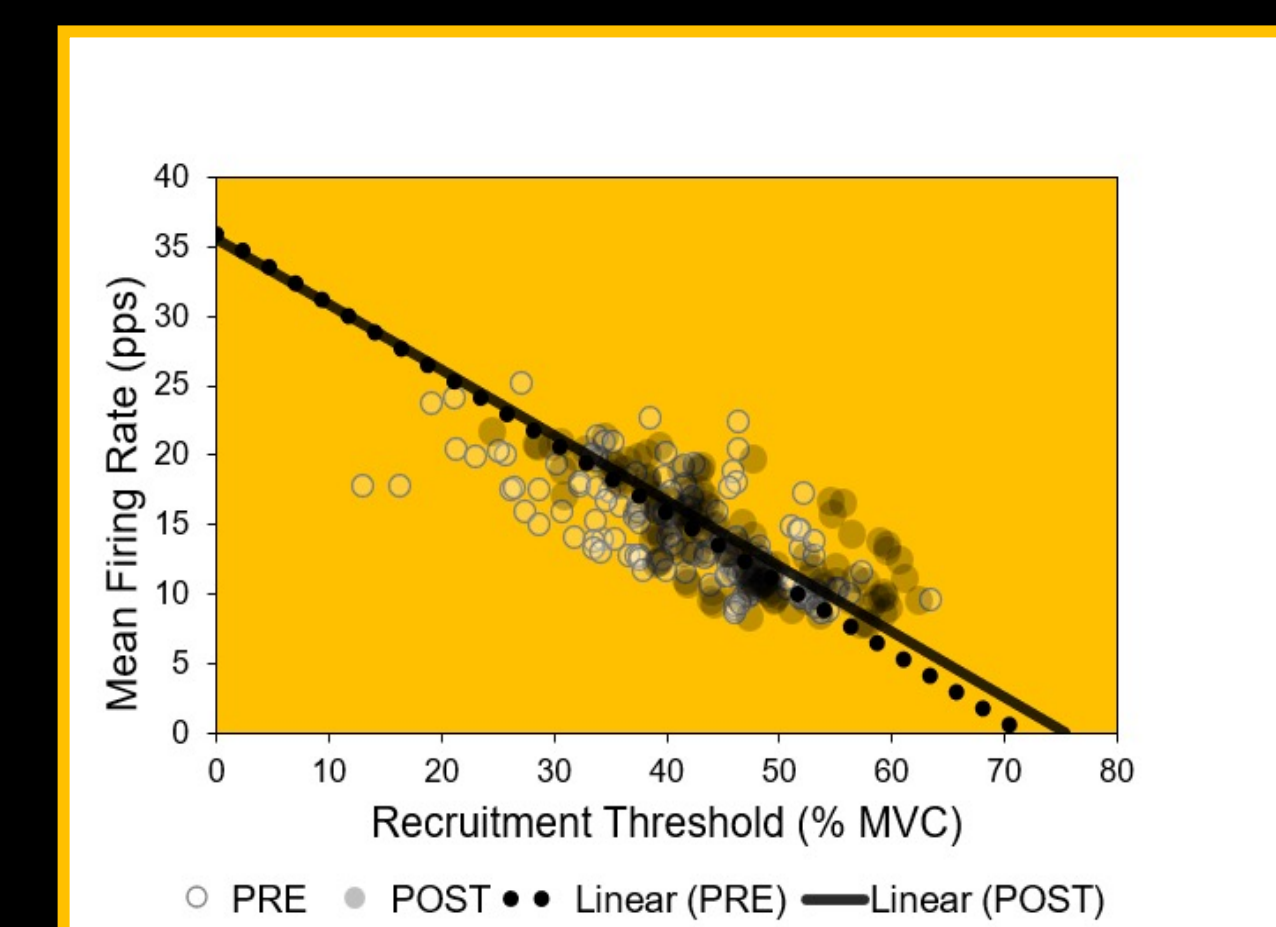
Aim #2 Results

PRE to POST motor unit firing characteristics were **significantly different within the Low RIR group**. Motor unit firing characteristics did not differ following training within the high RIR group.

Low RIR



High RIR



Conclusion

Low-RIR and high-RIR training **elicited similar increases in 1RM strength following a six-week powerlifting training protocol**. In contrast, low-RIR training resulted in **greater improvements in unilateral, isometric MVC peak torque and motor unit firing rates**.

Practical Relevance

In resistance trained adults, both low- and high-RIR training can be used to improve 1RM back squat, bench press, and deadlift strength.

Key References

- Herda, T. J. (2022). Resistance exercise training and the motor unit. *European Journal of Applied Physiology*, 122(9), 2019–2035.
- Grgic, J., Schoenfeld, B. J., Orazem, J., & Sabol, F. (2022). Effects of resistance training performed to repetition failure or non-failure on muscular strength and hypertrophy: A systematic review and meta-analysis. *Journal of Sport and Health Science*, 11(2), 202–211.

