

THE IMPACT OF HIIT ON MUSCLE FUNCTION AND SERCA1 IN OLDER ADULTS: A PILOT STUDY

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Purpose

High-intensity interval training (HIIT) can help maintain muscle mass, strength, and independence in older adults; however, the underlying molecular mechanisms that explain this preservation are poorly understood.

The purpose of this study is to examine changes in SERCA 1 expression, vastus lateralis cross-sectional area (VL_{CSA}), lower body strength, and estimated cardiorespiratory fitness (eVO₂) following 12-weeks of HIIT in older adults.

Methods

Table 1. Participant Demographics

	n (M/F)	Age (y)	Height (m)	Weight (kg)
Participants	4 (1/3)	80 ± 8	1.69 ± 0.03	64.08 ± 10.06

The HIIT protocol is described in Table 2. Panoramic ultrasound images of the right VL were collected at baseline (PRE) and following training (POST) to estimate VL_{CSA}. Micro biopsies from the right VL were obtained to examine changes in SERCA 1 expression at rest (1 week ± 1 day POST) using Western Blots. GAPDH was used as loading control. Each sample was run in duplicate to ensure reliability. Muscular strength was assessed by estimating one-repetition maximum (e1RM) using a belt squat. Starting weights were determined using a percentage of the participant's body weight (males=120%, females=100%) and were gradually increased until they were unable to perform >3-5 reps. eVO₂ was calculated based on 6-minute walk test performance using validated gender-specific equations. Differences (p < 0.05) between PRE and POST for each variable were identified using paired t-tests and Hedges g was used to determine effect sizes.

Results

There was a significant increase in SERCA 1 expression from PRE to POST (29,564.06 ± 19,267.31 au vs. 49,136.57 ± 2,2995.21 au, p = 0.007, g = -2.06), as well as significant improvements in squat e1RM (75.96 ± 18.28 kg vs. 123.58 ± 30.34 kg, p = 0.036, g = -2.50) and eVO₂ (27.40 ± 4.93 mL/kg/min, 34.20 ± 2.89 mL/kg/min, p = 0.047, g = -1.18). There were no significant improvements in VL_{CSA} (9.96 ± 2.38 cm² vs. 10.53 ± 2.95 cm², p = 0.201, g = -0.59).

Table 2. HIIT Circuit Outline

Training Component	Specific Exercises and Resistance	Time
Warm-up	Stationary bike/dynamic mobility	5 Minutes
HIIT Circuit:	<ul style="list-style-type: none"> Squats (30% of e1RM) Medicine ball forward chest throw (5% of BW) Medicine ball overhead throw (5% of BW) Farmers walk (walking with dumbbell in each hand) (20% of BW) Seated shoulder press (30% of e1RM) Seated row sitting on fitness ball (30% of BW) Aerobic riser step ups Foot ladder drills* Twisting medicine ball pass** 	Weeks 1-4 (20:40s, W:R) Weeks 5-8 (30:30s, W:R) Weeks 9-12 (40:20s, W:R) Total Time: 7-9 Minutes
	2-minute rest break	
	Repeat HIIT Circuit	
	2-minute rest break	
Bike HIIT	Total body (push, pull, and pedal) all-out intervals on the Assault Airbike	Same as HIIT circuit
Cool Down	Stretching and relaxation exercises	5 Minutes

W:R = Work to rest ratio, BW = Body weight, e1RM = estimated 1RM, *Exercises introduced at 5 weeks, **Exercises introduced at 9 weeks

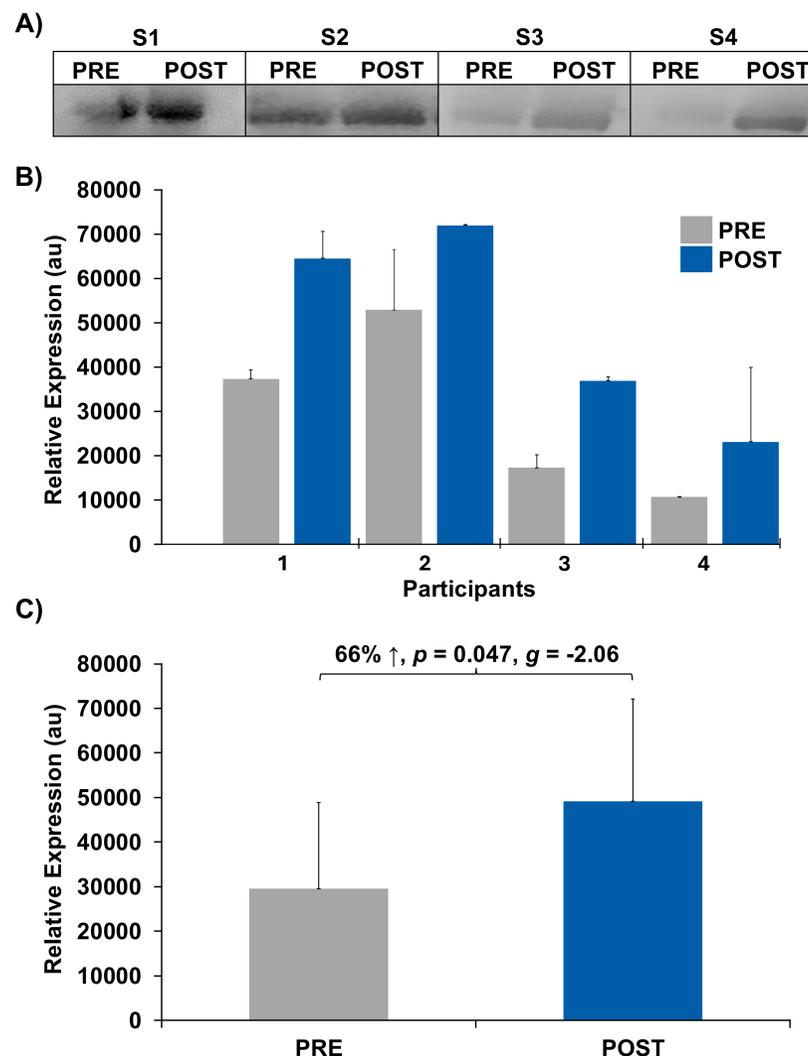


Figure 1. SERCA1 expression A) Individual relative SERCA1 expression on PVDF membranes B) Individual relative SERCA1 expression from PRE to POST HIIT training C) Average relative SERCA1 expression from PRE to POST HIIT

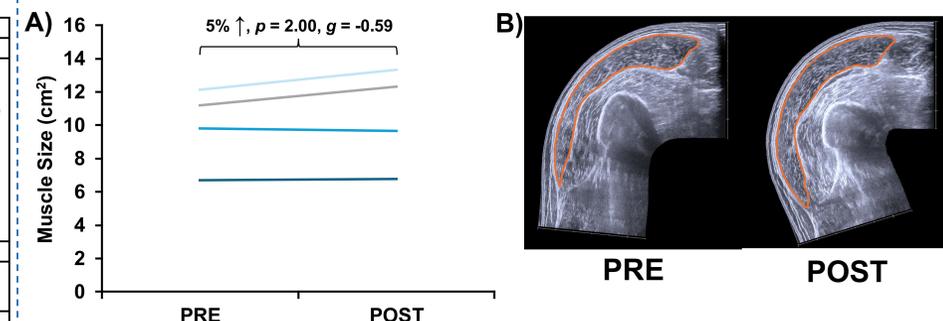


Figure 2. Ultrasonographic VL changes from PRE to POST HIIT A) Individual changes from PRE to POST VL ultrasounds B) Example size changes from PRE VL_{CSA}: 12.146 cm² to POST VL_{CSA}: 13.338 cm²

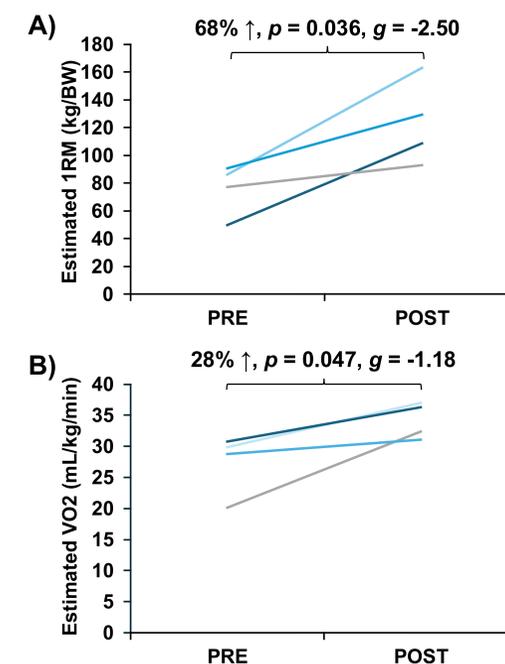


Figure 3. Performance outcomes from PRE to POST HIIT A) Estimated 1RM from PRE to POST HIIT B) Estimated VO₂ max from PRE to POST HIIT

Conclusions

These data suggest that the 12-weeks of HIIT increased cardiorespiratory fitness, muscle size, and strength in older adults which may be explained, in part, by an improvement in intramuscular calcium handling.

Practical Applications

This study contributes to the growing body of literature citing HIIT training as an effective exercise modality to potentially ameliorate age-associated declines in lower body strength and cardiorespiratory fitness. Strength and conditioning professionals and practitioners can use this data to prescribe exercise for older adult clients.