

Introduction

- By 2030, it is estimated that there will be roughly 1.4 billion adults over the age of 60 years old and 202 million adults over the age of 80 in the population.^{1,2}
- HIIT workouts are much shorter in duration compared to other forms of exercise, making it more effective of exercise with greater health benefits than low- and moderate-workout programs.^{1,3-5}
- Additionally, aerobic exercise and resistance training can be beneficial in combating the ill effects of aging.
- Using a high-intensity interval training program may be a better method compared to low-impact training programs for improving overall fitness in older adults.

Purpose

Therefore, the purpose of the current study was to evaluate the impact of high intensity interval training (HIIT) on aerobic fitness and muscular strength in older men and women.

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High-Intensity Interval Training Protocol: Twenty-three older adult (Female: n=10, age=74±7 yrs, height=1.6±0.05m, weight=71.1±14.0 kg; Men: Age=75±6, Height=1.8±0.04m, Weight=85.9±10.2kg) volunteers completed 12-weeks of total body HIIT consisting of three sessions per week (35-40 min; nonconsecutive days). Work-to-rest ratios (W-R) were increased from weeks 1-4 (20-sec:40-sec W-R) to weeks 5-8 (30-sec:30-sec W-R), and to weeks 9-12 (40-sec:20-sec W-R). Each participant was instructed to maintain 85%-95% maximum heart rate throughout the study monitored by heart rate monitors. Estimated one repetition maximum (1RM) assessments were completed and normalized to body weight (load/BW) for belt squat (rSQ), seated cable row (rSR), and seated overhead press (rOP) were assessed before (Pre), week 6 (MID), and following the HIIT training protocol (POST; 12 weeks). Additionally, aerobic fitness was determined using an estimated VO2max (eVO2) protocol derived from a 6-minute walk test.

Table 1. HIIT Outline

Training Component	Specific Exercises and Resistance	Time
Warm-up	Stationary bike/dynamic mobility	5-7 Minutes
Circuit HIIT: 1-minute training blocks 1 set of each exercise	<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 (20:40, exercise:rest, seconds) Weeks 5-8 (30:30, exercise:rest, seconds) Weeks 9-12 (40:20, exercise:rest, seconds) Total Time: 7-9 Minutes
2-minute rest break		
Repeat of Circuit HIIT: 1-minute training blocks 1 set of each exercise	Same as above	Same as above
Bike HIIT	Total body (push, pull, and pedal) all-out intervals on the Assault Airbike	Same as circuit HIIT
Cool Down	Stretching and relaxation exercises	4-5 Minutes

BW = Body weight, e1RM – estimated 1RM

*Exercises introduced at 5 weeks

**Exercises introduced at 9 weeks

Statistical Analysis: A series of 2x2 repeated-measures ANOVAs were conducted to examine the effects of Time (PRE vs. POST) and Sex (Male vs. Female) on each performance measure. Effect sizes were reported as generalized eta squared (η^2g), and Bonferroni-adjusted post-hoc comparisons were performed for significant interactions.

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Significant main effect of Time was found for eVO2, $F(1,21)=42.83$, $p<.001$, $\eta^2g=.208$, across Sex from PRE (25.1±3.9 ml/kg/min) to POST (29.4±4.7ml/kg/min). No significant effects were observed for Sex, $F(1,21)=1.27$, $p=.273$, or the Sex×Time interaction, $F(1,21)=0.01$, $p=.939$. Post hoc analysis showed significant ($p<0.05$) improvements for both males (Pre: 24.3±4.3 ml/kg/min vs. Post: 28.5±4.6 ml/kg/min) and females (Pre: 26.2±3.4 ml/kg/min vs. Post: 30.5±4.7ml/kg/min). For rSQ, Time has a significant effect, $F(1,20)=29.57$, $p<.001$, $\eta^2g=.275$, with increased relative squat strength post-training (Pre: 1.3±0.3 kg/BW vs. Post: 1.8±0.5 kg/BW). No significant effects were found for Sex, $F(1,20)=0.31$, $p=.581$, or the Sex×Time interaction, $F(1,20)=0.10$, $p=.753$, indicating similar improvements across sexes (Males: Pre: 1.4±0.3 kg/BW vs. Post: 1.9±0.6 kg/BW; Females: Pre: 1.3±0.3 kg/BW vs. Post: 1.8±0.5kg/BW). For rOP, significant main effects were observed for Time significant effects were observed for Time, $F(1,21)=22.37$, $p<.001$, $\eta^2g=.187$, and Sex, $F(1, main21)=10.56$, $p=.004$, $\eta^2g=.283$, but the Sex×Time interaction was not significant, $F(1,21)=0.19$, $p=.668$. These findings indicate that both males (Pre: 0.3±0.1 kg/BW vs. Post: 0.4±0.1 kg/BW) and females (Pre: 0.2±0.1 kg/BW vs. Post: 0.3±0.1 kg/BW) improved relative shoulder press strength similarly. For rSR, significant main effects of Time, $F(1,21)=70.18$, $p<.001$, $\eta^2g=.298$, and Sex, $F(1,21)=7.82$, $p=.011$, $\eta^2g=.245$, were found. The Sex × Time interaction was not significant, $F(1,21)=1.15$, $p=.296$, indicating similar relative improvements between males (Pre: 0.5±0.1 kg/BW vs. Post: 0.6±0.1 kg/BW) and females (Pre: 0.3±0.1 kg/BW vs. Post: 0.5±0.1 kg/BW).

Table 2. Participant Demographics

	n	Age (y)	Height (m)	Weight (kg)	MoCA
Female	10	74 ± 7	1.6 ± 0.05	71.1 ± 14.0	27.6 ± 2.0
Male	13	75 ± 6	1.8 ± 0.04	85.9 ± 10.2	27.2 ± 1.2

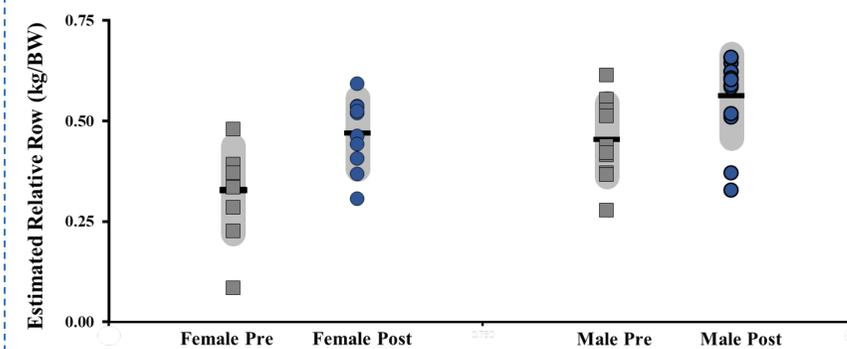


Figure 1. Differences in PRE and POST in Estimated Relative Row between genders.

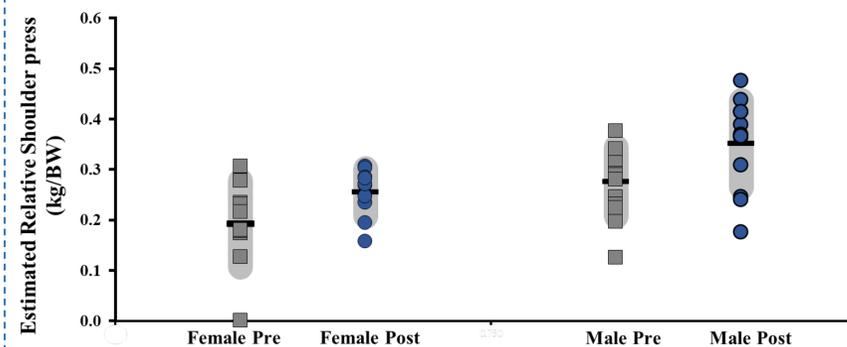


Figure 2. Differences in PRE and POST in Estimated Relative Shoulder press between genders.

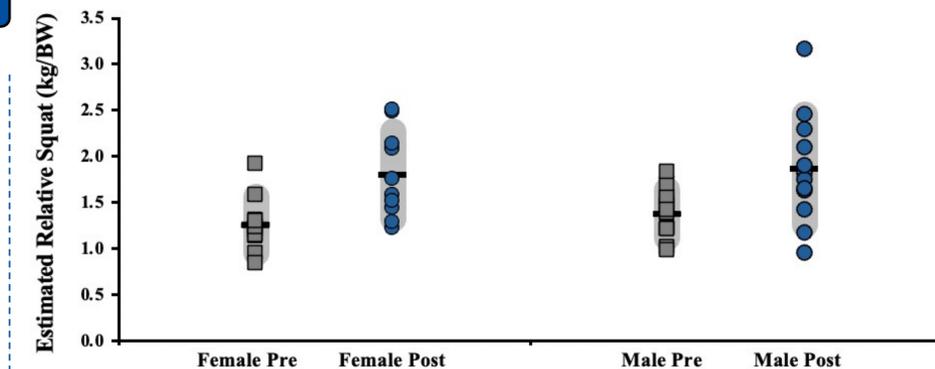


Figure 3. Differences in PRE and POST in Estimated Relative Squat between genders.

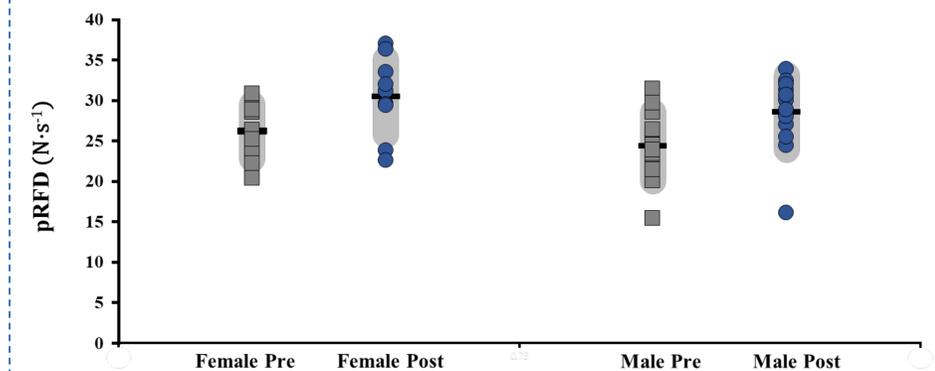


Figure 4. Differences in PRE and POST in pRFD between genders.

Conclusions

These data indicate significant performance improvements over time in all measures following the intervention collapsed across gender. HIIT effectively improves aerobic capacity and strength in older adults, supporting its use as a viable training method for this population.

Practical Applications

This data implies that a HIIT protocol is an adequate measurement of exercise for older adults to improve aerobic fitness and increase muscle strength.

References

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³ Ramirez-Vélez R, Hernández-Quinones PA, Tordecilla-Sanders A, et al. Effectiveness of HIIT compared to moderate continuous training in improving vascular parameters in inactive adults. *Lipids Health Dis*. 2019;18(1):42-z.
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