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High Intensity Interval Training in High Risk Individuals: A Systematic Review of the Literature

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Background

- One of the barriers to including aerobic exercise in physical therapy treatment plans is lack of time⁴
- Moderate intensity exercise is the current exercise recommendations for populations who are at high risk for adverse events during exercise¹⁰
- **High intensity interval training (HIIT)** uses short bouts of high-energy exercise that can accumulate to a shorter overall exercise time
- HIIT has positive health benefits in healthy adults including improvement in anaerobic and aerobic capacity⁹ and decreasing risk of coronary artery disease⁸
- HIIT may also prove beneficial in populations with progressive diseases who are at high-risk for exercise complications such as **chronic obstructive pulmonary disease (COPD) and chronic heart failure (HF)**

Purpose

- This systematic review of the literature (SRL) aims to demonstrate that high intensity interval training is an **effective, safe, and more efficient** training protocol as compared to continuous moderate intensity exercise in patients with COPD or HF

Methods

Timeline

- Began July 2015

Databases

- Cochrane, CINAHL, Scopus, and Ovid Medline

Search terms

- (“high intensity interval training” AND “COPD”) and (“high intensity interval training” AND “heart failure”)

Table 1 Average Subject Characteristics

	Heart Failure	COPD
n (Total)	45.1	21.7
Age	64.4	63.9
Sex (M/F)	35.2/10	15/6.7
EF (%)	32.6	-
FEV1/FVC (%)	-	46.3
PEDro Score	5.3/10	4.7/10
Attrition (%)	21.4	11.7

FEV1/FVC: percentage of vital capacity expired in first second of maximal expiration; EF: left ventricular ejection fraction

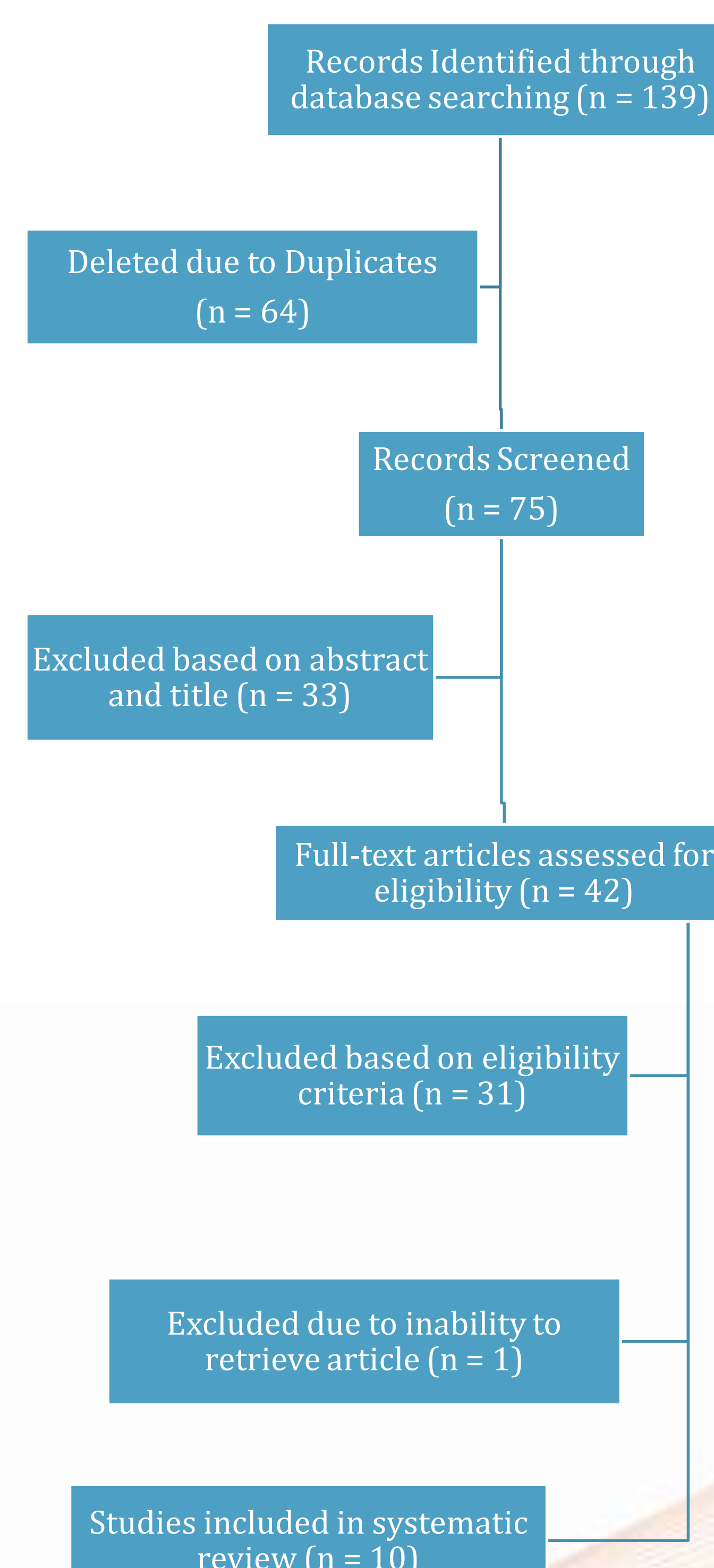


Figure 1 Prisma

Results

Table 2 HIIT Protocol Examples

Study Ref.	Modality	High Intensity	Low Intensity or Rest	Intervals	Total session time
Heart Failure					
32	Cycle ergometer	80-100% WRpeak	Passive	30s HI, 30s rest	45 min
28	Uphill treadmill and outdoor walking	90-95% of peak HR	50-70% peak HR	4x4min at HI, 3 min LI	25 min
Chronic Obstructive Pulmonary Disease					
42	Cycle ergometer	85-95% peak PHR	Passive rest while other leg cycles	4x4 min each leg, 8 series, 100% SpO ₂	32 min

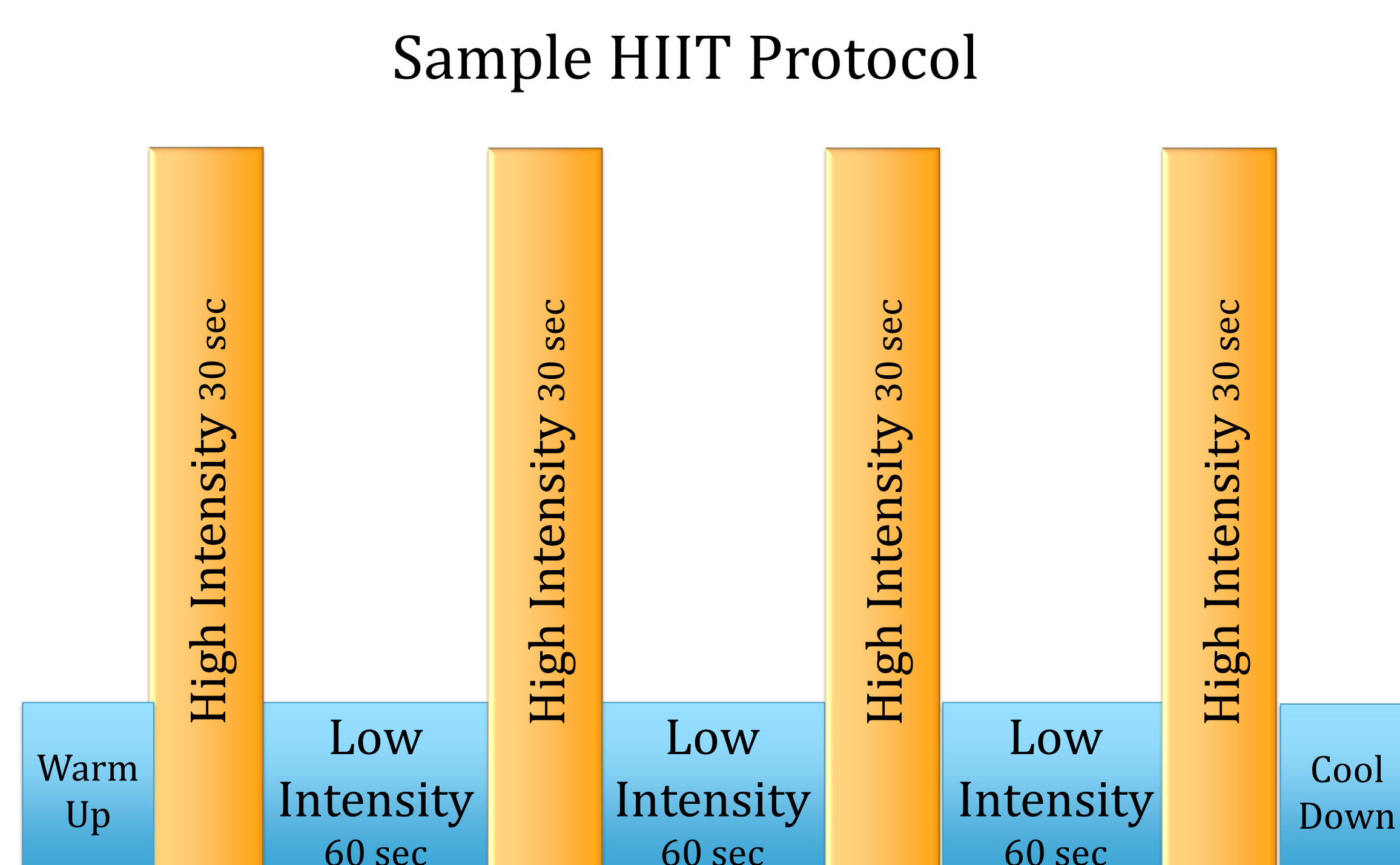


Table 3 Outcomes in Subjects with Heart Failure

Study Ref.	Method of Exercise	Lung Function	Cardiovascular Function	Functional Mobility	QOL
32	High Intensity	↑ VO ₂ peak, WRpeak	↑ LV function, elastic qualities of aorta	↑ 6MWT	↑ QOL (MLHFQ)
	Control	No change	↑ PWV	No change	No change
41	High Intensity	↑ VO ₂ peak, time at VT1 ^a	NT	↑ 6MWT	↑ QOL (HADS)
	Continuous Exercise	↑ time at VT1	NT	↑ 6MWT	↑ QOL (HADS)
33	High Intensity + Resistance Exercise	↑ VO ₂ peak, WRpeak, VO ₂ AT, RRR ^a	NT	NT	NT
	High Intensity	↑ VO ₂ peak, WRpeak, VO ₂ /t slope	NT	NT	NT
39	High Intensity	↑ VO ₂ peak, RER	↑ DBP ^a , HR, NYHA class	NT	NT
	Continuous Exercise	↑ VO ₂ peak, RER	↑ DBP, HR, NYHA class	NT	NT
34	High Intensity	↑ VO ₂ peak	No change	↑ gait speed	No change
	Continuous Exercise	↑ VT performance	↑ NYHA class	↑ sit to stand measure, gait speed	No change
35	High Intensity	NT	NT	↑ 6MWT ^a , workload ^a , exercise time ^a	↑ QOL ^a (MLHFQ)
	Control	NT	NT	NR	NR
37	High Intensity	↑ VO ₂ peak ^a , work economy ^a	↑ structural changes in heart ^a , hemodynamic measures ^a , HR	NT	↑ QOL ^a (MacNew)
	Continuous Exercise	↑ VO ₂ peak	↑ hemodynamic measures	NT	↑ QOL (MacNew)
	Control	NR	NR	NR	No change

Table 4 Outcomes in Subjects with COPD

Study Ref.	Method of Exercise	Lung Function	Cardiovascular Function	Functional Mobility	QOL
36	Hypoxic High Intensity	↑ VO ₂ peak, workload, multiple PFT measures	No change in HR	NT	NT
	Normoxic High Intensity	↑ VO ₂ peak, workload, and RER	No change in HR	NT	NT
38	High Intensity	↑ VO ₂ peak	↑ hemodynamic measures, HR	NT	NT
	Continuous Exercise	↑ VO ₂ peak	↑ hemodynamic measures, HR	NT	NT
42	High Intensity	↑ WRpeak, minute ventilation	NR	↑ leg discomfort/dyspnea	NT
	Continuous Exercise	↑ WRpeak	NR	NR	NT

6MWT: 6-minute walk test, *: significant difference between groups noted, AT: anaerobic threshold, CE: continuous exercise, DBP: diastolic blood pressure, HADS: Hospital Anxiety and Depression Scale, HI: high intensity, HOMA-IR: homeostasis model assessment—insulin resistance, HR: heart rate, LV: left ventricular, MLHFQ: Minnesota Living with Heart Failure Questionnaire, NR: not reported, NT: not tested, NYHA: New York Heart Association, PWV: pulse wave velocity, RER: respiratory exchange ratio, RRR: respiratory rate recovery, RT: resistance training, VO₂/t slope: first-degree slope of VO₂ at first minute recovery, VT: ventilatory threshold, VT1: first ventilatory threshold, WRpeak: work rate peak, ↑: improved compared to baseline, PFT: pulmonary function test, RER: respiratory exchange ratio

Discussion

Safety

- No significant adverse events occurred due to exercise training. Three deaths reported were unrelated to the research interventions³⁵

Efficacy

- HIIT subjects improved: VO₂peak^{34, 41}, left ventricular function³², structural changes to the heart³⁷, resting HR³⁷, Six Minute Walk Test^{32, 35}, decreased leg discomfort during exercise⁴², and Quality of Life^{32, 35}

Efficiency

- The high intensity protocols involve less total active exercise time than continuous exercise
- When comparing HIIT and CE total start-to-finish session time, some HIIT protocols were shorter and some were longer than CE sessions

Limitations

- Limitations include high attrition, appropriateness of studies included, variation of protocols, and completeness of outcomes reported

Further Research

- Identifying HIIT protocols that utilize minimal possible time for exercise training yet maintain effectiveness will be beneficial for this patient population.

Conclusion

- This SRL provides evidence that high intensity interval training can be an effective, safe, and possibly a more time efficient exercise program for patients between the ages of 18-80 years old diagnosed with either chronic heart failure without preserved ejection fraction or chronic obstructive pulmonary disease

Clinical Recommendation

- Estimate maximal power with a test such as the steep ramp to determine proper intensity level
- HIIT should be conducted within the clinic with close supervision, especially when initially implementing the training protocol
- Supervision ensures proper patient education with various intensity levels, ensures patient safety, and provides motivation for high intensity

Additional Information

Full Poster



Full Paper



References

