Indiana Society of Cardiovascular & Pulmonary Rehabilitation

Exercise Prescription: The Basics & Beyond

Matthew Harber, PhD, FACSM

Professor of Clinical Exercise Physiology

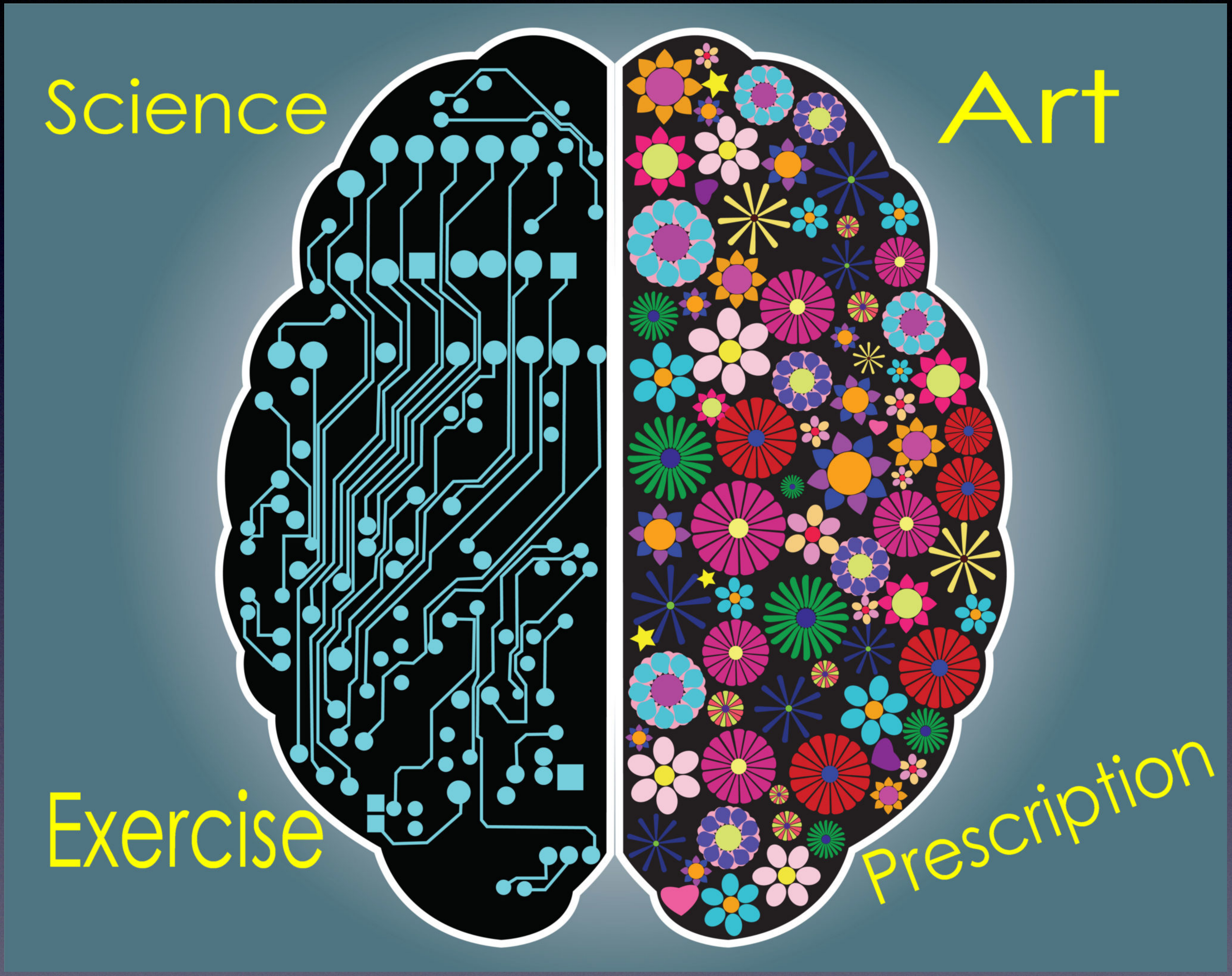
Ball State University

BALL STATE UNIVERSITY
College of Health
Clinical Exercise Physiology

Disclosures

Exercise is the BEST Medicine

Science vs Art of Exercise Prescription



Session Goals

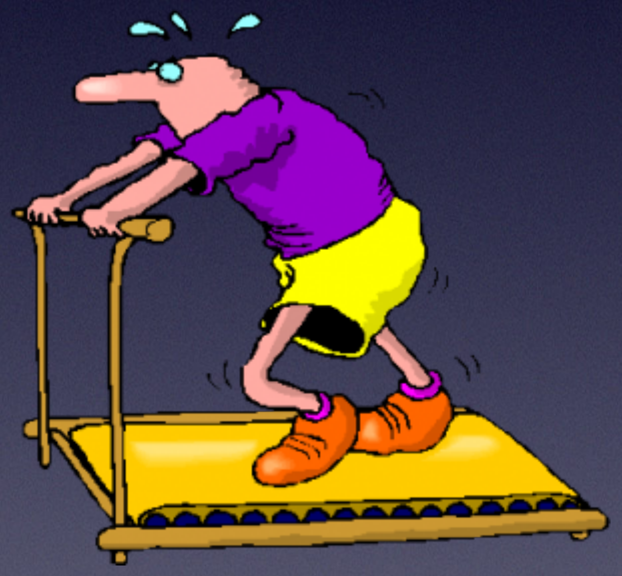
- Learn about exercise testing, training, and prescription guidelines
- Describe exercise training benefits
- Discuss exercise training clinical considerations

What is the purpose of exercise in cardiopulmonary rehabilitation?

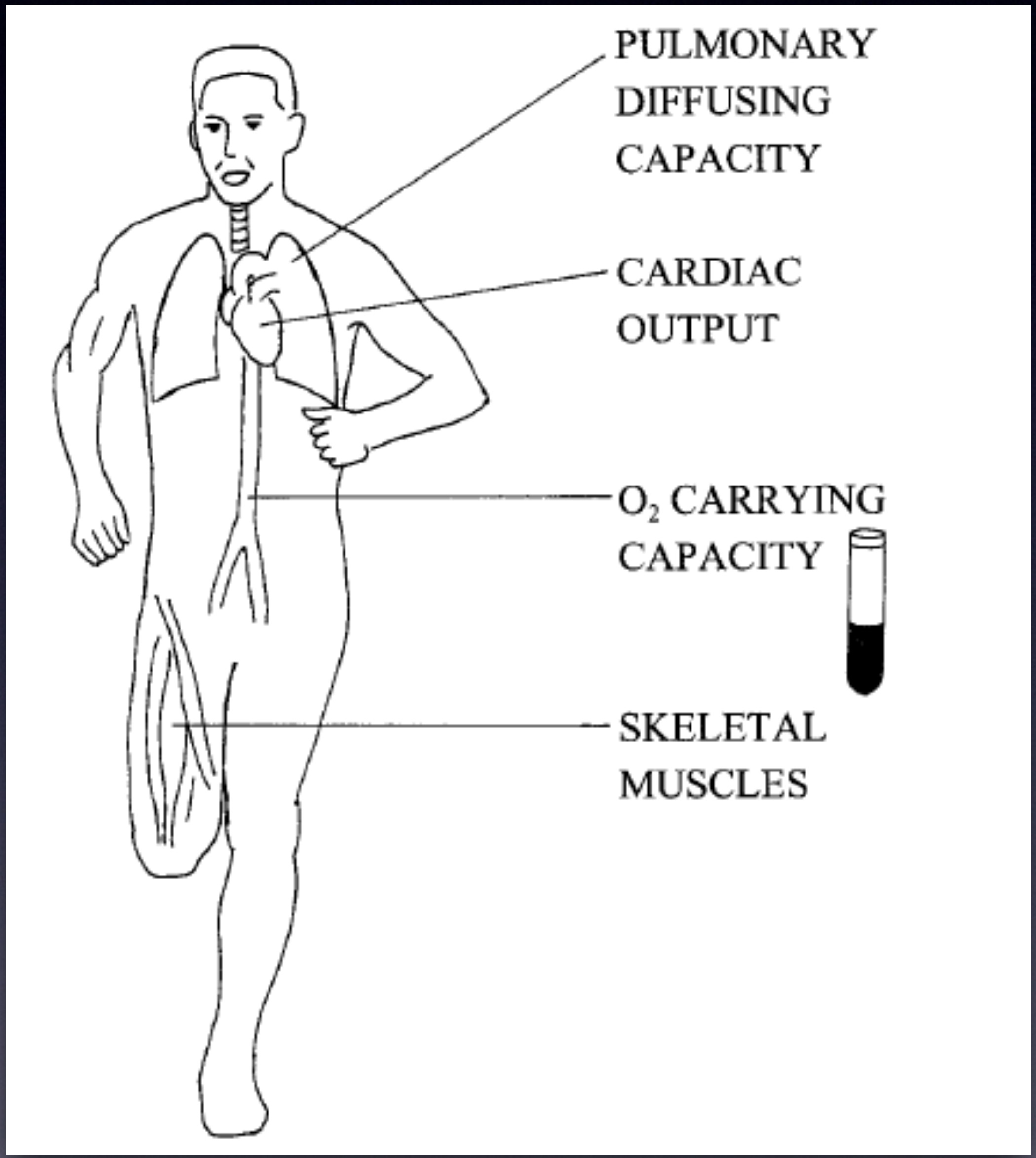
Increase habitual physical activity to a level that promotes health, improves cardiorespiratory fitness, and reduces chronic disease risk

Cardiorespiratory Fitness

- What is it?
- Why is it important?
- How is it assessed?
- What's it used for?

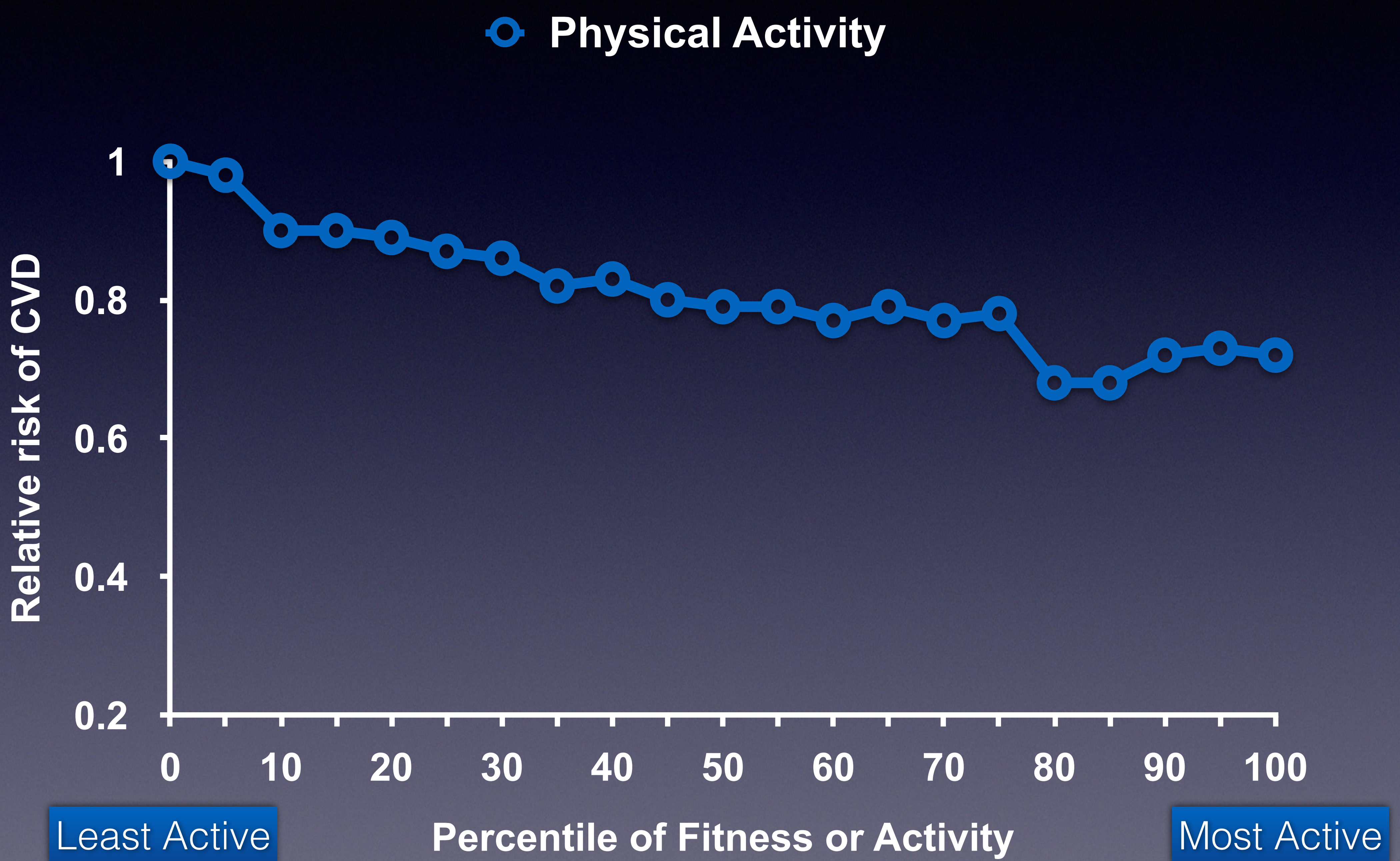


CRF is a strong predictor of health outcomes

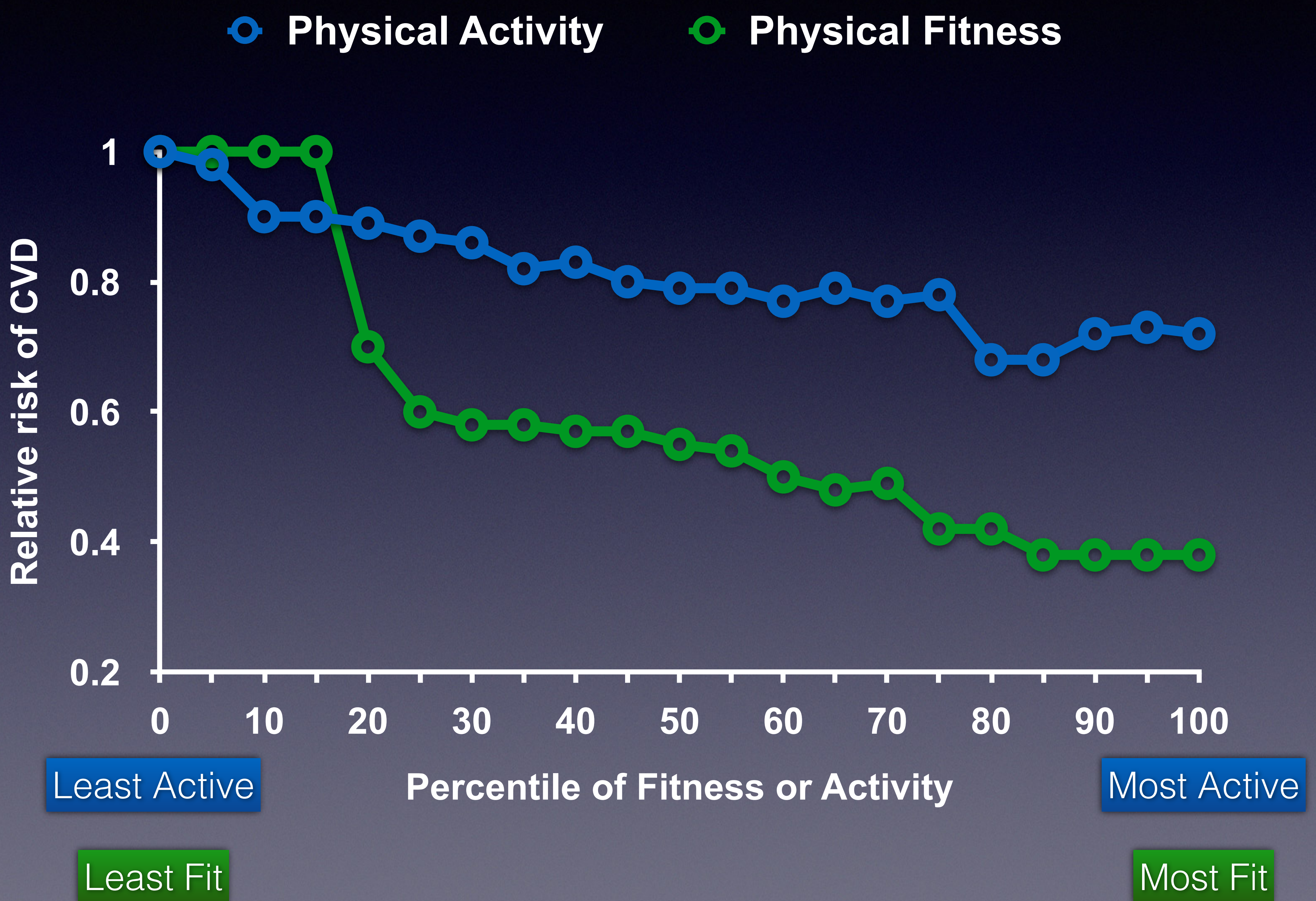


Maximum amount of oxygen that can be utilized by the body during strenuous exertion

Cardioprotective effects of physical activity and CRF



Cardioprotective effects of physical activity and CRF



AHA SCIENTIFIC STATEMENT

Importance of Assessing Cardiorespiratory Fitness in Clinical Practice: A Case for Fitness as a Clinical Vital Sign

A Scientific Statement From the American Heart Association

American Heart Association®

2016

Prediction of Long-Term Prognosis in 12 169 Men Referred for Cardiac Rehabilitation

Terence Kavanagh, MD, FRCP(C); Donald J. Mertens, MD, MSc; Larry F. Hamm, PhD; Joseph Beyene, PhD; Johanna Kennedy, RN; Paul Corey, PhD; Roy J. Shephard, MD, PhD

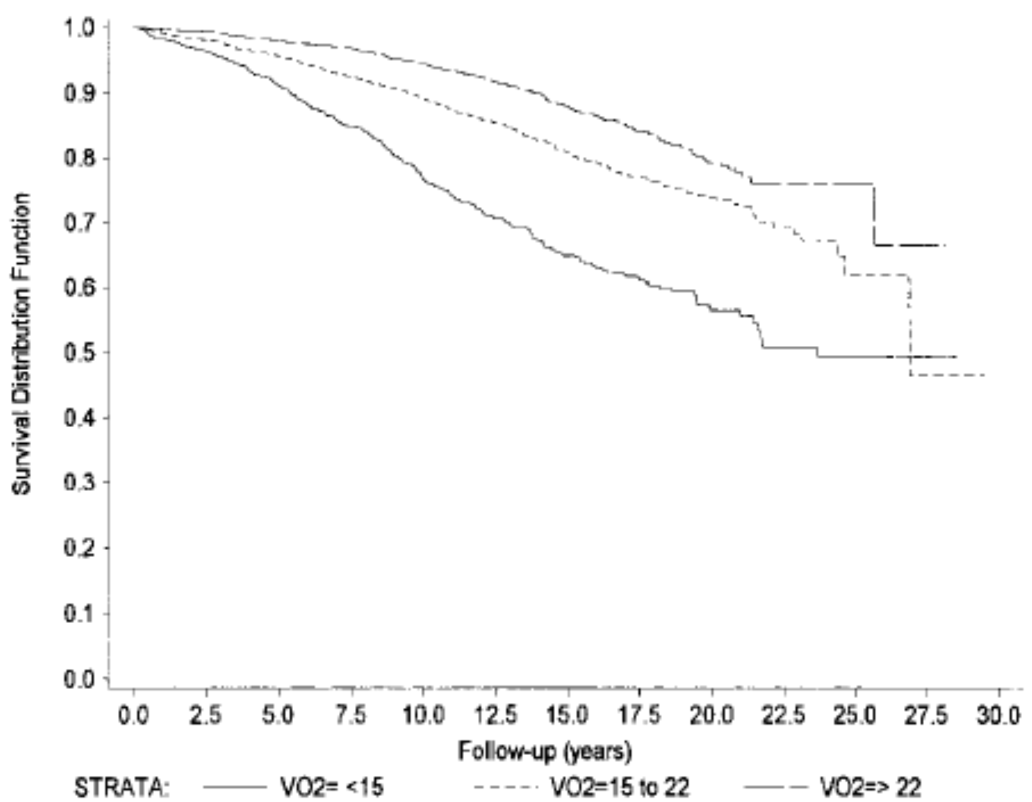


Figure 3. Kaplan-Meier survival curves for cardiac deaths, based on $\dot{V}O_{2peak}$ at referral.

Conclusions

Whether a cardiac patient is referred for rehabilitation after MI, CABG, or the onset of IHD, the most important single predictor of both cardiac and all-cause deaths is the Vo_{2peak} as measured by cardiorespiratory testing. Even a small exercise-induced gain in aerobic power should thus make a major difference not only in functional capacity but also in survival prospects.

CRF single best predictor of mortality in cardiac patients

European Journal of
Preventive
Cardiology

ESC
European Society
of Cardiology

Full research paper

European Journal of Preventive Cardiology
2020, Vol. 27(8) 811–819

DOI: 10.1177/2047487319887835
journals.sagepub.com/home/cpr
SAGE

Improvement in VO_{2peak} predicts readmissions for cardiovascular disease and mortality in patients undergoing cardiac rehabilitation

Nicolai Mikkelsen[1], Carmen Cadarso-Suárez[2], Oscar Lado-Baleato[2], Carla Díaz-Louzao[2], Carlos P Gil[3], Jacob Reeh[1], Hanne Rasmusen[1] and Eva Prescott[1]

Change in CRF after CR is highly predictive for readmission risk even independent of baseline CRF

> J Cardiopulm Rehabil Prev. 2022 Sep 30. doi: 10.1097/HCR.0000000000000734.
Online ahead of print.

Long-Term Maintenance of Cardiorespiratory Fitness Gains After Cardiac Rehabilitation Reduces Mortality Risk in Patients With Multimorbidity

Cemal Ozemek [1], Ross Arena, Codie R Rouleau, Tavis S Campbell, Trina Hauer, Stephen B Wilton, James Stone, Deepika Laddu, Tamara M Williamson, Hongwei Liu, Daniele Chirico, Leslie D Austford, Sandeep Aggarwal

Affiliations + expand

PMID: 36203224 DOI: 10.1097/HCR.0000000000000734

Abstract

Purpose: The objective of this study was to characterize the impact of multimorbidity and cardiorespiratory fitness (CRF) on mortality in patients completing cardiac rehabilitation (CR).

Methods: This cohort study included data from patients with a history of cardiovascular disease (CVD) completing a 12-wk CR program between January 1996 and March 2016, with follow-up through March 2017. Patients were stratified by the presence of multimorbidity, which was defined as having a diagnosis of ≥2 noncommunicable diseases (NCDs). Cox regression analyses were used to evaluate the effects of multimorbidity and CRF on mortality in patients completing CR. Symptom-limited exercise tests were completed at baseline, immediately following CR (12 wk), with a subgroup completing another test at 1-yr follow-up. Peak metabolic equivalents (METs) were determined from treadmill speed and grade.

Results: Of the 8320 patients (61 ± 10 yr, 82% male) included in the analyses, 5713 (69%) patients only had CVD diagnosis, 2232 (27%) had CVD+1 NCD, and 375 (4%) had CVD+≥2 NCDs. Peak METs at baseline (7.8 ± 2.0, 6.9 ± 2.0, 6.1 ± 1.9 METs), change in peak METs immediately following CR (0.98 ± 0.98, 0.83 ± 0.95, 0.76 ± 0.95 METs), and change in peak METs 1 yr after CR (0.98 ± 1.27, 0.75 ± 1.17, 0.36 ± 1.24 METs) were different (P < .001) among the subgroups. Peak METs at 12 wk and the presence of coexisting conditions were each predictors (P < .001) of mortality. Improvements in CRF by ≥0.5 METS from baseline to 1-yr follow-up among patients with or without multimorbidity were associated with lower mortality rates.

Conclusion: Increasing CRF by ≥0.5 METs improves survival regardless of multimorbidity status.

Increasing CRF by >0.5 METs improves survival

Cardiorespiratory Fitness

- What is it?
- Why is it important?
- How is it assessed?
- What's it used for?

Patient Group	CRF Assessment Method	Recommended Equation/ Protocol
Healthy*	Option 1: Nonexercise estimate of CRF[294]	Nes et al,[38,190] others in Table 6
	Option 2: Submaximal exercise test or field/clinical test†	One-mile walk,[166] 6-min walk[167]
	Option 3: Maximal exercise test without CPX	Individualized[159] or standardized[157] ramp, others in Table 5
	Option 4: Maximal exercise test with CPX	Individualized[159] or standardized ramp[157]
Chronic disease	Maximal exercise test with CPX measures	Individualized ramp[159]

Purpose of Exercise Testing

- Diagnostic - identify abnormal physiology
- Prognostic - identify risk for adverse events
- Therapeutic - monitor impact of intervention

Guiding the management of the patient, including exercise prescription

Fletcher et al, AHA Exercise Standards for Testing and Training 2013

TABLE 4.3 • Best Practices for Monitoring during a Symptom-Limited Maximal Exercise Test

Variable	Before Exercise Test	During Exercise Test	After Exercise Test
Electrocardiogram	Monitor continuously; record in supine position and position of exercise (*e.g.*, standing).	Monitor continuously; record during the last 5–10 s of each stage or every 2 min (ramp protocol).	Monitor continuously; record immediately postexercise, after 60 s of recovery and then every 2 min.
Heart rate[a]	Monitor continuously; record in supine position and position of exercise (*e.g.*, standing).	Monitor continuously; record during the last 5–10 s of each minute.	Monitor continuously; record during the last 5–10 s of each minute.
Blood pressure[a,b]	Monitor continuously; record in supine position and position of exercise (*e.g.*, standing).	Measure and record during the last 30–60 s of each stage or every 2 min (ramp protocol).	Measure and record immediately postexercise, after 60 s of recovery and then every 2 min.
Signs and symptoms	Monitor continuously; record as observed.	Monitor continuously; record as observed.	Monitor continuously; record as observed or as symptoms resolve.
Rating of perceived exertion	Explain scale.	Record during the last 5–10 s each stage or every 2 min (ramp protocol).	Obtain peak exercise shortly after exercise is terminated.

[a]In addition, heart rate and blood pressure should be assessed and recorded whenever adverse symptoms or abnormal electrocardiogram changes occur.

[b]An unchanged or decreasing systolic blood pressure with increasing workloads should be retaken (*i.e.*, verified immediately).

Adapted and used with permission from Brubaker PH, Kaminsky LA, Whaley MH. *Coronary Artery Disease: Essentials of Prevention and Rehabilitation Programs*. Champaign (IL): Human Kinetics; 2002. 364 p.

Exercise recommendations for healthy adults

TABLE 5.1 • Aerobic (Cardiovascular Endurance) Exercise Recommendations

FITT	Recommendation
***F**requency*	• At least 3 d · wk^{-1} • For most adults, spreading the exercise sessions across 3–5 d · wk^{-1} may be the most conducive strategy to reach the recommended amounts of PA.
***I**ntensity*	• Moderate (40%–59% HRR) and/or vigorous (60%–89% HRR) intensity is recommended for most adults.
***T**ime*	• Most adults should accumulate 30–60 min · d^{-1} (≥150 min · wk^{-1}) of moderate intensity exercise, 20–60 min · d^{-1} (≥75 min · wk^{-1}) of vigorous intensity exercise, or a combination of moderate and vigorous intensity exercise daily to attain the recommended targeted volumes of exercise.
***T**ype*	• Aerobic exercise performed in a continuous or intermittent manner that involves major muscle groups is recommended for most adults.

HRR, heart rate reserve; PA, physical activity.

TABLE 5.5 • Resistance Training Exercise Recommendations

FITT	Recommendation
***F**requency*	• For novice trainers, each major muscle group should be trained at least 2 d · wk^{-1}. • For experienced exercisers frequency is secondary to training volume, thus individuals can choose a weekly frequency per muscle group based on personal preference.
***I**ntensity*	• For novices, 60%–70% 1-RM, performed for 8–12 repetitions are recommended to improve muscular fitness. • For experienced exercisers, a wide range of intensities and repetitions are effective dependent on the specific muscular fitness goals.
***T**ype*	• Multijoint exercises affecting more than one muscle group and targeting agonist and antagonist muscle groups are recommended for all adults. • Single-joint and core exercises may also be included in a resistance training program, typically after performing multijoint exercise(s) for that particular muscle group. • A variety of exercise equipment and/or body weight can be used to perform these exercises.

Exercise recommendations for clinical populations

TABLE 5.1 • Aerobic (Cardiovascular Endurance) Exercise Recommendations

FITT	Recommendation
***F**requency*	• At least 3 d · wk^{-1} • For most adults, spreading the exercise sessions across 3–5 d · wk^{-1} may be the most conducive strategy to reach the recommended amounts of PA.
***I**ntensity*	• Moderate (40%–59% HRR) and/or vigorous (60%–89% HRR) intensity is recommended for most adults.
***T**ime*	• Most adults should accumulate 30–60 min · d^{-1} (≥150 min · wk^{-1}) of moderate intensity exercise, 20–60 min · d^{-1} (≥75 min · wk^{-1}) of vigorous intensity exercise, or a combination of moderate and vigorous intensity exercise daily to attain the recommended targeted volumes of exercise.
***T**ype*	• Aerobic exercise performed in a continuous or intermittent manner that involves major muscle groups is recommended for most adults.

HRR, heart rate reserve; PA, physical activity.

FITT RECOMMENDATIONS FOR INDIVIDUALS WITH CARDIOVASCULAR DISEASE PARTICIPATING IN OUTPATIENT CARDIAC REHABILITATION (7,10,16)

	Aerobic	Resistance	Flexibility
Frequency	Minimally 3 d · wk^{-1} preferably up to 5 d · wk^{-1}	2–3 nonconsecutive d · wk^{-1}	≥2–3 d · wk^{-1} with daily being most effective.
Intensity	With an exercise test, use 40%–80% of exercise capacity using HRR, $\dot{V}O_2R$, or $\dot{V}O_{2peak}$. Without an exercise test, use seated or standing resting heart rate (HR_{rest}) +20 to +30 beats · min^{-1} or an RPE of 12–16 on a scale of 6–20 (11).	Perform 10–15 repetitions of each exercise without significant fatigue; RPE 11–13 on a 6–20 scale or 40%–60% of 1-RM.	To the point of feeling tightness or slight discomfort.
Time	20–60 min.	1–3 sets; 8–10 different exercises focused on major muscle groups.	10–30 s hold for static stretching; ≥4 repetitions of each exercise.
Type	Arm ergometer, combination of upper and lower (dual action) extremity cycle ergometer, upright and recumbent cycle ergometer, recumbent stepper, rower, elliptical, stair climber, treadmill.	Select equipment that is safe and comfortable for the individual to use.	Static and dynamic stretching focused on the major joints of the limbs and the lower back Consider PNF technique.

1-RM, one repetition maximum; HRR, heart rate reserve; PNF, proprioceptive neuromuscular facilitation; RPE, rating of exertion; $\dot{V}O_{2peak}$, peak oxygen uptake; $\dot{V}O_2R$, oxygen uptake reserve.

Intensity is the key element

Exercise recommendations for clinical populations

TABLE 5.5 • Resistance Training Exercise Recommendations

FITT	Recommendation
*F*requency	• For novice trainers, each major muscle group should be trained at least 2 d · wk^{-1}. • For experienced exercisers frequency is secondary to training volume, thus individuals can choose a weekly frequency per muscle group based on personal preference.
*I*ntensity	• For novices, 60%–70% 1-RM, performed for 8–12 repetitions are recommended to improve muscular fitness. • For experienced exercisers, a wide range of intensities and repetitions are effective dependent on the specific muscular fitness goals.
*T*ype	• Multijoint exercises affecting more than one muscle group and targeting agonist and antagonist muscle groups are recommended for all adults. • Single-joint and core exercises may also be included in a resistance training program, typically after performing multijoint exercise(s) for that particular muscle group. • A variety of exercise equipment and/or body weight can be used to perform these exercises.

FITT — FITT RECOMMENDATIONS FOR INDIVIDUALS WITH CARDIOVASCULAR DISEASE PARTICIPATING IN OUTPATIENT CARDIAC REHABILITATION (7,10,16)

	Aerobic	Resistance	Flexibility
Frequency	Minimally 3 d · wk^{-1} preferably up to 5 d · wk^{-1}	2–3 nonconsecutive d · wk^{-1}	≥2–3 d · wk^{-1} with daily being most effective.
Intensity	With an exercise test, use 40%–80% of exercise capacity using HRR, $\dot{V}O_2R$, or $\dot{V}O_{2peak}$. Without an exercise test, use seated or standing resting heart rate (HR_{rest}) +20 to +30 beats · min^{-1} or an RPE of 12–16 on a scale of 6–20 (11).	Perform 10–15 repetitions of each exercise without significant fatigue; RPE 11–13 on a 6–20 scale or 40%–60% of 1-RM.	To the point of feeling tightness or slight discomfort.
Time	20–60 min.	1–3 sets; 8–10 different exercises focused on major muscle groups.	10–30 s hold for static stretching; ≥4 repetitions of each exercise.
Type	Arm ergometer, combination of upper and lower (dual action) extremity cycle ergometer, upright and recumbent cycle ergometer, recumbent stepper, rower, elliptical, stair climber, treadmill.	Select equipment that is safe and comfortable for the individual to use.	Static and dynamic stretching focused on the major joints of the limbs and the lower back. Consider PNF technique.

1-RM, one repetition maximum; HRR, heart rate reserve; PNF, proprioceptive neuromuscular facilitation; RPE, rating of exertion; $\dot{V}O_{2peak}$, peak oxygen uptake; $\dot{V}O_2R$, oxygen uptake reserve.

Intensity is the key element

European Journal of Preventive Cardiology

EUROPEAN SOCIETY OF CARDIOLOGY®

Policy statement

European Journal of Preventive Cardiology
20(3) 442–467

Reprints and permissions:
sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/2047487312460484
ejpc.sagepub.com
SAGE

Aerobic exercise intensity assessment and prescription in cardiac rehabilitation: a joint position statement of the European Association for Cardiovascular Prevention and Rehabilitation, the American Association of Cardiovascular and Pulmonary Rehabilitation and the Canadian Association of Cardiac Rehabilitation

Alessandro Mezzani[1]*, Larry F Hamm[2]*, Andrew M Jones[3], Patrick E McBride[4], Trine Moholdt[5], James A Stone[6], Axel Urhausen[7] and Mark A Williams[8]

Intensity is the key element

Intensity optimally prescribed from peak HR or VO_2

<20% patients have maximal exercise test

Resting HR +20 or +30 bpm is most common method in CR

	%HRR or VO_2R	%peak VO_2	%peak HR	RPE Borg scale
Very light	<20	<25	<35	<10
Light	20–39	25–44	35–54	10–11
Moderate	40–59	45–59	55–69	12–13
Heavy	60–84	60–84	70–89	14–16
Very heavy	≥85	≥85	≥90	17–19
Maximal	100	100	100	20

Modified from Tipton et al.[43]; ACSM: American College of Sports Medicine; HRR: heart rate reserve; VO_2R: VO_2 reserve; HR: heart rate; RPE: rating of perceived exertion.

Among Patients Taking Beta-Adrenergic Blockade Therapy, Use Measured (Not Predicted) Maximal Heart Rate to Calculate a Target Heart Rate for Cardiac Rehabilitation

Steven J. Keteyian, PhD; Katherina Steenson, MS; Crystal Grimshaw, MS; Noah Mandel, MS; Wanda Koester-Qualters, MS; Robert Berry, MS; Dennis J. Kerrigan, PhD; Jonathon K. Ehrman, PhD; Edward L. Peterson, PhD; Clinton A. Brawner, PhD

Percentage of Subjects That Would Be Given a Target Heart Rate That Corresponds to a Heart Rate Reserve Range Calculated Using Measured Maximal Heart Rate From a Cardiopulmonary Exercise Test[a]

	Target $HR_{reserve}$ Using Measured HR_{max}		
		Guideline[b]	
	<50%	50-80%	>80%
Target HR using straight percent method			
Equation of 220 − age to predict HR_{max}, with Target HR set at			
60% HR_{max}	72	19	9
85% HR_{max}	0	16	84
Disease-specific equations[c] to predict HR_{max}, with Target HR set at			
60% HR_{max}	>99	<1	0
85% HR_{max}	45	40	15
Target HR using $HR_{reserve}$ method			
Equation of 220 − age to predict HR_{max}, with target HR set at			
50% $HR_{reserve}$	5	61	34
80% $HR_{reserve}$	0	<7	>93
Disease-specific equations[c] to predict HR_{max}, with target HR set at			
50% $HR_{reserve}$	71	23	6
80% $HR_{reserve}$	15	57	28
Target HR using standing resting HR			
+20 bpm	100	0	0
+30 bpm	48	40	12

Abbreviations: CPX, cardiopulmonary exercise test; HR, heart rate; HR_{max}, maximal heart rate; $HR_{reserve}$, heart rate reserve.
[a]Data are presented as %.
[b]From American College of Sports Medicine[7]; (measured HR_{max} − resting HR) + resting HR.
[c]164 − 0.72(age) for patients without heart failure[11] or 119 + 0.5(resting HR) − 0.5(age) for patients with heart failure.[12]

Calculated Mean Percent Measured Heart Rate Reserve That Corresponds to the Target Heart Rates From Each of the Three Methods Used to Prescribe Exercise Intensity[a]

	Equivalent % Measured $HR_{reserve}$ Using Results From CPX
Target HR set using straight percent method	
Equation of 220 − age to predict HR_{max}, with target HR set at	
60% HR_{max}	43 ± 26
85% HR_{max}	118 ± 50
Disease-specific equations[b] to predict HR_{max}, with target HR set at	
60% HR_{max}	1 ± 19
85% HR_{max}	59 ± 28
Target HR set using $HR_{reserve}$ method	
Equation of 220 − age to predict HR_{max}, with target HR set at	
50% $HR_{reserve}$	81 ± 34
80% $HR_{reserve}$	131 ± 54
Disease-specific equations[b] to predict HR_{max}, with target HR set at	
50% $HR_{reserve}$	47 ± 20
80% $HR_{reserve}$	75 ± 32
Target HR set using standing resting HR	
+20 bpm	38 ± 16
+30 bpm	56 ± 24

Abbreviations: CPX, cardiopulmonary exercise test; HR, heart rate; HR_{max}, maximal heart rate; $HR_{reserve}$, heart rate reserve.
[a]Data are presented as mean ± SD.
[b]164 − 0.72(age) for patients without heart failure[11] or 119 + 0.5(resting HR) − 0.5(age) for patients with heart failure.[12]

Effectiveness of High Intensity Training

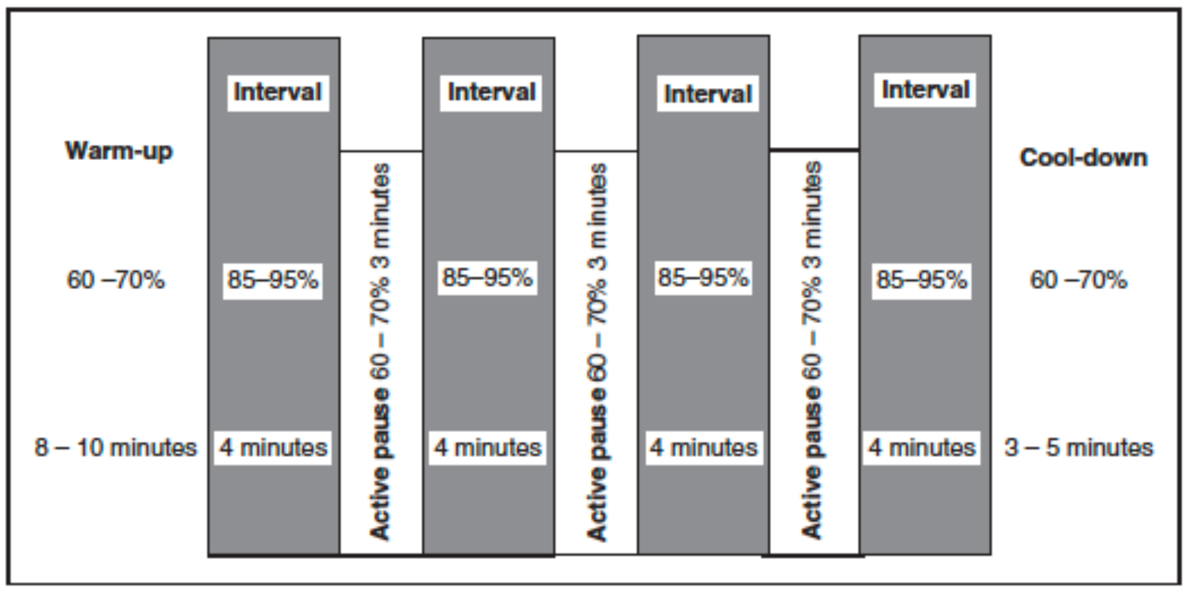


Figure 5. The 4 × 4 min aerobic interval training model. Intensity is given as percentage of peak heart rate.

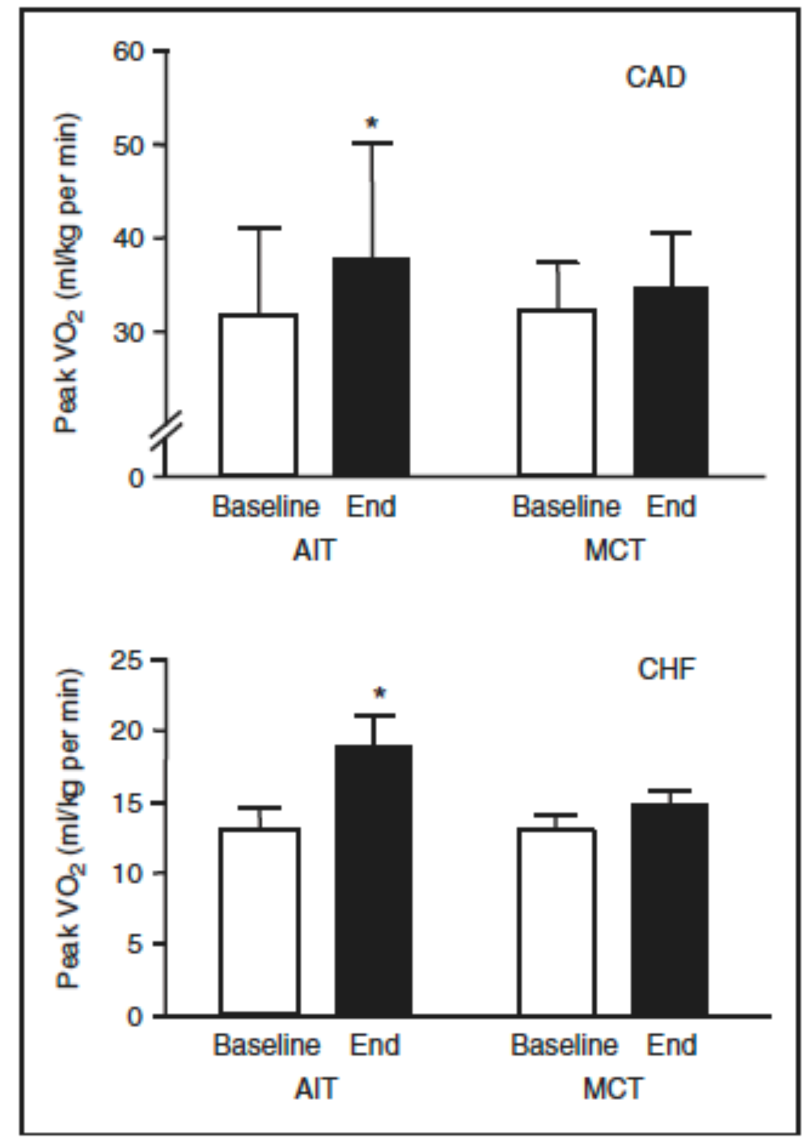
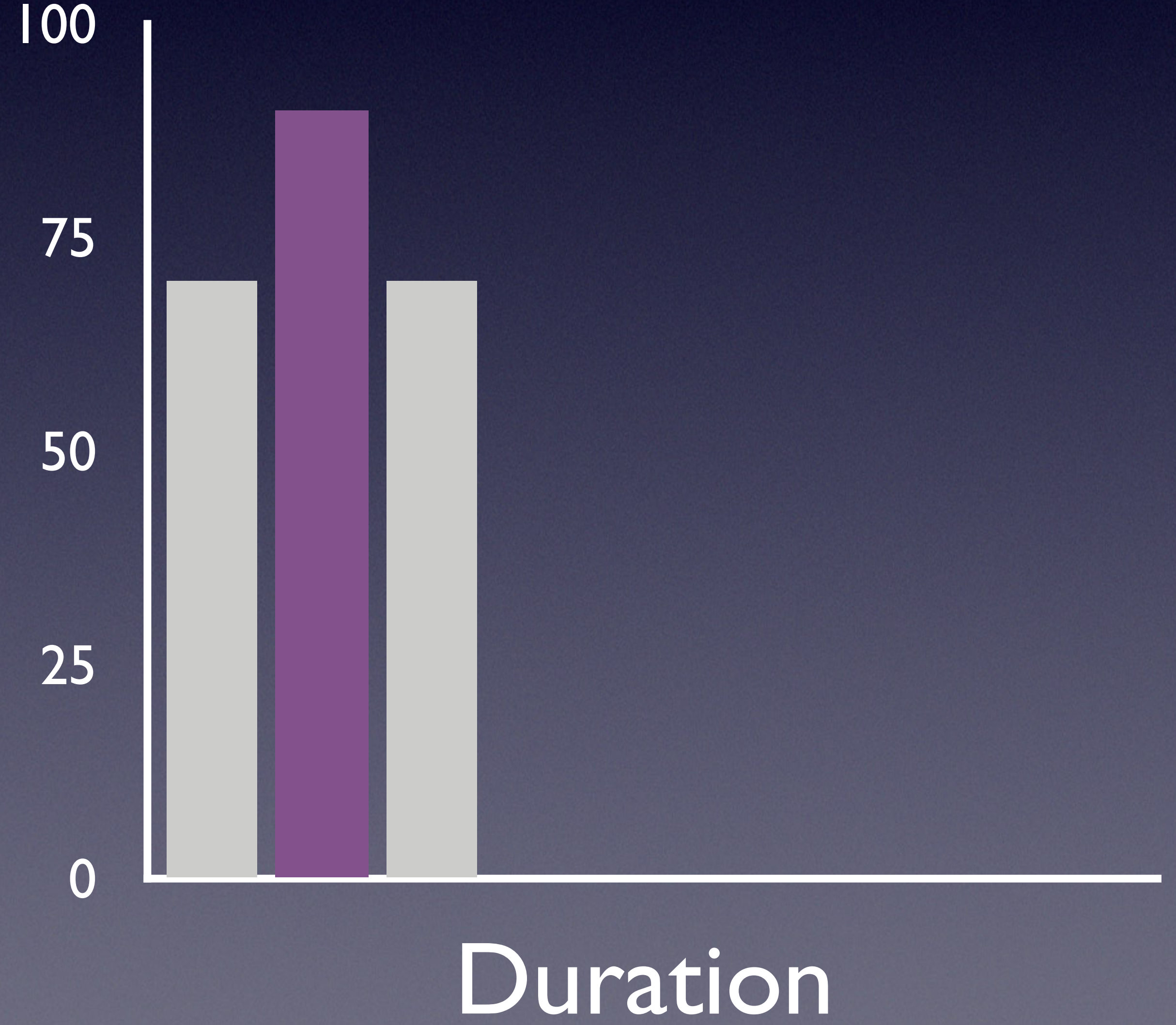


Figure 6. Peak VO_2 before and after aerobic interval training and moderate to high-intensity continuous training in patients with coronary artery disease and chronic heart failure. Modified from Rognmo et al.[95] and Wisløff et al.[96]
CAD: coronary artery disease; CHF: chronic heart failure; AIT: aerobic interval training; MCT: moderate to high-intensity continuous training; $^{*}p < 0.05$ vs. MCT.

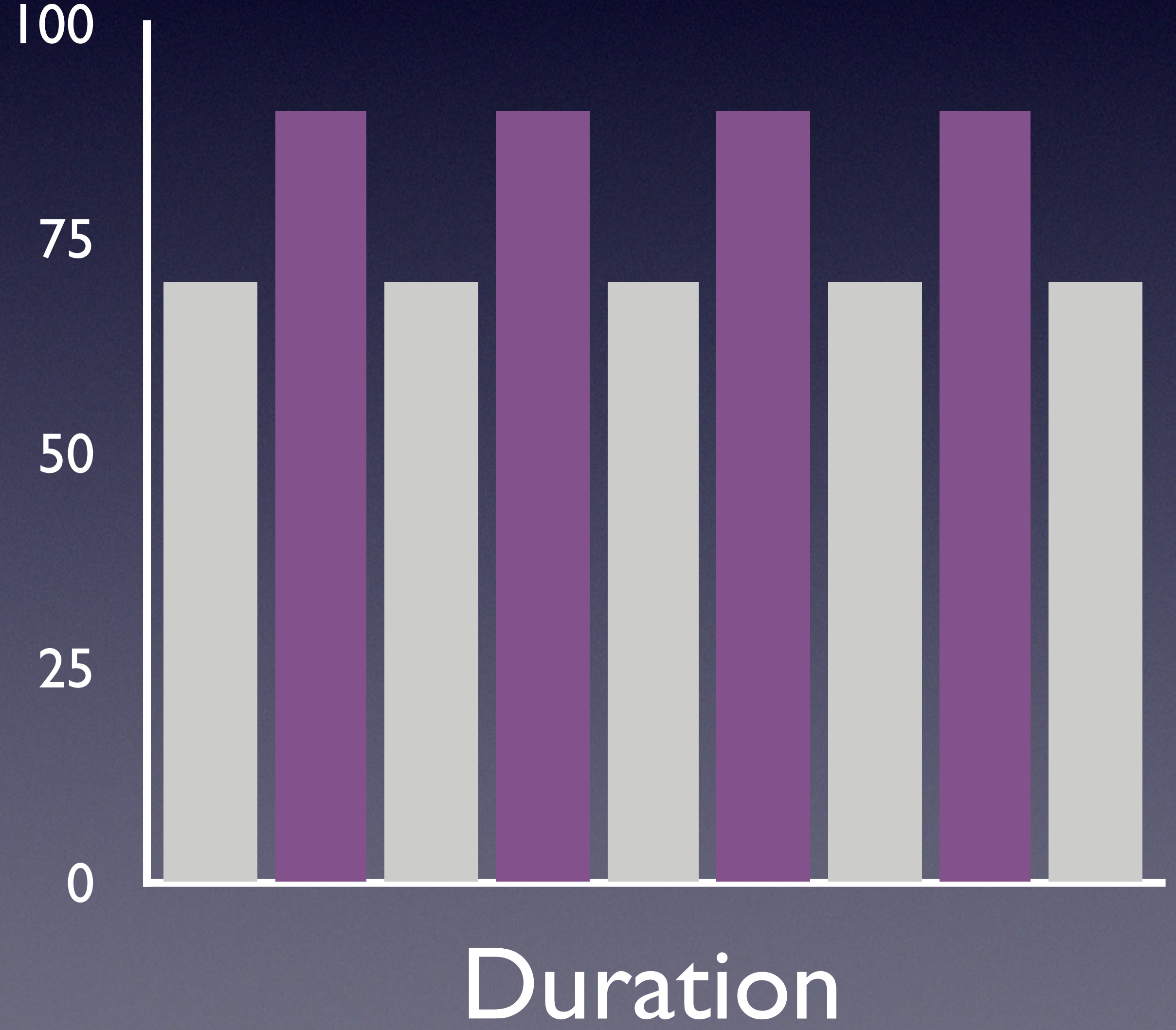
High intensity intervals increase CRF more effectively

Low Volume vs High Volume HIIT

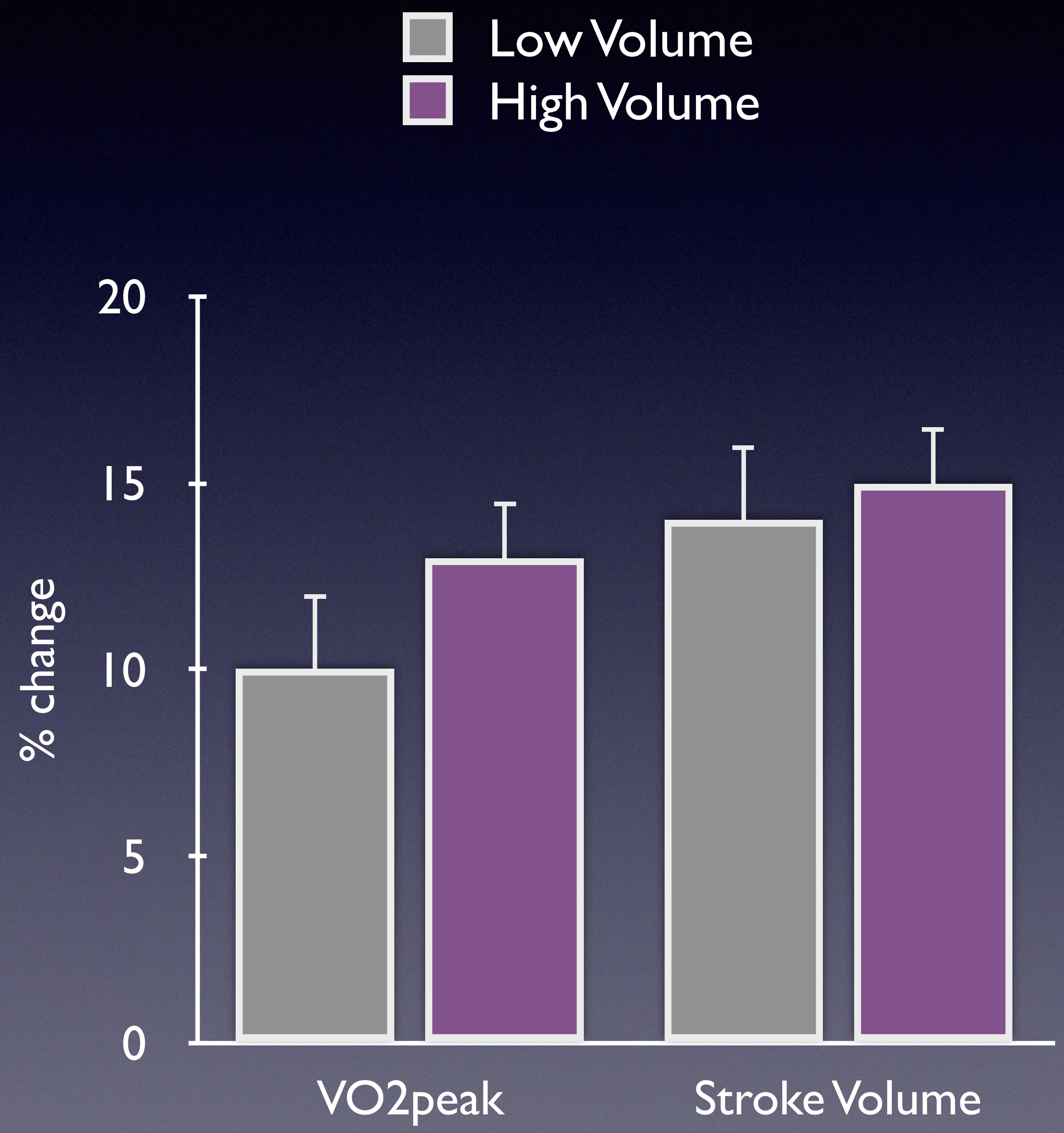
LV
1x4 min @ 90%
3 min @ 70%



HV
4x4 min @ 90%
3 min @ 70%



Low-volume vs High-volume



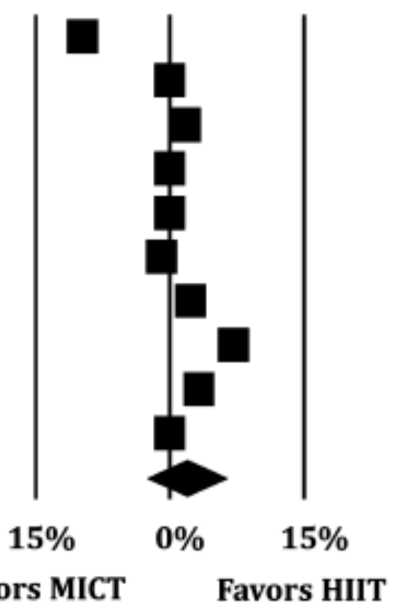
Both groups reduced:

- ✓ blood glucose
- ✓ blood pressure
- ✓ % body fat

Adherence to HIIT suggests it is well tolerated

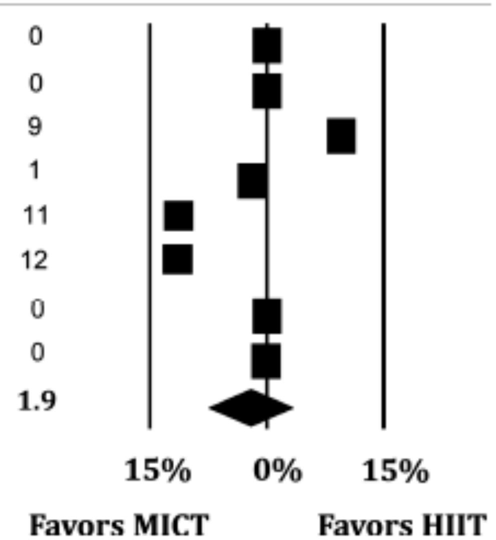
A

Study	Session Attendance (%)			Difference
	MICT	HIIT	Difference	
Currie *et al.* (2013) [26]	92	80	12	
Conraads *et al.* (2015) [22]	99	99	0	
Lee *et al.* (2019) [25]	80	84	4	
Keteyian *et al.* (2014) [28]	97	97	0	
Tschentscher *et al.* (2016) [27]	99	99	0	
Moholdt *et al.* (2009) [20]	84	82	2	
Moholdt *et al.* (2012) [24]	81	85	4	
Rognmo *et al.* (2004) [21]	85	94	9	
Villelabeitia-Jaureguizar *et al.* (2016) [34]	87.5	92	4.5	
Abdelhalem *et al.* (2018) [35]	100	100	0	
	90.5	**91.2**	**0.7**	



B

Study	Participant Attendance (%)			Difference
	MICT	HIIT	Difference	
Abdelhalem *et al.* (2018) [35]	100	100	0	
Madssen *et al.* (2014) [38]	100	100	0	
Taylor *et al.* (2020) [11]	91	100	9	
Boidin *et al.* (2019) [15]	100	99	1	
Heber *et al.* (2020) [39]	79	68	11	
Kim *et al.* (2015) [40]	100	88	12	
Ha-Yoon *et al.* (2018) [17]	94	94	0	
Cardozo *et al.* (2015) [16]	100	100	0	
	95.5	**93.0**	**1.9**	



Aerobic intensity by cardiac diagnosis

Table 5. Evidence-based prescribable aerobic exercise intensity in cardiac patient groups

	Exercise intensity domains			
	Light to moderate	Moderate to high	High to severe	Severe to extreme
Stable angina pectoris	√[a]	√[a]	√[a]	
Chronic CAD (no residual ischaemia)	√	√	√	√
PCI	√	√	√	
Pacemaker	√	√		
ICD	√	√		
Chronic AF	√[b]	√[b]		
CABG	√	√	√	
Valve repair/replacement	√	√		
CHF	√	√	√	
LVAD	√			
Heart transplantation	√[c]	√[c]	√[c]	

The grey areas identify intensity domains for which no scientific evidence is available in a specific population; CAD: coronary artery disease; PCI: percutaneous coronary intervention; ICD: implantable cardioverter defibrillator; AF: atrial fibrillation; CABG: coronary artery by-pass grafting; CHF: chronic heart failure; LVAD: left ventricular assist device; [a]Heart rate and/or work rate must in any case be lower than those corresponding to the ischaemic threshold; [b]Heart rate may not be usable due to highly variable chronotropic response; [c]Heart rate may not be usable due to denervation-related blunted chronotropic response.

Prescribing Exercise Intensity

Rating	Descriptor
6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very Hard
18	
19	Extremely hard

Borg Scale

Light

RPE <12; <40% HRR

Moderate

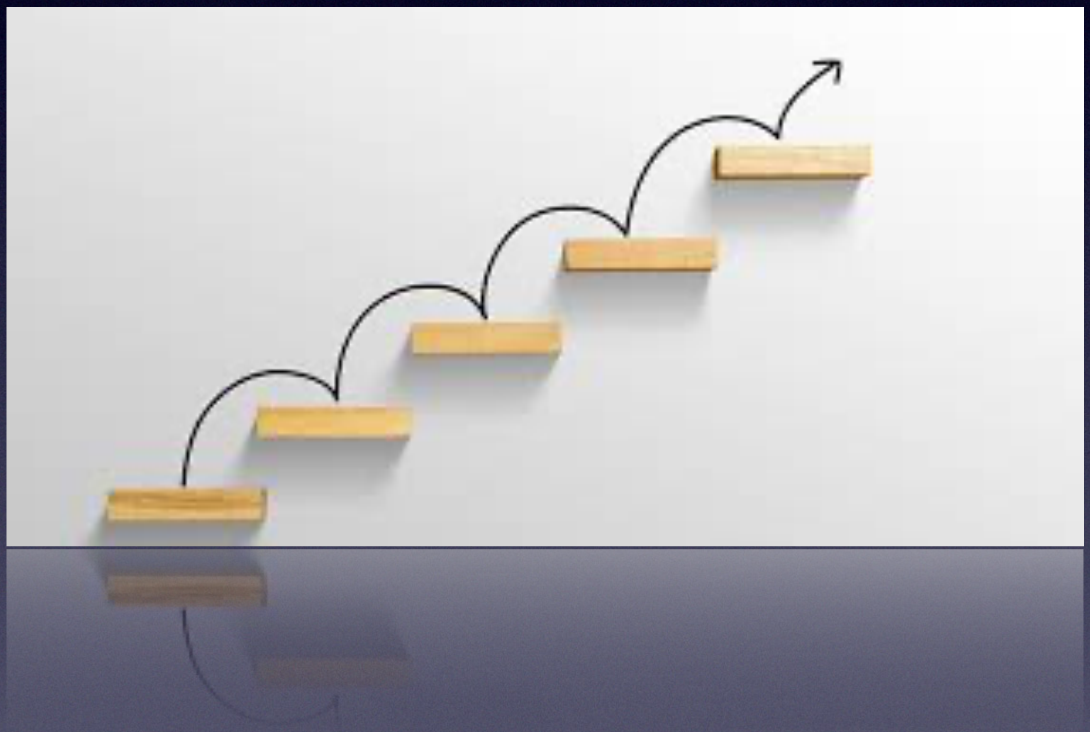
RPE 12-13; 40-59% HRR

Vigorous/High

RPE 14-16; 60-80% HRR

Progression of the Exercise Prescription

- ✓ Individualized
- ✓ Reviewed each session
- ✓ Weekly evidence
- ✓ One FITT component at a time
- ✓ Duration 1-5 min/session
- ✓ 5-10% increases usually tolerated
- ✓ Increase duration then intensity



Don't neglect resistance training

- ✓ 2 days/week
- ✓ 40-60% 1RM
- ✓ RPE 11-13
- ✓ 10-15 repetitions
- ✓ 8-10 exercises
- ✓ 1-3 sets

AHA SCIENTIFIC STATEMENT

Resistance Exercise Training in Individuals With and Without Cardiovascular Disease: 2023 Update: A Scientific Statement From the American Heart Association

Pulmonary Disease

- ✓ Value of CPET
- ✓ Resistance training
- ✓ Intensity is key
- ✓ HR parameters may not be appropriate
- ✓ Dyspnea 4-6 = 50-80% peak work rate
- ✓ Intervals maybe preferred
- ✓ Inspiratory muscle training

0	No breathlessness at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight breathlessness
3	Moderate
4	Somewhat severe
5	Severe breathlessness
6	
7	Very severe breathlessness
8	
9	Very, very severe (almost maximal)
10	Maximal

Figure 8.1 Borg Category-Ratio 0–10 scale modified for dyspnea.

Exercise Training Considerations

- ExRx depends on patient factors (diagnosis, disease severity, co-morbidities)
- Any activity is beneficial for extremely deconditioned patients
- Intensity should be at HR and work rate below ischemic or angina threshold (upper limit is at least 10 bpm below threshold)
- Meds taken as prescribed (note B-blockers). Any change in B-blocker dose will require new exercise test

Exercise Considerations

- If B-blocker has changed…monitor s/s and note RPE and HR at most recent workload
- Exercise testing recommended with any change in symptoms or clinical status
- Diuretics increase risk of volume depletion, hypokalemia, or orthostatic HTN.
    - monitor BP, symptoms of dehydration and arrhythmias

Exercise is the BEST Medicine

BALL STATE UNIVERSITY

College of Health
Clinical Exercise Physiology

Thank you!!