6th Asian Preventive Cardiology & Cardiac Rehabilitation Conference
Cum 10th Certificate Course in Cardiac Rehabilitation
3-6 November 2016 | Hong Kong Convention and Exhibition Centre

Exercise in various Heart Diseases

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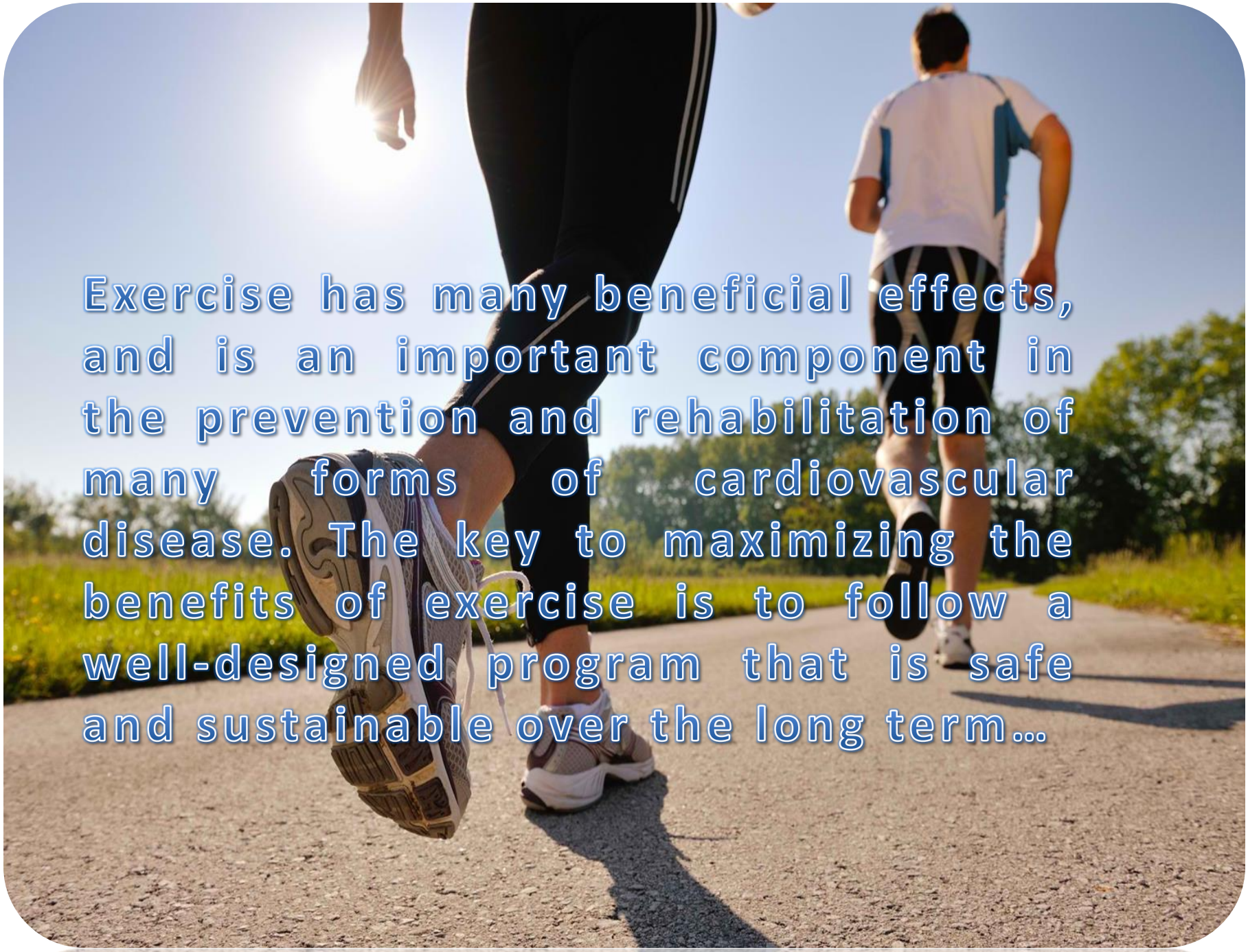
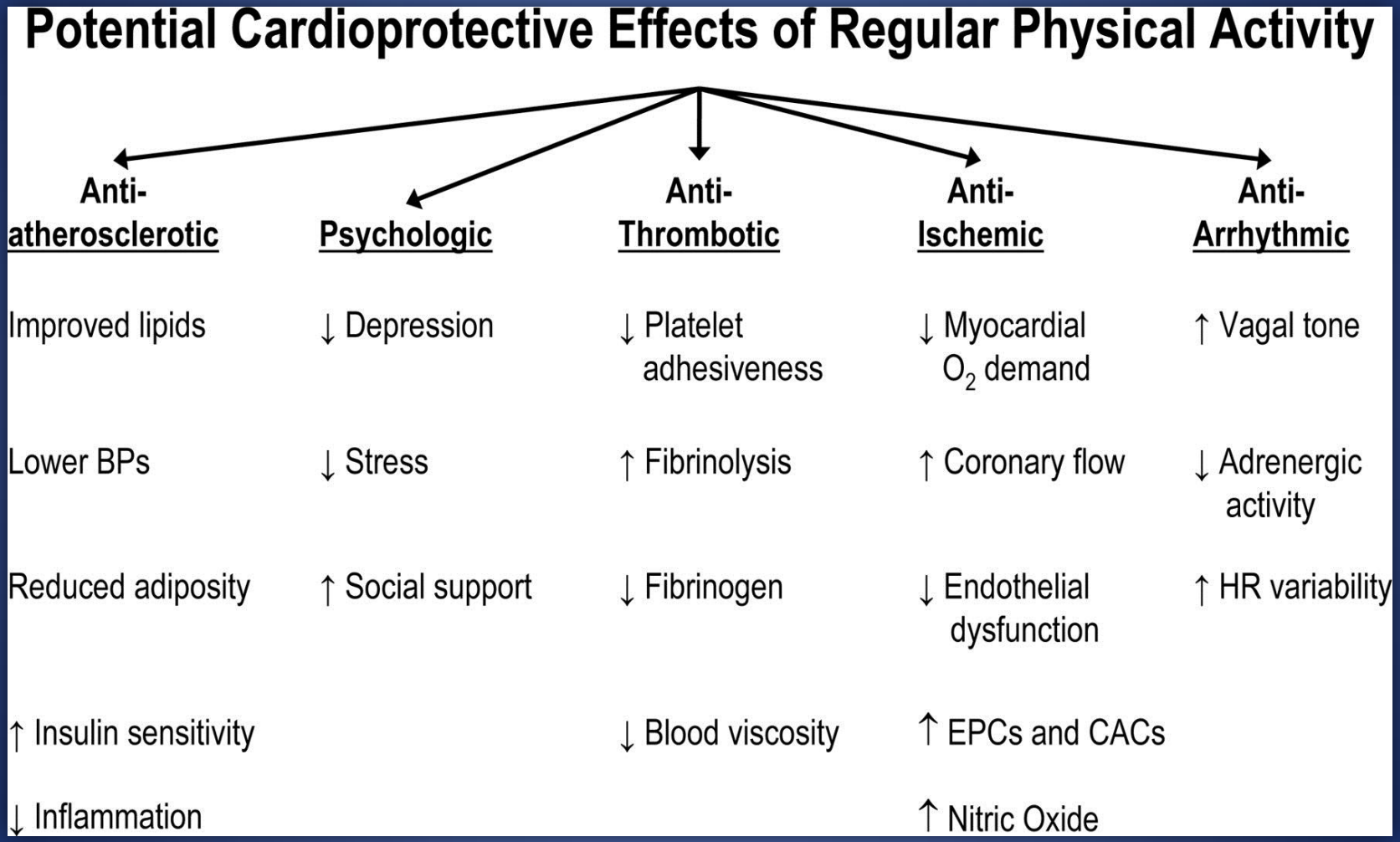

Exercise has many beneficial effects, and is an important component in the prevention and rehabilitation of many forms of cardiovascular disease. The key to maximizing the benefits of exercise is to follow a well-designed program that is safe and sustainable over the long term…

Benefits of Regular Physical Activity



Franklin B A , Cushman M Circulation 2011;123:2274-2283

London Bus study

Fitter you are, the longer you live!! (up to a point)

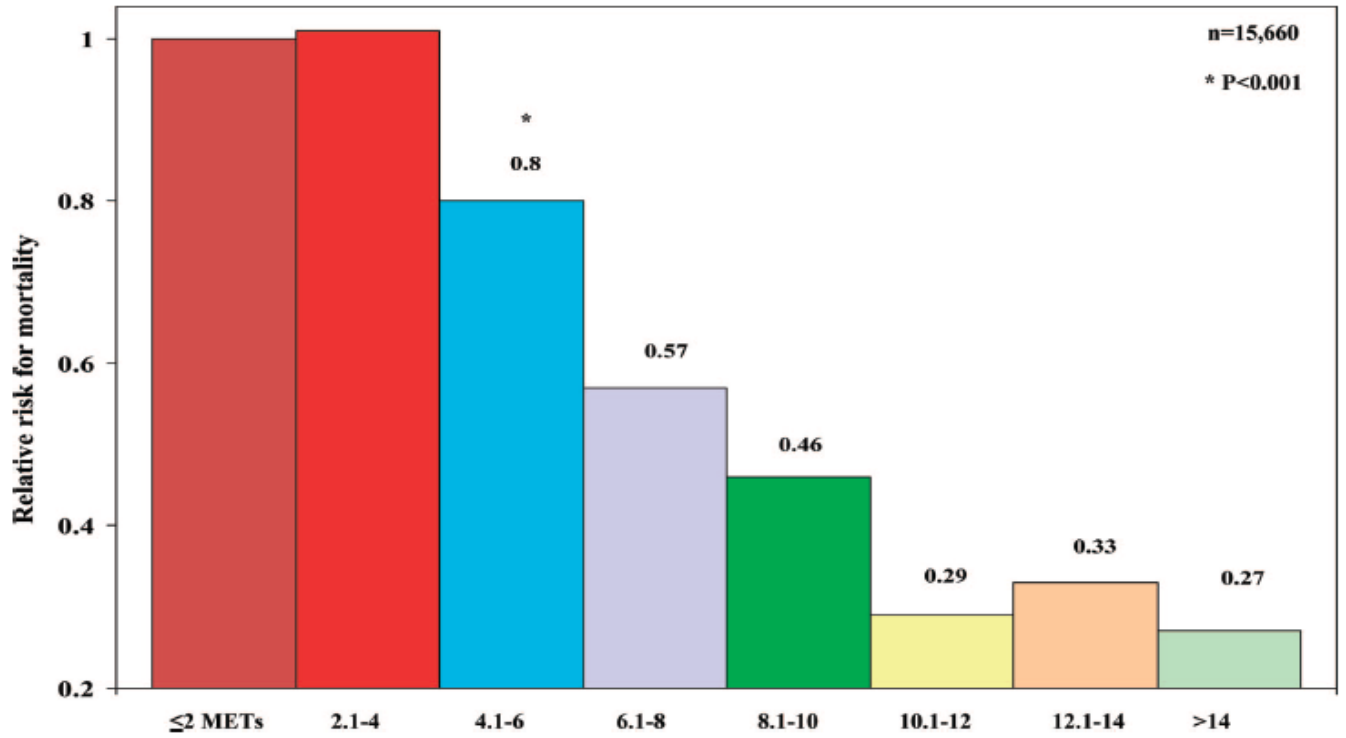


Figure 1. Mortality risk according to exercise capacity. Note that significant reductions in mortality are evident at >4 METs and reach an asymptote at >10 METs. Data from Kokkinos et al.[2]

Common questions

- Doctor, I have XXX heart problem, can I exercise? How much exercise can I do?
- More specifically can I play squash, football or run a marathon like I use to?
- Can I take part in competitive sports? Is it safe?

Safety of Exercise in Heart Diseases

Main concern is sudden cardiac death or acute decompensation

Progressive intensity required for exercise training

Progression of underlying condition (unsubstantiated)

- Valvular heart disease
- Heart failure
- Hypertrophic cardiomyopathy and other cardiomyopathies
- Congenital Heart diseases (ASD, VSD)
- Pulmonary hypertension
- Peripheral vascular disease

General Principles

1. Everyone should participate in regular physical activity – question is type and how much

2. Physical activity can be divided in recreational sports/exercise and competitive sports

3. Most heart diseases if stable or adequately controlled are eligible for the first

4. Regular monitoring required as status may change

General Principles

1. Nature of heart disease, type of abnormality and etiology
2. Clinical history and physical examination – Signs & symptoms of decompensation, e.g. dyspnea, syncope, palpations or angina
3. Comorbid conditions e.g. diabetes, hypertension
4. Severity and stability of the heart disease based on echocardiographic and clinical features
5. Presence of adverse secondary features such as left ventricular systolic dysfunction, chamber dilatation, exercise induced pulmonary hypertension on echo, or exercise induced hypotension or syncope
6. Evidence of concurrent significant arrhythmias

General Flow Chart

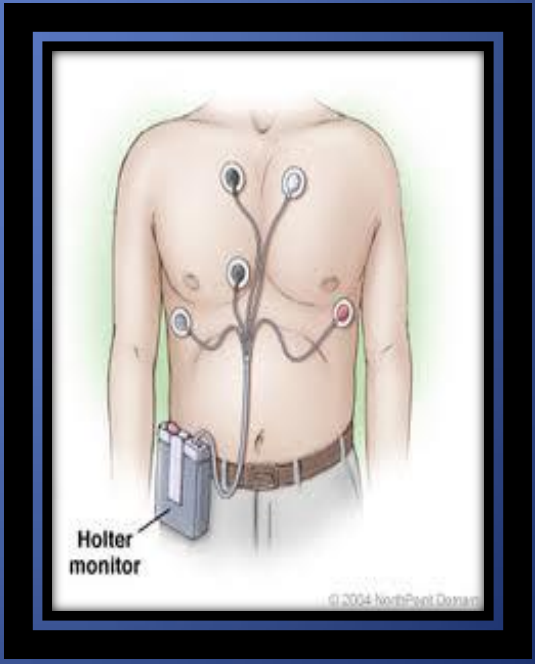
Echo important assessment

- For initial evaluation of known or suspected heart diseases (HDs)
  - For diagnosis, etiology, severity, prognosis, and evaluate timing of intervention
- Known HDs with change in symptoms or P/E findings
- Routine FU of known HDs

Stage	Aortic Stenosis	Aortic Regurgitation	Mitral Stenosis	Mitral Regurgitation
Progressive (B)	**Mild** Every 3-5 years	**Mild** Every 3-5 years	**Mild** Every 3-5 years	**Mild** Every 3-5 year
	Moderate Every 1-2 years	**Moderate** Every 1-2 years	**Moderate** Every 1-2 years	**Moderate** Every 1-2 years
Severe (C)	**Severe** Every 6-12 mo	**Severe** Every 6-12 mo Dilating LV: more frequently	**Severe** Every year	**Severe** Every 6-12 mo Dilating LV: more frequently

Additional Evaluations

- Stress testing – TMX test, CPET, stress echo
- Supervised sessions with telemetry
- Ambulatory holter monitoring



Reference for Athletes with CV abnormalities

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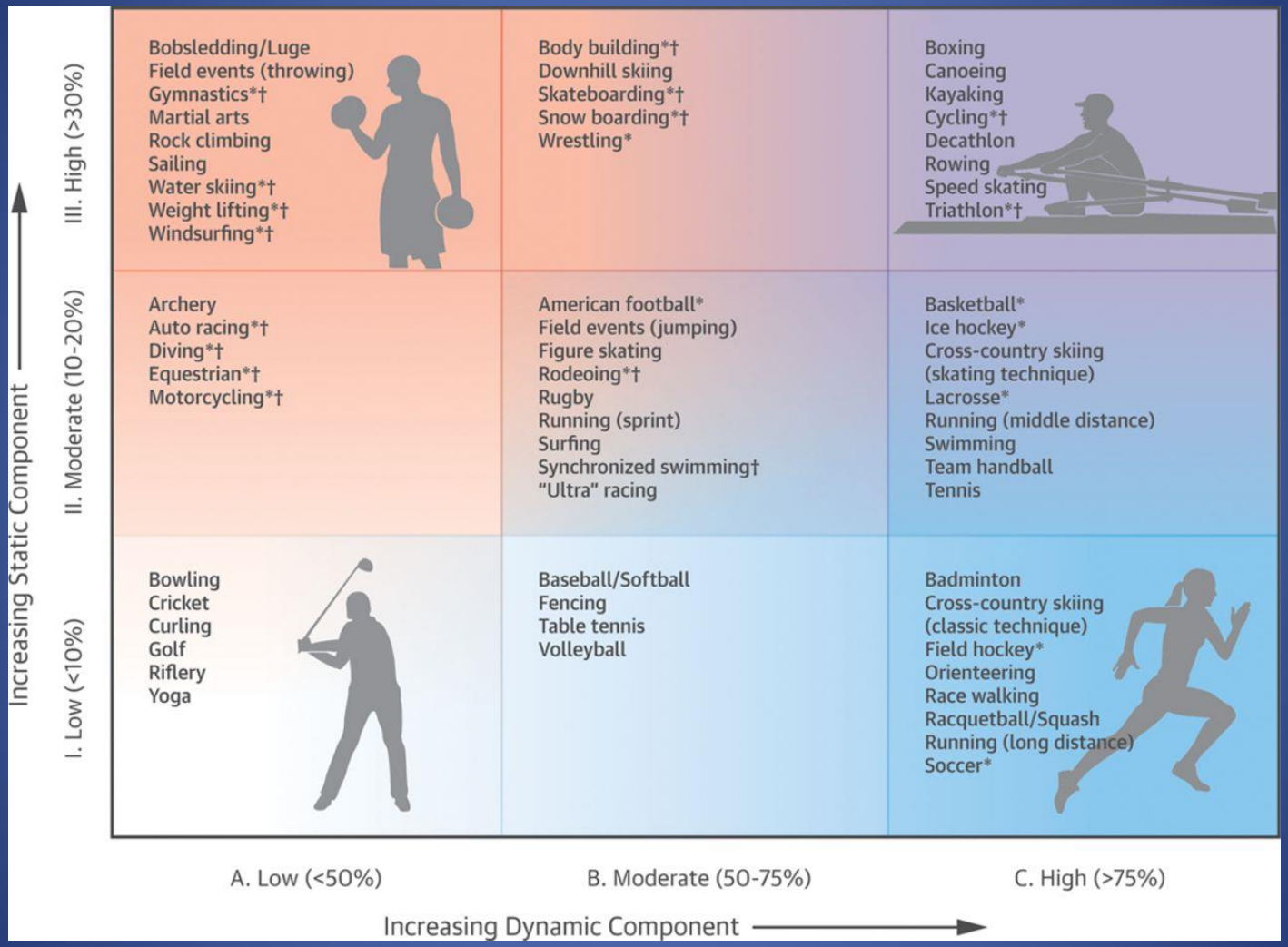
http://dx.doi.org/10.1016/j.jacc.2015.09.032

AHA/ACC SCIENTIFIC STATEMENT

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Preamble, Principles, and General Considerations

A Scientific Statement From the American Heart Association and American College of Cardiology

Classification of sports



Benjamin D. Levine et al. Circulation. 2015;132:e262-e266

American Heart Association.

Risk of Impact

Table Sports According to Risk of Impact and Educational Background

	Junior High School	High School/College
Impact expected	American football Ice hockey Lacrosse Wrestling Karate/judo Fencing Boxing	American football Soccer Ice hockey Lacrosse Basketball Wrestling Karate/judo Downhill skiing Squash Fencing Boxing
Impact may occur	Soccer Basketball Field hockey Downhill skiing Equestrian Squash Cycling	Field hockey Equestrian Cycling Baseball/softball Gymnastics Figure skating
Impact not expected	Baseball/softball Cricket Golf Riflery Gymnastics Volleyball Swimming Track and field Tennis Figure skating Cross-country skiing Rowing Sailing Archery Weightlifting Badminton	Cricket Golf Riflery Volleyball Swimming Track and field Tennis Cross-country skiing Rowing Sailing Archery Weightlifting Badminton

*Danger of bodily collision (see Table for more detail on collision risk). †Increased risk if syncope occurs. Modified from Mitchell et al[3] with permission.

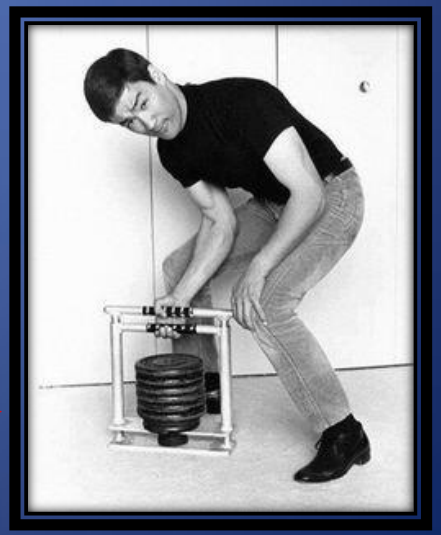
Limitations to the Scheme

- Different position players may have quite different cardiovascular loads
- Low-intensity sports such as yoga can be practiced at much higher intensities
- Cardiovascular load may be different at different times during the competition
- The types and intensities of exercise required for training may be different from competition
- These guidelines may not apply to participation in sports at a recreational level. Moreover, many higher-class activities (such as cycling and running) can be performed by patients with cardiovascular disease after they have received counseling about intensity restriction and competition avoidance as part of healthy secondary prevention
- Environmental conditions may alter the cardiovascular load for a given sport substantially. E.g. Heat or altitude
- The psychological and emotional demands of sports are also relevant

Specific Disease Conditions

Exercise for VHD patient

- Exercise is good…..but is it safe?
- Regular aerobic exercise is recommended to maintain cardiorespiratory fitness
- Heavy isometric training will increase afterload of LV and is discouraged



Sports with AR/MR

- In general, exercise causes no change or slight reduction in regurgitant fraction (decrease SVR)
- Generally more tolerant of physical activity
- BUT, elevated HR or BP and cause increased regurgitation

AR

Patient group	Recommendation
Mild to moderate AR with normal LV size	No restrictions
Mild to moderate AR with moderate LV enlargement	Low/moderate static and low/moderate/high dynamic sports *if tested
Severe AR	No competitive sports
Dilated aortic root (> 4.5 cm)	IA sports only

MR

Patient group	Recommendation
Mild to moderate MR with normal LV size	No restrictions
Mild to moderate MR with increased LV size	Low/moderate static and low/moderate/high dynamic sports
Severe MR and LV enlargement, LV dysfunction or pulmonary HTN	No competitive sports

Competitive Sports with MS

- Exercise may increase pulmonary capillary and pulmonary artery systolic pressure which may result in acute pulmonary edema
- AS patients in competitive sports need annual evaluation

Patient group	Recommendation
Mild AS	No restrictions
Moderate AS	IA sports IB and IIA sports in selected patients
Severe AS	No competitive sports

AS

Patient group	Recommendation
Mild MS (with exercise PASP < 50 mm Hg)	No restrictions
Moderate MS (and PASP < 50 mm Hg)	Low/moderate static and low/moderate dynamic sports
Severe MS (or any with exercise PASP > 50 mm Hg)	No competitive sports

*Patients with anticoagulation should avoid sports with risk of bodily collision

MS

Sports with Bicuspid Aortic Valve/ Prosthetic valves

- BiAOV there is increased risk of aortic

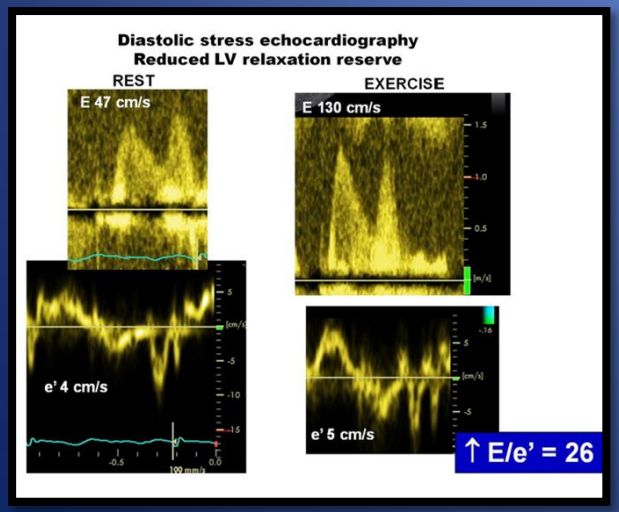
Patient group	Recommendation
No significant AS/AR and aortic root < 4.0 cm	No restrictions
Aortic root 4.0-4.5 cm	Low/moderate static and low/moderate dynamic sports *Avoid collision sports
Dilated aortic root (> 4.5 cm)	IA sports only

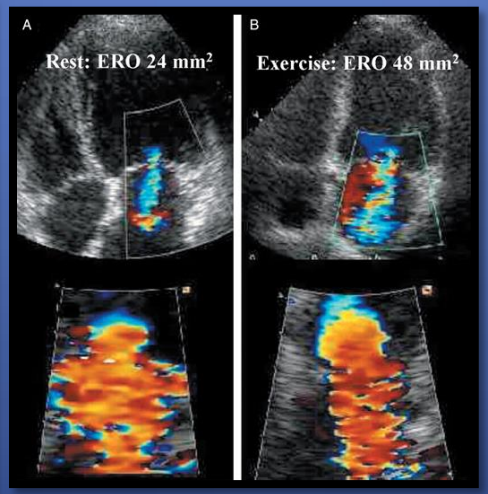
- Insufficient long term data on exercise effects

Patient group	Recommendation
Bioprosthetic mitral valve	Low/moderate static and low/moderate dynamic sports
Bioprosthetic or mechanical aortic valve	Low/moderate static and low/moderate dynamic sports *if tested

Exercise testing in VHD – Stress echo/CPET

- Assessing presence of symptoms
- Functional status, suitability for participation in competitive sports
- Assess dynamic nature of VHD (severity)
- Help determine timing for surgery





Heart Failure

- Exercise therapy in systolic heart failure (HFREF)
- Exercise therapy in diastolic heart failure (HFPEF)
- Alternative modes of exercise
  - HIIT
  - High caloric

Efficacy and Safety of Exercise Training as a Treatment Modality in Patients With Chronic Heart Failure: Results of A Randomized Controlled Trial Investigating Outcomes of Exercise TraiNing (HF-ACTION)

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Jefferson Medical College, Philadelphia, PA

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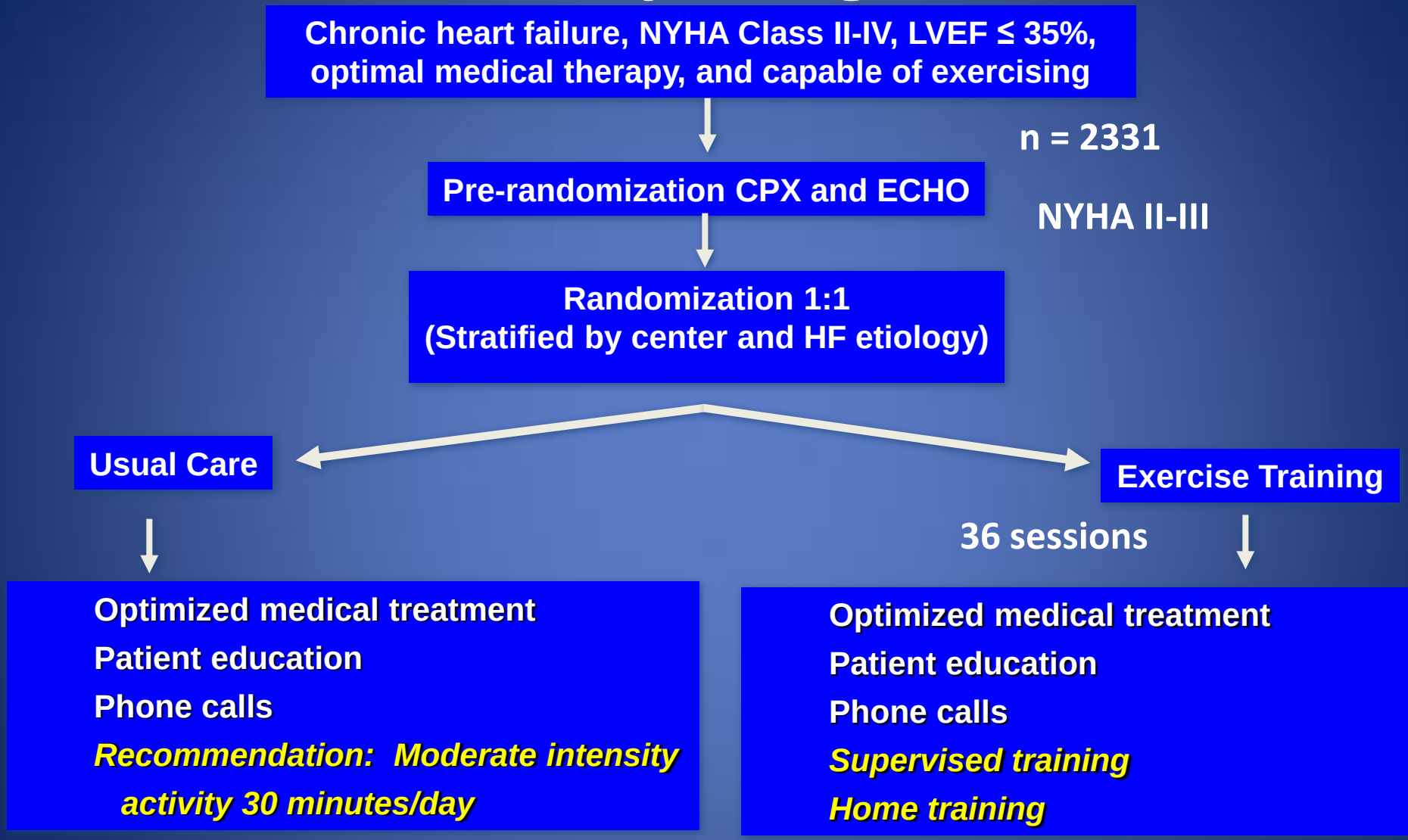
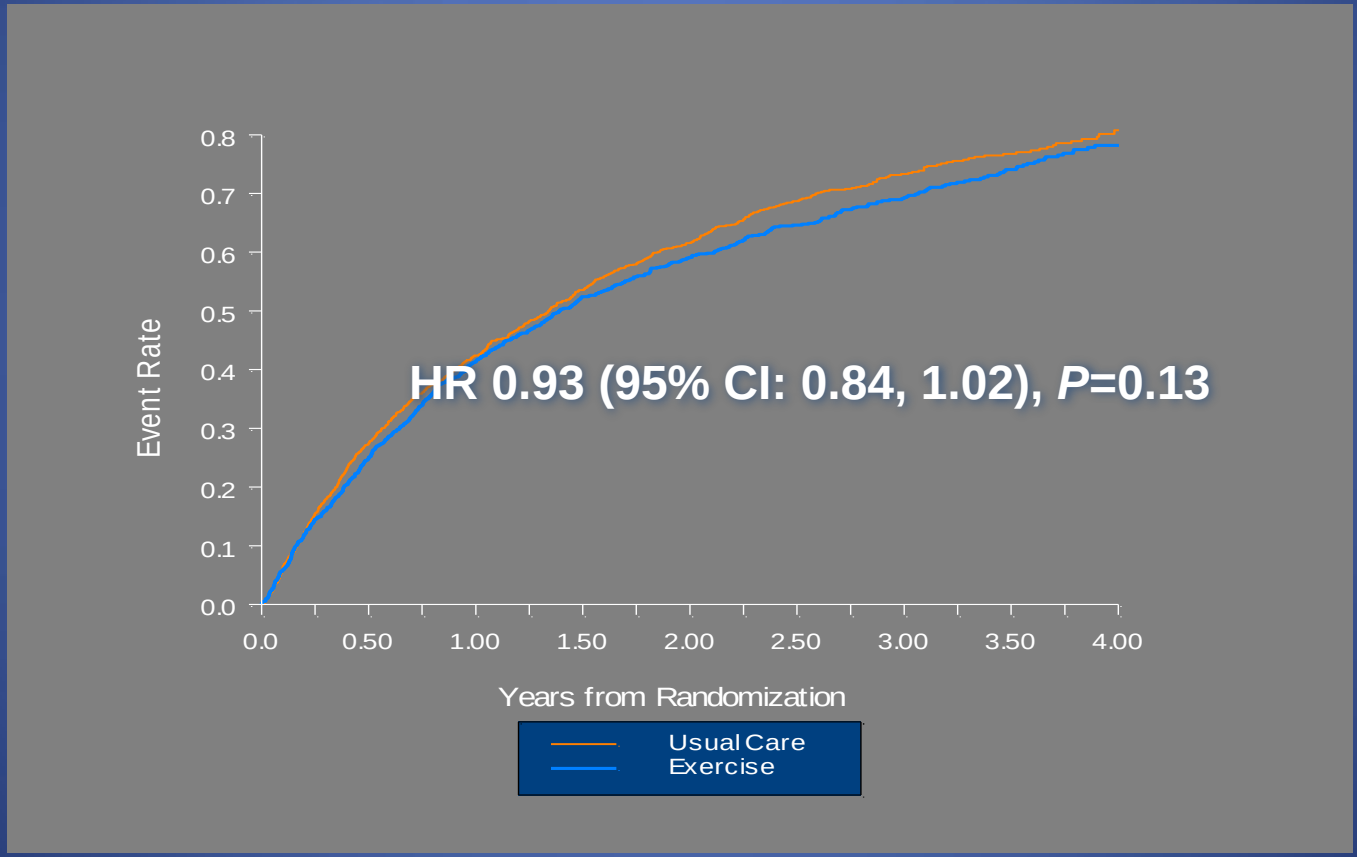
Duke University Medical Center, Durham, NC

HF-ACTION Steering Committee, Investigators, and Coordinators
Funded by NHLBI

Study Design



Time to All-Cause Mortality or All-Cause Hospitalization



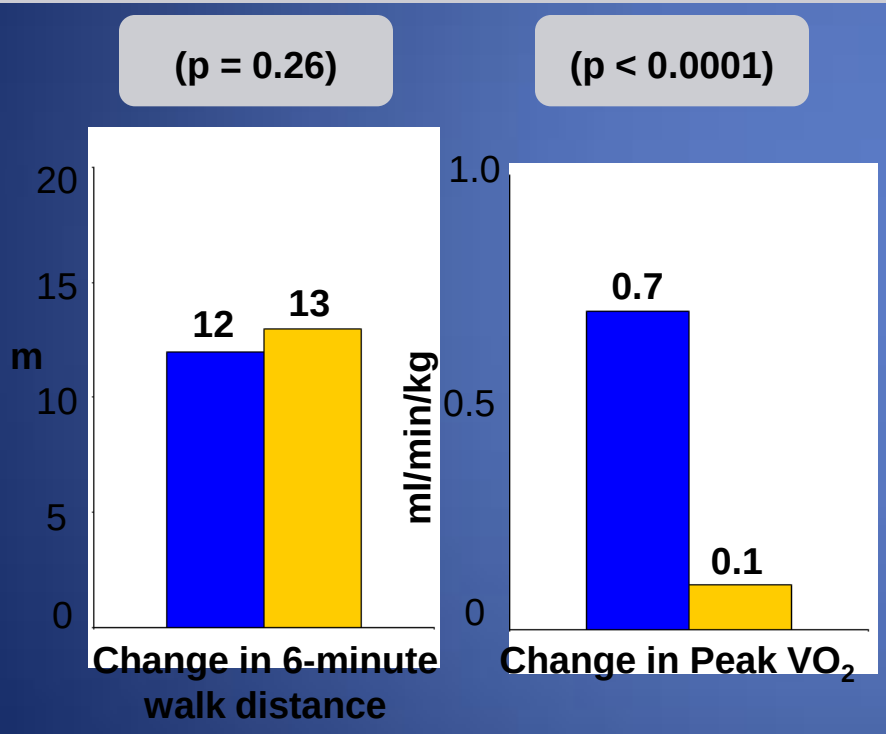
Summary of Major Outcomes

	Hazard Ratio	95% CI	p-value
All-cause mortality and hospitalization (primary)			
Main analysis	0.93	0.84, 1.02	0.13
CV mortality and HF hospitalization			
Main analysis	0.87	0.75, 1.00	0.06
Adjusted analysis	0.85	0.74, 0.99	0.03

Poor Adherence! Failure to Achieve therapeutic dose

HF-ACTION – modest benefit?

Trial design: Patients with symptomatic systolic CHF on optimal medical therapy were randomized to either exercise training or usual medical care. Clinical outcomes were compared at 3 years. **However only 30% in intervention group achieved targets and 8% in control exercised regularly**



Results

- No difference in mortality/hospitalizations between the two arms (HR 0.93, 95% CI 0.84-1.02, p = 0.13). On adjustment for other prognostic factors, was ↓ in exercise training arm (p = 0.03)
- CV mortality & CV hospitalizations (p = 0.14), 6-minute walk distance similar, but peak VO_2 higher in the exercise training arm
- Serious side effects similar between two arms

Conclusions

- Prescribed exercise training program in patients with systolic CHF safe and effective, when added on to optimal medical therapy
- Strengthens current recommendations for exercise in CHF patients

O'Connor CM, et al. JAMA 2009;301:1439-50

Limitations

- Adherence in exercise training group and physical activity by the usual care group may have diminished the identified benefit of exercise training
- Blinding of subjects and research personnel not possible
  - Core labs blinded
  - Clinical Endpoint Committee blinded
- Home exercise adherence data are difficult to collect and to precisely quantify

Published in final edited form as:
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Relation between Volume of Exercise and Clinical Outcomes in Patients with Heart Failure

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Keteyia

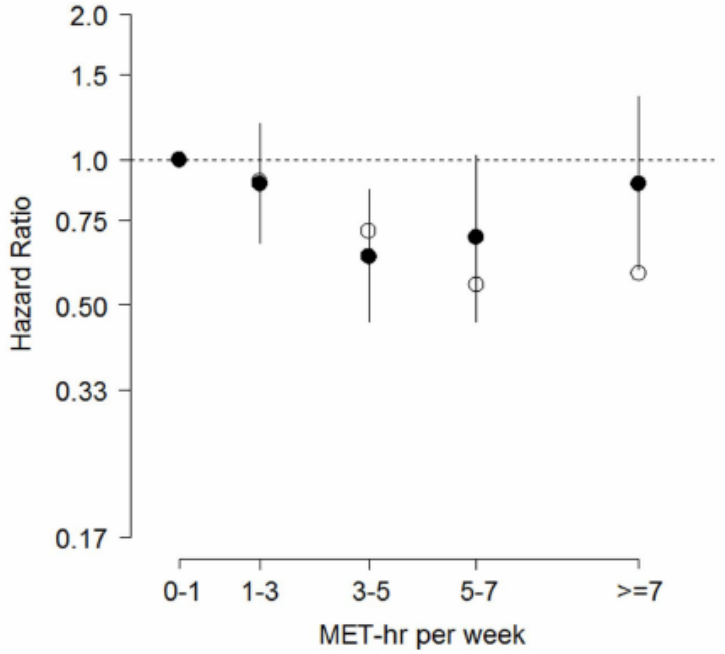


Figure 2. Hazard Ratios for All-cause Mortality or Hospitalization
Among patients event-free for at least three months, adjusted hazard ratios (filled circles, log scale) for all-cause mortality or hospitalization with 95% confidence intervals; reference category is 0–1 MET-hr per week. Unadjusted hazard ratios are plotted with open circles.

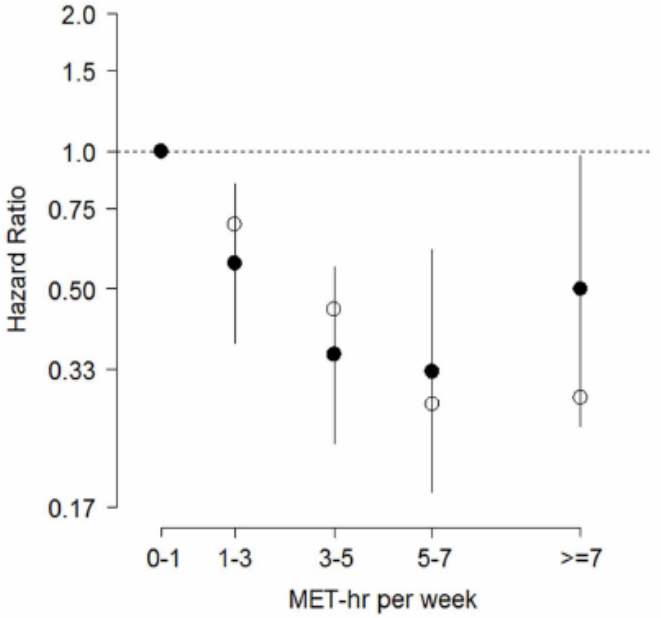
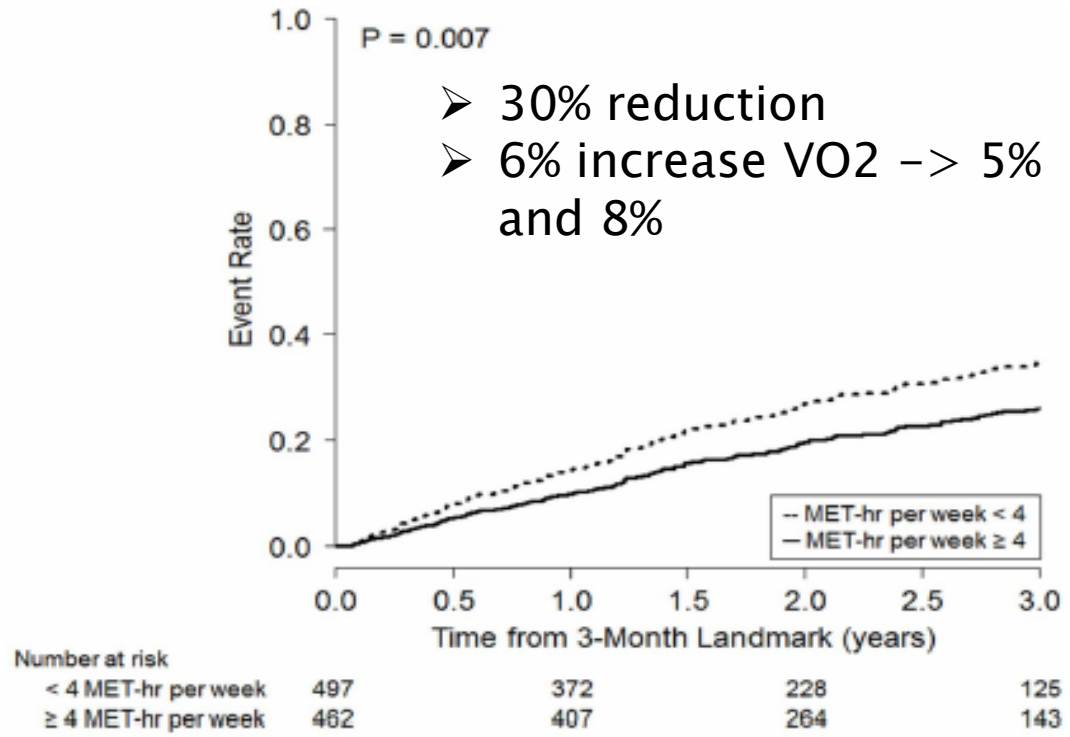


Figure 3. Hazard Ratios for Cardiovascular Mortality or Heart Failure Hospitalization
Among patients event-free for at least three months, adjusted hazard ratios (filled circles, log scale) for cardiovascular mortality or heart failure hospitalization with 95% confidence intervals; reference category is 0–1 MET-hr per week. Unadjusted hazard ratios are plotted with open circles.

Exercise volume and Outcome in HF ACTION



- 30% reduction
- 6% increase VO2 -> 5% and 8%

Figure 4. Adjusted Kaplan-Meier Curves for Clinical Outcomes
Adjusted Kaplan-Meier curves for all-cause mortality or hospitalization (left panel) and cardiovascular mortality or heart failure hospitalization (right panel) in patients event-free for at least 3 months, stratified at the median exercise volume of 4 MET-hr per week.

J Am Coll Cardiol. Author manuscript; available in PMC 2013 November 06.

HFPEF

- >=50% of HF patients older than 65 (Kiitzman et al 1991)
- Morbidity and mortality comparable to HFREF
- Exercise intolerance with major impact on QOL

Exercise training in HFPEF

Table 2 Controlled Exercise Intervention Trials in HFPEF Patients

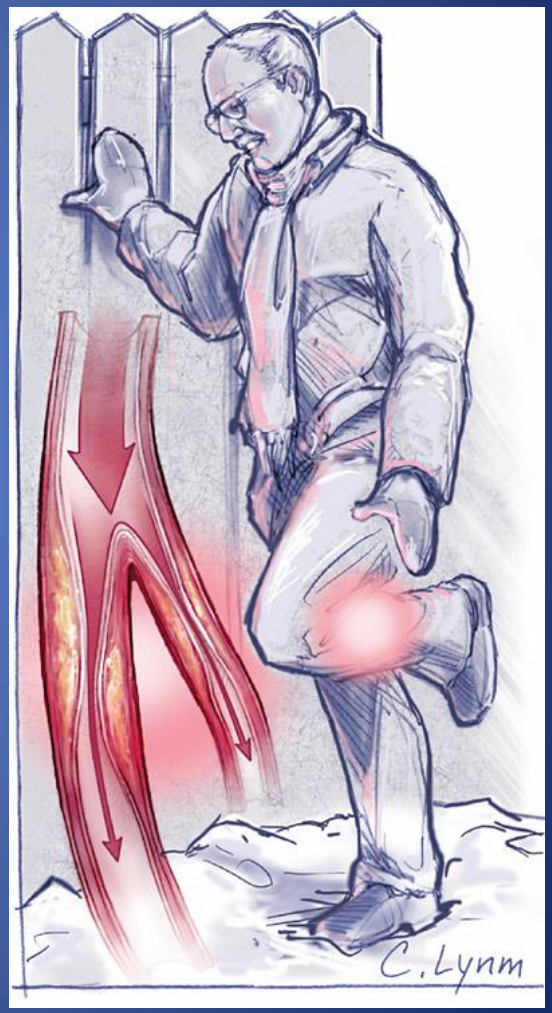
First Author (Ref. #)	Group/Sample Size	Age, yrs	EF %	Mode	Frequency, days/week	Intensity	Duration, min	Length of Program, weeks	Main Findings
Gary et al. 2006 (17)	ET (n = 15) CNT (n = 13)	67 69	54 57	Walk	3	40%–60%	30	12	↑ 6MWD, QOL
Kitzman et al. 2010 (18)	ET (n = 24) CNT (n = 22)	70 69	61 60	Walk, cycle	3	40%–70% HRR	60	16	↑ peak Vo_2, ventilation threshold, 6MWD, and physical QOL
Edelmann et al. 2011 (19)	ET (n = 44) CNT (n = 20)	64 65	67 66	Cycle, RT (UE/LE)	2–3 2	HR: 50%–70% peak Vo_2 60%–65% 1RM	20–40 15 REPS	12 weeks 5–12	↑ peak Vo_2, 6MWD, physical function, ↓ rest LAV, E/e′, and procollagen type I
Alves et al. 2012 (20)	ET (n = 20) CNT (n = 11)	GP 63	GP 56	Cycle, treadmill	3	5–7 intervals (3–5 min duration) at 70%–75% HR_{max} with 1-min active recovery at 45%–55% HR_{max}	15–35	24	↑ peak MET, ↑ rest LVEF, E/A ratio, ↓ DT
Kitzman et al. 2013 (21)	ET (n = 32) CNT (n = 31)	70	58 56	Walking, cycle, arm ergometry	3	40%–79% HRR	60	16	↑ peak Vo_2, ↑ QOL, no change FMD, arterial stiffness
Smart et al. 2012 (22)	ET (n = 15) CNT (n = 15)	64	57	Cycle ergometry	3	60%–70% peak Vo_2	30	16	↑ peak Vo_2, ↓ VE/VCo_2, no change systolic or diastolic LV function
Fujimoto et al. 2012 (23)	ET (n = 7) CNT (n = 13)	73	76	Walking, cycling	3	70%–80% HR_{max}	25–40	52	No change in peak Vo_2, arterial stiffness, LV compliance, and volumes

No large RCT as yet

Smaller studies suggest exercise training is at least as effective and safe as for HFREF

CR in Peripheral arterial disease

- Exercise training is key, accessibility and utilization is poor
- Not always considered mainstream in CR
- Home-based programs can improve utilization
- RCT of 119 with intermittent claudication compared quantified home-based exercise (using a step activity monitor) with traditional supervised exercise and usual care controls
- Adherence to both groups was high (> 80%)



CR in Peripheral arterial disease

- After 12 weeks:

	Home based	Standard
Claudication time	+165 sec	+134 sec
Peak walking time	+ 215 sec	+124 sec

]

- Similar home-based quantified protocols could be expanded to other conditions for which exercise programs are beneficial

Congenital Heart Disease

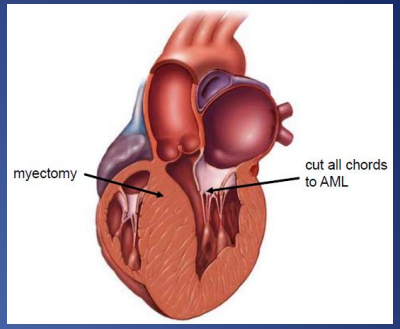
- More patients with CHD surviving to adulthood (90%)
- Physical activity and exercise is recommended in American and European guidelines, but data lacking
- Recently, Dua and colleagues evaluated the effect of home based walking in 61 ACHD – increased treadmill test duration and improved QOL measures
- Holloway and colleagues noted similar improvement in exercise tolerance when 11 patients were enrolled in a formal cardiac rehabilitation program with appropriate exercise prescriptions
  - Dua JS et al. IntJ Cardiol. 2010;138:196 –205
  - Holloway TM et al. Int J Cardiol. 2011;150:345–346.

ASD & VSD

In General in ASD/VSD treated or untreated, if small defect with no cardiac enlargement or decompensation, no pulmonary hypertension – can participate in all sports at all intensities

Caution if pulmonary hypertension, arrhythmias, myocardial dysfunction, cyanosis or large right to left shunts

HOCM

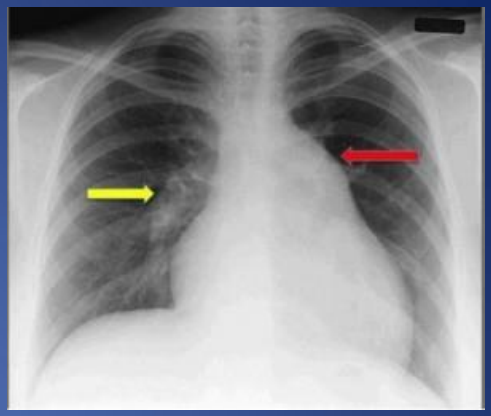


- Genotype-positive HCM patients but no morphological evidence of LV hypertrophy can participate in all sports, particularly in the absence of a family history of HCM-related sudden death, however education and monitoring required

- Probable or unequivocal clinical expression and diagnosis of HCM (ie, with the disease phenotype of LV hypertrophy) should not participate in most competitive sports, with the exception of those of low intensity (class IA sports)

- Pharmacological agents or prophylactic ICDs should be administered based on clinical indications and not for the purpose of permitting participation in high-intensity sports

Pulmonary arterial hypertension



- RCT evaluated the risks and benefits of moderate intensity exercise and respiratory training in 30 patients with chronic, severe pulmonary hypertension (MPAP 50 mm Hg)
- 15 weeks later: significant improvement in 6-minute walk distance by 22%, QOL scores, World Heart Organization functional classification, and peak VO2 (from 13.2 mL/kg per min to 15.4 mL/kg per min, p=0.05)
- Further trials are needed to evaluate the effect of activity training on clinical outcomes in this high-risk group.

Mereles D et al. Circulation. 2006;114:1482–1489.

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Rest...

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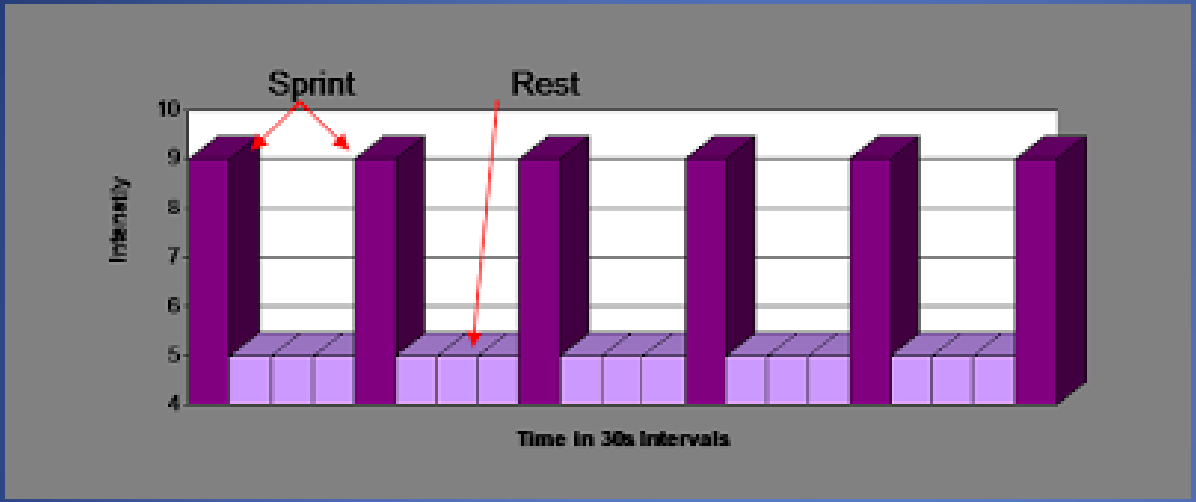
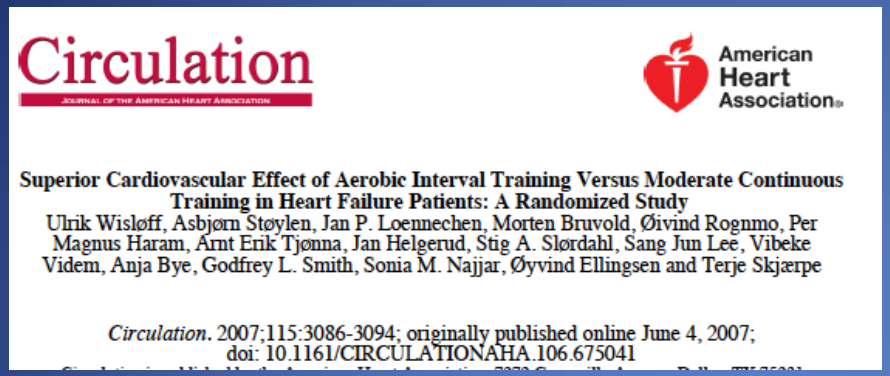
High intensity interval training (HIIT)



- Moderate-intensity continuous exercise training (50% to 80% of maximum heart rate [HRpeak])

- Aerobic interval training involves alternating 3- to 4-minute periods of exercise at high intensity (90%–95% HRpeak) with exercise at moderate intensity (60%–70% HRpeak). Such training for 40 minutes, 3 times per week has been recently evaluated by Wisløff and colleagues,

High intensity interval training (HIIT)



Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association

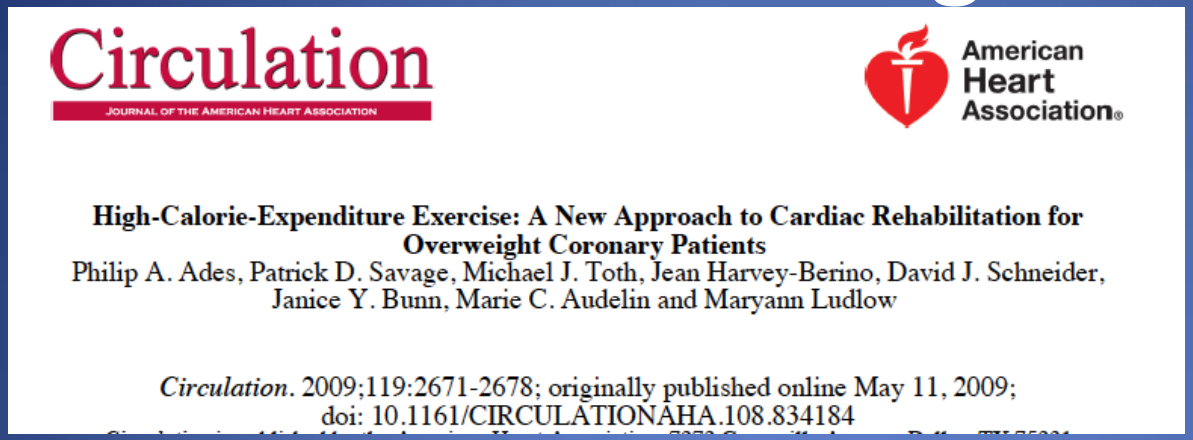
Superior Cardiovascular Effect of Aerobic Interval Training Versus Moderate Continuous Training in Heart Failure Patients: A Randomized Study

Ulrik Wisløff, Asbjørn Støylen, Jan P. Loennechen, Morten Bruvold, Øivind Rognmo, Per Magnus Haram, Arnt Erik Tjønna, Jan Helgerud, Stig A. Slørdahl, Sang Jun Lee, Vibeke Videm, Anja Bye, Godfrey L. Smith, Sonia M. Najjar, Øyvind Ellingsen and Terje Skjærpe

Circulation. 2007;115:3086-3094; originally published online June 4, 2007;
doi: 10.1161/CIRCULATIONAHA.106.675041

- 27 patients post MI with HF (avg EF 29%)
- Up to **95%** of peak heart rate!
- Improved VO2 by 46% cf 14% (improvements also seemed more sustained)
- Favorable remodeling of the left ventricle
- Better brachial artery flow mediated dilation (endothelial function)
- Reductions in proBNP levels
- No increase in complications
- Recent metaanalyses by Haykowsky et al. greater improvements in exercise tolerance
- Evidence tends to suggest that it is safe, however more work to elucidate its use in older patients and women

High Calorie Expenditure Exercise training



Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association®

High-Calorie-Expenditure Exercise: A New Approach to Cardiac Rehabilitation for Overweight Coronary Patients

Philip A. Ades, Patrick D. Savage, Michael J. Toth, Jean Harvey-Berino, David J. Schneider, Janice Y. Bunn, Marie C. Audelin and Maryann Ludlow

Circulation. 2009;119:2671-2678; originally published online May 11, 2009;
doi: 10.1161/CIRCULATIONAHA.108.834184

- 74 Overweight/obese IHD patients
- 3000-3500kcal/week vs. 700-800kcal/week
- Lower intensity 50-60% peak VO2 for longer duration and more often

High Calorie Expenditure Exercise training - RESULTS

	High caloric	Standard
Weight loss	8.2 kg	3.7kg ($p<0.01$)
Fat Mass	5.9 kg	2.8kg ($p=0.01$)
Waist circumference	7cm	5cm ($p=0.02$)

- Improved lipid profiles and insulin resistance after 5 mths
- Prevalence of metabolic syndrome reduced from 59% to 31%

Summary

- Regular physical activity should be encouraged in all patients with stable heart disease
- Participation in competitive sports require more in-depth evaluation (see AHA/ACC 2015 statement)
- Right exercise prescription must be made for safety, health maintenance and relevant training effect
- Status should be regularly monitored for changes (frequency depending on underlying condition)
- Patients should be empowered and educated to self-monitor and adjust
- More research is required to establish specific training protocols for safe effective exercise training


End