

## **The role of HIT training in the general population and in cardiac patients**

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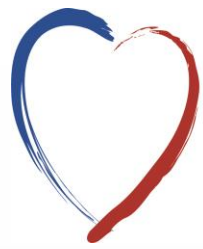
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# **The role of HIT training in the general population and in cardiac patients**

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British Cardiovascular Society

# **The role of HIT training in the general population and in cardiac patients**

Dr Simon Nichols

Conflicts of Interest: None

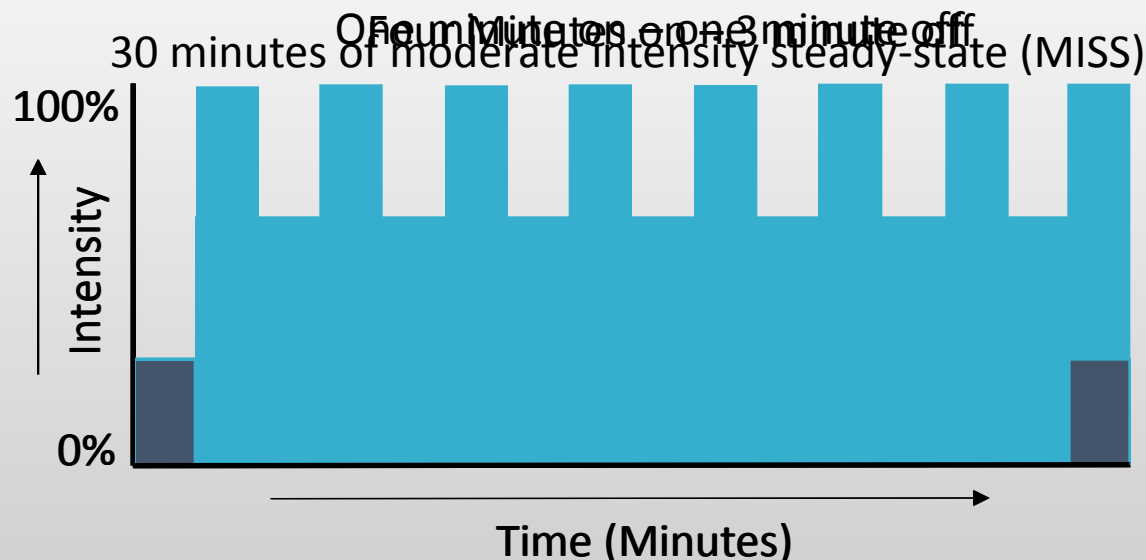
- Brief background of HIT
- The benefits of HIT – Focus on  $\text{VO}_{2\text{peak}}$
- HIT in cardiac populations

# What is HIT?

Repeat bouts of short duration high intensity exercise interspersed with short duration low intensity active recovery periods

Some disagreement in intensity zones - typically submaximal efforts  $>80\%$  of maximal HR/ $>80$  peak work rate

Variations in exercise volume/programme length



# Where did HIT come from?

Reported as early as the 1920s in athletic populations

1954 - Sir Rodger Bannister used HIIT during as a medical student during his lunch break - achieved the 4 minute mile

1960's peer-reviewed literature begins to emerge in healthy/athletic populations

1970/80's— Evidence for interval and high intensity interval training in clinical populations begins to emerge

1996 – Katerina Meyer found that interval training in CHF resulted in  
– Assessed catecholamine, cardiac/metabolic stress, & dyspnoea - CHF patients tolerate HIIT.

Today – A vast volume of literature on the efficacy of HIIT in health and disease

# Is it safe?

**Table 1.** The number of patients, exercise-hours and the corresponding number of cardiovascular events associated with moderate- and high-intensity exercise, respectively.

Center	Patients (n)	Total training (hours)	Moderate-intensity (hours)	High-intensity (hours)
Ålesund	775	25 720 <sup>1</sup>	15 232	10 488 <sup>1</sup>
Feiring	2629	85 208 <sup>2</sup>	63 032 <sup>1</sup>	22 176 <sup>1</sup>
Røros	1442	64 892	51 192	13 700
<b>Total</b>	<b>4846</b>	<b>175 820</b>	<b>129 456</b>	<b>46 364</b>
<b>Event rates:</b>				
Cardiac arrest, fatal			1	0
Cardiac arrest, non-fatal			0	2
Myocardial infarction			0	0
<b>Risk of events</b>		<b>1/58 607</b>	<b>1/129 456</b>	<b>1/23 182</b>

The likelihood of a cardiac event in high risk individuals appears to be low when conducting either moderate, or high intensity exercise

# Is it Effective?

$VO_{2max}$ , insulin sensitivity and endothelial function all improve to a greater extent during HIIT, compared to MISS

## Caveat: Findings can be variable

Improved endothelial  
function/increased  
NO

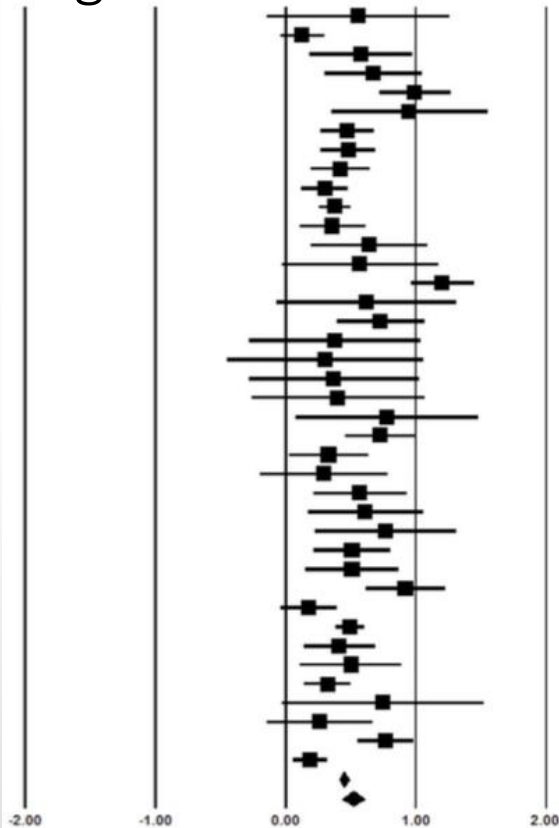
Improvements in muscle  
oxidative  
capacity/mitochondrial  
volume/quality

Greater depletion of  
muscle glycogen stores  
leading to enhanced  
muscle glycogen uptake  
→ improve insulin  
sensitivity



# Is it Really Effective?

Higher Vol.



Bacon et al (2013)

Favours HIIT 0.51 L/min (43 to 0.60 L/min) up to 0.9 L for longer studies

Lower Vol.

	Effect on VO <sub>2</sub> max (%)		Inference
	Mean	±90 % CL	
Effect on treatment groups <sup>a</sup>			
Sedentary males	10.0	±5.1	Possibly moderate ↑
Sedentary females	7.3	±4.8	Likely small
Active non-athletic males	6.2	±3.1	Likely moderate ↑
Active non-athletic females	3.6	±4.3	Possibly moderate ↑
Athletic males	2.7	±4.6	Unclear
Controls	1.2	±2.0	Unclear

Weston et al (2014)

Weston et al (2014)

The effects of HIT appear to be greater in less fit populations

There is no definitive consensus on whether HIT is superior to *Well Prescribed* endurance exercise training apparently healthy/sedentary populations

# Benefits of HIT in the General Population

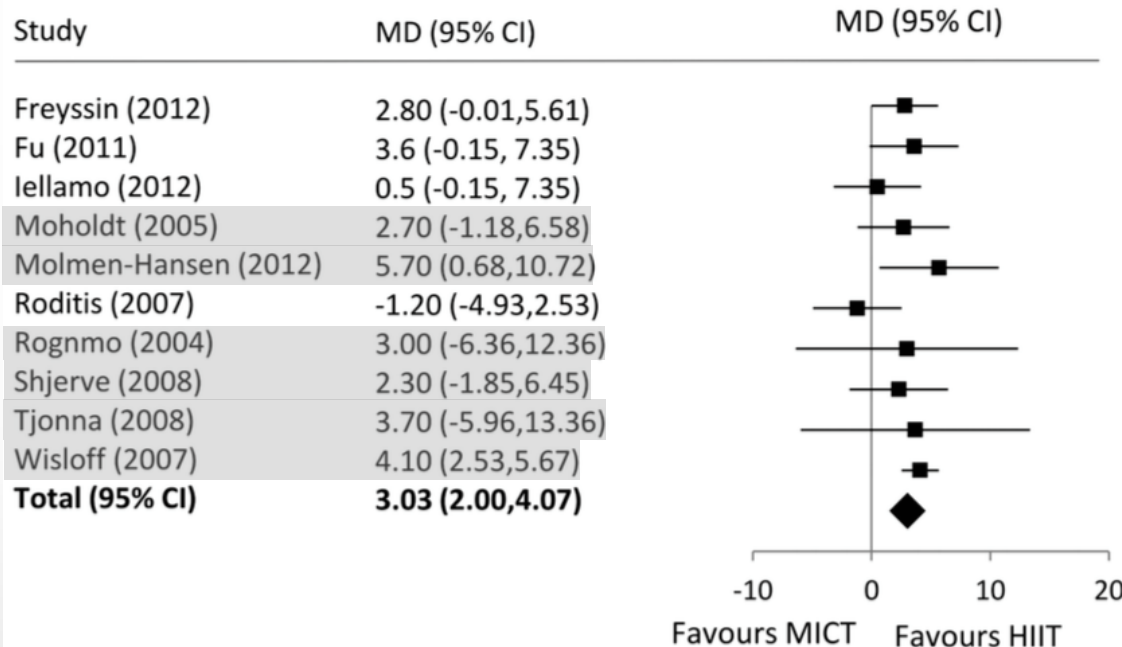
Type	Frequency	Time	Intensity	Result
MISS	Exercise 3 x p/week for 8 weeks	Exercise progressed from 20 to 35 minutes	~60% PPO	$VO_{2peak}$ - MISS 9% : HIIT 15% $a-VO_2$ diff – MISS ↑: HIIT ↑ $Q_{max}$ : MISS ~ : HIIT ↑ $VO_2$ Kinetics - MISS~ : HIIT: ↑ Exhaustion Time - MISS↑: MISS↑ ↑ Capillary/Fibre R - MISS↑: MISS↑
HIIT			4 min low / 1 minute 90% PPO	

Effect of interval versus continuous training on cardiorespiratory and mitochondrial functions: relationship to aerobic performance improvements in sedentary subjects

**Frédéric N. Daussin,<sup>1</sup> Joffrey Zoll,<sup>1</sup> Stéphane P. Dufour,<sup>1</sup> Elodie Ponsot,<sup>1</sup> Evelyne Lonsdorfer-Wolf,<sup>1</sup> Stéphane Doutreleau,<sup>1</sup> Bertrand Mettauer,<sup>1,2</sup> François Piquard,<sup>1</sup> Bernard Geny,<sup>1</sup> and Ruddy Richard<sup>1</sup>**

<sup>1</sup>CHRU of Strasbourg, Physiology and Functional Explorations Department, Civil Hospital, Strasbourg, France and University Louis Pasteur, Faculty of Medicine, Physiology Department, Strasbourg, France; and <sup>2</sup>Cardiology Department, Civil Hospital, Colmar, France

# Is HIT Effective in Cardiac Populations?



Weston KS, et al. *Br J Sports Med* 2014

Mean difference favours HIT by 3.03 mL/kg/min (95% CI 2.00 to 4.07;  $p < 0.001$ )

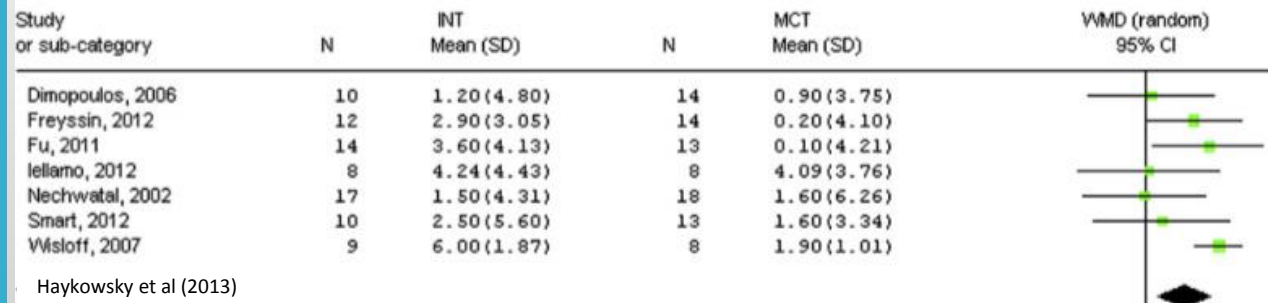
Six out of 10 studies conducted by the same research group

Only 273 patients included

Other systematic reviews/meta-analyses show similar results

## Heart Failure Only

Mean difference favours HIT by 2.14 mL/kg/min (95% CI 0.66 to 3.63)



Haykowsky et al (2013)

# The Significance

$\text{VO}_{2\text{peak}}$  is one of the strongest clinical prognosticators. Improvements in  $\text{VO}_{2\text{peak}}$  are consistently associated with improved survival:

- Kodama *et al.* (2009): ~103,000 patients; demonstrate 1 MET improvement in aerobic fitness confers 13% survival advantage
- Myers *et al.* (2002): ~6200 patients: 1 MET improvement in aerobic fitness confers 12% survival advantage
- Vanhees *et al.* (1995): 1% improvement in exercise training induced  $\text{VO}_{2\text{peak}}$  confers a 2% survival advantage in patients with CHD

# @HIITorMISSUK

Pragmatic multi-centre  
RCT – 510 patients

Eight weeks – 2 x per week

10 x high intensity bouts at 85 -  
90% PPO

10 x high intensity bouts at 20 -  
25% PPO

Control group – standard care  
at 40-70% HRR

Assessed following intervention  
~8 weeks and at 12 months

Primary outcome measure -  
 $VO_{2peak}$

Also assessing other  
physiological, psychosocial and  
economic outcomes

**BMJ Open High-intensity interval training versus moderate-intensity steady-state training in UK cardiac rehabilitation programmes (HIIT or MISS UK): study protocol for a multicentre randomised controlled trial and economic evaluation**

Gordon McGregor,<sup>1,2</sup> Simon Nichols,<sup>3</sup> Thomas Hamborg,<sup>4</sup> Lucy Bryning,<sup>5</sup> Rhiannon Tudor-Edwards,<sup>5</sup> David Markland,<sup>6</sup> Jenny Mercer,<sup>2</sup> Stefan Birkett,<sup>3</sup> Stuart Ennis,<sup>1,2</sup> Richard Powell,<sup>1</sup> Brian Begg,<sup>2,7</sup> Mark J Haykowsky,<sup>8</sup> Prithwish Banerjee,<sup>1,9</sup> Lee Ingle,<sup>3</sup> Rob Shave,<sup>2</sup> Karianne Backx<sup>2</sup>



@HIITorMISSUK 



# The Role of HIT in Cardiac Populations

**Exercise-based cardiac rehabilitation for coronary heart disease (Review)**

Heran BS, Chen JMH, Ebrahim S, Moxham T, Oldridge N, Rees K, Thompson DR, Taylor RS



## **Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease**

**Cochrane Systematic Review and Meta-Analysis**

Lindsey Anderson, PhD,\* Neil Oldridge, PhD,† David R. Thompson, PhD,‡ Ann-Dorthe Zwisler, MD,§ Karen Rees, PhD,|| Nicole Martin, MA,¶ Rod S. Taylor, PhD\*

## **Changes in cardiorespiratory fitness in cardiac rehabilitation patients: A meta-analysis**

Gavin Sandercock\*, Valentina Hurtado, Fernando Cardoso

## **Rehabilitation after myocardial infarction trial (RAMIT): multi-centre randomised controlled trial of comprehensive cardiac rehabilitation in patients following acute myocardial infarction**

Robert R West,<sup>1</sup> Dee A Jones,<sup>2</sup> Andrew H Henderson<sup>3</sup>

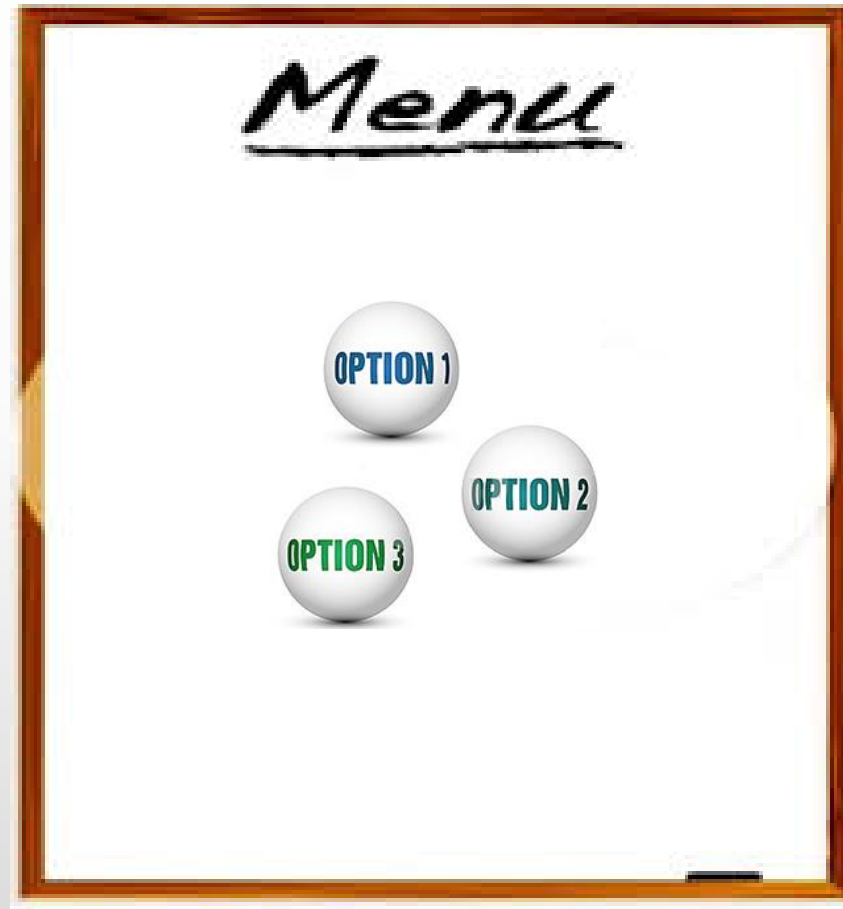
## **Cardiorespiratory fitness changes in patients receiving comprehensive outpatient cardiac rehabilitation in the UK: a multicentre study**

Gavin R H Sandercock,<sup>1</sup> Fernando Cardoso,<sup>1</sup> Meshal Almodhy,<sup>1</sup> Garyfallia Pepera<sup>2</sup>

## **The minimum clinically important improvement in the incremental shuttle walk test following cardiac rehabilitation**

**Linzy Houchen-Wolloff, Sally Boyce and Sally Singh**

# The Role of HIT in Cardiac Populations



## Summary

- Compared to MISS, HIT appears to provide superior health benefits
- Variation in HIT protocols and magnitude of benefit
- HIT appears to be safe and effective in cardiac populations – More ecologically valid research needed



Thank You

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