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

NICHOLS, Simon <http://orcid.org/0000-0003-0377-6982>

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

Dr Simon Nichols

✉ simon.nichols@ncl.ac.uk
 @nichols87simon

British Cardiovascular Society Annual Conference 2017
The role of HIT training in the general population and in cardiac patients

Dr Simon Nichols

Conflicts of Interest: None
Outline

• Brief background of HIT

• The benefits of HIT – Focus on VO_{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

30 minutes of moderate intensity steady-state (MISS)
Where did HIIT 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
Table 1. The number of patients, exercise-hours and the corresponding number of cardiovascular events associated with moderate- and high-intensity exercise, respectively.

<table>
<thead>
<tr>
<th>Center</th>
<th>Patients (n)</th>
<th>Total training (hours)</th>
<th>Moderate-intensity (hours)</th>
<th>High-intensity (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ålesund</td>
<td>775</td>
<td>25 720(^1)</td>
<td>15 232</td>
<td>10 488(^1)</td>
</tr>
<tr>
<td>Feiring</td>
<td>2629</td>
<td>85 208(^2)</td>
<td>63 032(^1)</td>
<td>22 176(^1)</td>
</tr>
<tr>
<td>Røros</td>
<td>1442</td>
<td>64 892</td>
<td>51 192</td>
<td>13 700</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4846</strong></td>
<td><strong>175 820</strong></td>
<td><strong>129 456</strong></td>
<td><strong>46 364</strong></td>
</tr>
</tbody>
</table>

Event rates:
- Cardiac arrest, fatal: 1, 0
- Cardiac arrest, non-fatal: 0, 2
- Myocardial infarction: 0, 0

Risk of events: 1/58 607, 1/129 456, 1/23 182

The likelihood of a cardiac event in high risk individuals appears to be low when conducting either moderate, or high intensity exercise.
VO$_{2\text{max}}$, 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
- Greater depletion of muscle glycogen stores leading to enhanced muscle glycogen uptake → improve insulin sensitivity
- Improvements in muscle oxidative capacity/mitochondrial volume/quality
Is it Really Effective?

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.

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

Bacon et al (2013)
Weston et al (2014)
Benefits of HIT in the General Population

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency</th>
<th>Time</th>
<th>Intensity</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>MISS</td>
<td>Exercise 3 x p/week for 8 weeks</td>
<td>Exercise progressed from 20 to 35 minutes</td>
<td>~60% PPO</td>
<td>VO₂peak - MISS 9% : HIIT 15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a-VO₂ diff – MISS ↑: HITT ↑</td>
</tr>
<tr>
<td>HIIT</td>
<td></td>
<td></td>
<td>4 min low / 1 minute 90% PPO</td>
<td>Q_max: MISS ~ : HITT ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>VO₂ Kinetics - MISS~ : HIIT: ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Exhaustion Time - MISS↑: MISS↑ ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Capillary/Fibre R - MISS↑: MISS↑ ↑</td>
</tr>
</tbody>
</table>

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

Frédéric N. Daussin,1 Joffrey Zoll,1 Stéphane P. Dufour,1 Elodie Ponsot,1 Evelyne Lonsdorfer-Wolf,1 Stéphane Doutreleau,1 Bertrand Mettauer,1,2 François Piquard,1 Bernard Geny,1 and Ruddy Richard1

1CHRU of Strasbourg, Physiology and Functional Explorations Department, Civil Hospital, Strasbourg, France and University Louis Pasteur, Faculty of Medicine, Physiology Department, Strasbourg, France; and 2Cardiology Department, Civil Hospital, Colmar, France
Is HIT Effective in Cardiac Populations?

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)
The Significance

$VO_{2\text{peak}}$ is one of the strongest clinical prognosticators. Improvements in $VO_{2\text{peak}}$ 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 $VO_{2\text{peak}}$ confers a 2% survival advantage in patients with CHD
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 - \( \text{VO}_2\text{peak} \)

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,¹,² Simon Nichols,³ Thomas Hamborg,⁴ Lucy Bryning,⁵ Rhiannon Tudor-Edwards,⁵ David Markland,⁶ Jenny Mercer,² Stefan Birkett,³ Stuart Ennis,¹,² Richard Powell,¹ Brian Begg,²,⁷ Mark J Haykowsky,⁸ Prithwish Banerjee,¹,⁹ Lee Ingle,³ Rob Shave,² Karianne Backx²

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Exercise-based cardiac rehabilitation for coronary heart disease (Review)
Henan BS, Chen JMH, Ibrahim S, Meskham T, Oldridge N, Rees K, Thompson DR, Taylor BS

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,1 Dee A Jones,2 Andrew H Henderson3

Cardiorespiratory fitness changes in patients receiving comprehensive outpatient cardiac rehabilitation in the UK: a multicentre study
Gavin R H Sandercock,1 Fernando Cardoso,1 Meshal Almodhy,1 Garyfallia Pepera2

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
References


Anderson L, Oldridge N, Thompson DR, Zwisler A-D, Rees K, Martin N and Taylor RS. Exercise-Based Cardiac Rehabilitation for Coronary Heart DiseaseCochrane Systematic Review and Meta-Analysis. *Journal of the American College of Cardiology* (2016); **67**: 1-12.


West RR, Jones DA and Henderson AH. Rehabilitation after myocardial infarction trial (RAMIT): multi-centre randomised controlled trial of comprehensive cardiac rehabilitation in patients following acute myocardial infarction. *Heart* (2012); **98**: 637-644.

