HIIT: Current evidence and future application in cardiovascular rehabilitation

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

Available from Sheffield Hallam University Research Archive (SHURA) at:
http://shura.shu.ac.uk/21041/

This document is the author deposited version. You are advised to consult the publisher's version if you wish to cite from it.

Published version


Copyright and re-use policy

See http://shura.shu.ac.uk/information.html
HIIT: Current evidence and future application in cardiovascular rehabilitation

Dr Simon Nichols

✉️ s.j.nichols@shu.ac.uk
🐦 @nichols87simon

BACPR Annual Conference 2017

Conflicts of Interest: None
Outline

• Brief background of HIIT
• The aerobic fitness benefits(?) of HIIT
• HIIT in cardiac populations
• Emerging UK evidence
What is HIIT?

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.
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920s</td>
<td>Reported as early as the 1920s in athletic populations</td>
</tr>
<tr>
<td>1954</td>
<td>Sir Rodger Bannister used HIIT during as a medical student during his lunch break - achieved the 4 minute mile</td>
</tr>
<tr>
<td>1960s</td>
<td>Peer-reviewed literature begins to emerge in healthy/athletic populations</td>
</tr>
<tr>
<td>1970/80's</td>
<td>Evidence for interval and high intensity interval training in clinical populations begins to emerge</td>
</tr>
<tr>
<td>1996</td>
<td>Katerina Meyer found that interval training in CHF was safe - Assessed catecholamine, cardiac/metabolic stress, &amp; dyspnoea - CHF patients can tolerate HIIT.</td>
</tr>
<tr>
<td>Today</td>
<td>A vast volume of literature on the efficacy of HIIT in health and disease</td>
</tr>
</tbody>
</table>
Is it safe?

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

### 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>Rørøs</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: 1/58 607
- Cardiac arrest, non-fatal: 0
- Myocardial infarction: 0

Risk of events:

- 1/129 456
- 1/23 182

---

Rognmo Ø et al, (2012)
Is it Effective?

$\text{VO}_{2\text{max}}$, insulin sensitivity and endothelial function all appear to improve to a greater extent during HIIT, compared to MISS.

**Findings can be variable**

- **Improved endothelial function/increased NO**
- **Greater depletion of muscle glycogen stores leading to enhanced muscle glycogen uptake \(\rightarrow\) improve insulin sensitivity**
- **Improvements in muscle oxidative capacity/mitochondrial volume/quality**

Findings can be variable.
Is it Really Effective?

The effects of low vol. HIIT appear to favour less fit populations.

There is no definitive consensus on whether HIIT is superior to Well Prescribed endurance exercise training apparently populations.
HIIT and Cardiometabolic Health

The effects of short-term HIIT also favour less fit populations

Batacan '17

Similar to VO_{2\text{peak}}, HIIT appears more effective at improving cardiometabolic health when individuals are unfit or sedentary
Adaptations in sedentary individuals

<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>VO\textsubscript{2peak} - MISS 9% : HIIT 15%</td>
</tr>
<tr>
<td>HIIT</td>
<td>4 min low / 1 minute 90% PPO</td>
<td></td>
<td></td>
<td>a-VO\textsubscript{2} diff – MISS ↑: HITT ↑</td>
</tr>
</tbody>
</table>

Capillary/Fibre R - MISS↑: MISS↑
So what might this mean for cardiovascular rehabilitation programmes?
Is HIIT Effective in Cardiac Populations?

Mean difference favours HIIT 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 HIIT by 2.14 mL/kg/min (95% CI 0.66 to 3.63)
VO$_{2peak}$ is one of the strongest clinical prognosticators. Improvements in VO$_{2peak}$ 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$_{2peak}$ confers a 2% survival advantage in patients with CHD
Low aerobic fitness indicates poor cardiometabolic health - Unpublished

- Lean body mass
- Android/gynoid ratio
- Ventilatory anaerobic threshold
- Heart rate recovery (1, 2, 3, and 6 minutes)
- Haemoglobin/Haematocrit
- BMI
- Waist to hip ratio
- Left ventricular ejection fraction
- Previous MI
- Lipid profiles
- NT-proBNP
- hs-CRP
- Glucose (non-fasting)
- VE/VCO₂ slope
- Oxygen uptake efficiency slope
- Resting heart rate
The Role of HIIT in Cardiac Populations

Exercise-based cardiac rehabilitation for coronary heart disease (Review)
Hran BS, Chen JMH, Ibrahim S, Menham 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,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 HIIT in Cardiac Populations

- Evidence for the application of HIIT in clinical practice is evolving.

- There remains a lack of high quality ‘pragmatic’ real-world evidence.

- A major research/logistical challenge in the UK? Prescribing HIIT when maximal exercise testing is not widely available.
@HIITorMISSUK - Study update

<table>
<thead>
<tr>
<th>Pragmatic multi-centre RCT – 510 patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight weeks – 2 x per week</td>
</tr>
<tr>
<td>10 x high intensity bouts at 85 - 90% PPO</td>
</tr>
<tr>
<td>10 x low intensity bouts at 20 - 25% PPO</td>
</tr>
<tr>
<td>Control group – standard care at 40-70% HRR</td>
</tr>
<tr>
<td>Assessed following intervention ~8 weeks and at 12 months</td>
</tr>
<tr>
<td>Primary outcome measure - $\text{VO}_2^{\text{peak}}$</td>
</tr>
<tr>
<td>Also assessing other physiological, psychosocial and economic outcomes</td>
</tr>
</tbody>
</table>
@HITtorMISSUK

Coventry

Hull

Cardiff

Sept 2016

Sept 2017

Sept 2017

n=102 recruited
4 SAE’s (2 per group)
13 lost to follow-up – 8 HIIT/5 MISS
Have Your Say!

• We would like to understand how UK CR exercise programmes are currently operating.

• At the end of our survey, there is a section relating to the future role that HIIT may have in UK CR programmes.

• We just need one response from each team – Someone directly involved in exercise provision

• [https://northumbria.onlinesurveys.ac.uk/an-evaluation-of-exercise-provision-within-uk-cardiac-reha](https://northumbria.onlinesurveys.ac.uk/an-evaluation-of-exercise-provision-within-uk-cardiac-reha)
Summary

• Compared to MISS, HIIT appears to provide superior health benefits

• Variation in HIIT protocols and magnitude of benefit

• HIIT appears to be safe and effective in cardiac populations – HIITorMISSUK may provide much needed ‘real-world’ evidence.
Thank You

✉️ s.j.nichols@shu.ac.uk
🐦 @nichols87simon
References


Bacon AP, Carter RE, Ogle EA and Joyner MJ. VO\textsubscript{2max} trainability and high intensity interval training in humans: a meta-analysis. *PloS one* (2013); **8**: e73182.


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.

