The Science and Application of High Intensity Interval Training

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High-Intensity Interval Training
TOPICS

1. What is High-Intensity Interval Training?

2. Incorporating HIIT into a Concurrent Training Program.

3. Physiological targets of HIIT.

4. HIIT Prescriptions.

5. HIIT Manipulations

6. Take home points.
1. High-Intensity Interval Training?

Performance Demands of Rowing

The chapter describes the sport of rowing, the athletic factors that are important for success in the sport. Olympic distance 2000 m and less, and 18-kilogram interval training (IHT) contributes a physiological development.

Sport Description and Factors of Winning

Rowing, often referred to as a crew in the United States, is a sport with origins back to ancient Egyptians, and is one of the oldest Olympic sports. The sport is based on propelling a boat (rowing shell) at a set speed using oars. By pushing against the water with an oar, the force is generated to move the boat. While rowing as a competitive sport can be traced to the early 18th century when races were held between professional watermen on the river Thames in London, United Kingdom. Amateur competition began around the end of the 18th century with the arrival of boat clubs at the British public schools.

In the 1970s, the International Olympic Committee (IOC), an official body for international gymnastics, was founded in 1892 to provide gymnastics at a time when the sport was gaining popularity. Across six continents, 150 countries now have rowing federations that participate in the sport.

Each year the Rowing World Championships, staged by FISA, sees 22 boat races during seven days. In Olympic years only the elite Olympic boat classes are raced at the World Championships. Rowing competitions take place over 2000 m for both men and women. Races are held for sculling (where the rower holds two oars) and sweep boats (where each rower holds one oar), and include pairs, fours, eights, and 4-4, as well as sometimes the inclusion of a coxswain, although “oared” fours and pairs are no longer events on the Olympic schedule. The single scull boat is raced by an individual rower (both gender) using two oars. There are additionally lightweight rowing events for both male and female divisions. The different types of rowing classes result in marginal variation in the time taken to complete the 2000 m event, ranging from 5 min (men’s eight rowing) to 7 min (women’s single scull). The Olympic boats (as of the last Olympics) are outlined in table 1.1. The table shows the abbreviated associations that will be used throughout the chapter.

Response to Load

Martin Buchholz, Paul Laursen, Jamie Storer, Dorteil Plovan, Kari Hildsedal, Matthew Locino, Ben Simpson, and Anna Stew

Performance Demands of Triathlon

The chapter describes the sport of triathlon, defining and analyzing the various factors and factors that influence success in the sport. How high-intensity interval training (IHT) contributes to physiological development in direct individual disciplines of swimming, cycling, and running.

Sport Description and Factors of Winning

Triathlon is considered by some to have begun in the 1970s in France. In the UK, amateur sport is known as “Junior”- or “Sprint”- or “Triathlon”-driven events. The most common events are sprint, junior, and relay. The total distance is 1.5 km (swimming), 40 km (cycling), and 10 km (running). The IHT is composed of swimming, cycling, and running. The main factors that determine performance in any triathlon are the physiological capacities of the individual triathlete. These physiological differences can be influenced by training in each individual discipline of the triathlete.

Table 19.1 Primary Triathlon Distances for Swimming, Cycling, and Running

<table>
<thead>
<tr>
<th>Event</th>
<th>Distance</th>
<th>Time (min)</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprint</td>
<td>750 m</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Junior</td>
<td>1500 m</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Relay</td>
<td>1800 m</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>
What is High-Intensity Interval Training (HIIT)?

“What is High-Intensity Interval Training (HIIT)?

“Exercise consisting of repeated bouts of high-intensity work performed above the lactate threshold (a perceived effort of ‘hard’ or greater) or critical speed/power, intersperssed by periods of low-intensity exercise or complete rest”.

![Diagram of HIIT intervals](image-url)
HIIT - Just one piece of the performance puzzle, but often an important one
Athlete psychological state

Desired physiological objectives
- Format of the HIIT session
  - e.g. metabolism involved,
  - amount of neuromuscular load,
  - integration of sport-specific skills,
  - cognitive load,
  - volume and intensity

Training periodization
- Daily plan
- Micro cycle
- Meso/macro cycle
Performance - Context is Important
Strength

Speed

Endurance
Strength

Speed

Endurance
Relative Contribution of Physical Performance
Fitness

• Being fitter/faster can’t guarantee success
• Not being fit/fast enough can be a problem

- Skills
- Players interactions
- Game insights (decision making)
- Physical capacities:
  - cope with the demands of the match
  - execute their tactical roles efficiently
  - Fit with the game model of the team
What is most important for performance in your sport?
2. Incorporating HIIT into a Concurrent Training Program
Concurrent Training and the ‘Interference Effect’

Concurrent training involves performing different types of exercises in the same training session, and it can lead to the 'interference effect.' This effect can be observed through various physiological changes. For instance, increased oxygen delivery and uptake, enhanced oxygen utilization, strength gain, muscle hypertrophy, and increased power development can be expected when engaging in concurrent training. The diagram illustrates the potential benefits and interactions involved in concurrent training.
Mechanisms for the ‘Interference Effect’

1. ‘Acute’ (or ‘neural’) mechanism
2. ‘Chronic’ (or ‘molecular’) mechanism
"These data suggest that a standard RT session minimally impacts the HRV of elites athletes, but may prime their neuromuscular system, allowing them to better perform quality HIIT sessions on the same day, rather than the following day."
What is your priority??

Strength
Speed
Endurance

Strength
Speed
Endurance
3. Physiological Targets of HIIT

- Aerobic
- Anaerobic
- Neuromuscular
Cerebral deoxygenation

T@VO₂max
Cardiac output
Oxidative function
Respiratory work

Aerobic enzymes
Muscle deoxygenation levels

PERIPHERAL

CENTRAL

Aerobic
Anaerobic contribution
Glycogen stocks
Perceived exertion
Decreased performance
Neuro- and musculoskeletal strain

- Injury risk
- Residual fatigue
- Perceived exertion
- Decreased performance
HIIT precision
4. HIIT Prescriptions
HIIT TYPES

- Short Intervals
- Long Intervals
- Repeated Sprint Training
- Sprint Interval Training
- Game-based Training
HIIT TYPES

- Short Intervals
- Long Intervals
- Repeated Sprint Training
- Sprint Interval Training
- Game-based Training
SHORT INTERVALS

Type #1  Type #2  Type #3  Type #4

✓ 40”/20”
✓ 470 W
LONG INTERVALS

4-6 x 3’ @BEST POWER, 3’rest
SPRINT INTERVAL TRAINING

6 x 20 sec MAX! 4 min recovery

- All out
- Long sprints
- 20-30 s
REPEATED SPRINT TRAINING

Example
• 5” Sprint/15” rest
X4-9reps

Type #4  Type #5
5. HIIT Manipulations.
Intervals take place at or above the anaerobic threshold, and we have a finite capacity for total work in this zone, known as $W'$

- High-intensity intervals deplete $W'$
- Rest allows $W'$ to be partially restored
- Fundamental HIIT manipulations – interval intensity and duration, rest intensity and duration - dictate the depletion and recovery of $W'$, and therefore the possible work output for the remainder of the session

Myoglobin

$O_2$

Transported

$O_2$

PCr

10-s Interval

60-s Interval

$O_2$ deficit = Anaerobic contribution

Very short (<10s) achieves low engagement of lactic system due to Mb
6. Take home points.
TAKE HOME POINTS

● Context before Content!

● Placement of HIIT within a training plan is key. What is your priority?

● Physiological aspects such as aerobic, anaerobic and neuromuscular, can be targeted using different HIIT Types.

● Long intervals, short intervals, repeated sprint training and sprint interval training all have differing physiological targets (context before content)

● However, all interval types can be manipulated to emphasize specific physiological targets to some degree.
The Science of High-Intensity Interval Training

Promo: SPRINZ for 20% discount on all HIIT Science courses.
<table>
<thead>
<tr>
<th>Exercise</th>
<th>Set x Reps</th>
<th>Warm-up</th>
<th>Main</th>
</tr>
</thead>
<tbody>
<tr>
<td>One arm kettle bell swing</td>
<td>3x5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dumbbell one arm row</td>
<td>2x4</td>
<td></td>
<td>5x3@3RM</td>
</tr>
<tr>
<td>Prone bench pull</td>
<td>2x4</td>
<td></td>
<td>5x3@3RM</td>
</tr>
<tr>
<td>Keiser-cable one arm row</td>
<td>1x4</td>
<td></td>
<td>5x3@23kg</td>
</tr>
<tr>
<td>Ball slam rotations</td>
<td></td>
<td></td>
<td>5x5@5RM</td>
</tr>
<tr>
<td>One arm alternating military press</td>
<td></td>
<td></td>
<td>5x5@5RM</td>
</tr>
<tr>
<td>Military press dropset</td>
<td></td>
<td></td>
<td>3x6+6+6</td>
</tr>
</tbody>
</table>