



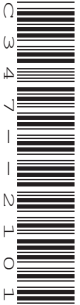
Oxford Cambridge and RSA

Wednesday 20 January 2021 – Afternoon

Level 3 Cambridge Technical in Applied Science

05874 Unit 23: Scientific research techniques

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INSTRUCTIONS

- Do **not** send this Insert for marking. Keep it in the centre or recycle it.

INFORMATION

- This document has **8** pages.

Case study: The impact of high-intensity interval training

Source A – Adapted from ‘No sweat: Does high-intensity interval training work?’

<https://www.newscientist.com/article/mg23731600-500-no-sweat-does-high-intensity-interval-training-work/>

Getting fit in 4 minutes: this is the promise of high-intensity interval training, marketed in gyms as HIIT. The idea was thought up by Izumi Tabata and a team of researchers from the National Institute of Fitness and Sports in Japan in the 1990s.

Tabata showed that 4-minute workouts, comprising repeated cycles of 20 seconds of all-out work followed by 10 seconds of rest, four days a week, brought greater aerobic improvements than an hour’s normal workout done five days a week for six weeks.

But does it deliver the goods? “The answer to that is absolutely, definitely,” says sports scientist Chris Easton at the University of the West of Scotland, UK. “High-intensity training works: it’s been shown pretty consistently to make you fitter, make you healthier,” he says. That is because pushing the body out of its comfort zone for short bursts forces it to adapt. The higher the intensity, the greater the adaptation, with benefits for your lungs, heart and circulation. “High blood flow through the heart, through the muscle, is the thing that causes those large changes in a short space of time,” says Easton.

That is not all. In a study published in 2017, Sreekumaran Nair at the Mayo Clinic in Minnesota and his colleagues compared muscle samples from younger and older people who had regularly done either HIIT training, a weights workout, or both, for three months. They found that HIIT reduced, and even sometimes reversed, the effects of old age on mitochondria, the energy powerhouses inside cells. With age, mitochondrial deterioration causes fatigue and can contribute to diabetes. What is more, high-intensity training helps boost your metabolic rate, which means you burn more energy even at rest.

Sounds great, but full-on HIIT is not for everyone, Easton warns: done properly, it is an unpleasant experience. “I do this with my students and invariably after all-out 30 seconds of maximal work on a bike, half of them are physically sick afterwards.” But incorporating some element of vigorous exercise in a longer routine – whether faster-paced walking or jogging, some hills or just a few stairs – will deliver benefits.

Further information

<https://www.newscientist.com/article/2123825-best-anti-ageing-exercise-is-high-intensity-interval-training/>

<https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/2596007>

Source B – Adapted from ‘Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO_2 max.

We were interested in learning whether the effects of training on anaerobic capacity are dependent on the magnitude of anaerobic energy release developed by specific training.

We compared two different training protocols:

- a moderate-intensity endurance training that is not supposed to depend on anaerobic metabolism and,
- a high-intensity intermittent training that is supposed to recruit the anaerobic energy releasing system almost maximally.

Subjects. Young, physically active male students majoring in physical education volunteered for the study. After receiving a detailed explanation of the purposes, potential benefits, and risks associated with participating in the study, each student gave his written consent.

Protocol. All experiments, as well as pre-tests, were done on a mechanically braked cycle ergometer at 90 rpm. Each test or high-intensity intermittent training session was introduced by a 10 minute warm-up at about 50% of VO_2 max.

Experiment 1

The subjects started training after their VO_2 max and maximal accumulated oxygen deficit were measured.

They exercised 5 days per week for 6 weeks at an intensity that elicited 70% of each subject's VO_2 max. The pedalling rate was 70 rpm, and the duration of the training was 60 min.

As each subject's VO_2 max increased during the training period, exercise intensity was increased from week to week as required to elicit 70% of the actual VO_2 max.

During the training, the maximal accumulated oxygen deficit was measured before, at 4 weeks, and after the training. VO_2 max was determined before and after the training and every week during the training period.

Experiment 2

Subjects exercised for 5 days per week for 6 weeks. On four of those days they exercised using exhaustive intermittent training.

They were encouraged by the supervisor to complete seven to eight sets of the exercise. Exercise was terminated when the pedalling frequency dropped below 85 rpm. When they could complete more than nine sets of the exercise, exercise intensity was increased by 11 W.

On one day per week the subjects exercised for 30 min at an intensity of 70% VO_2 max before carrying out four sets of the intermittent exercise at 170% VO_2 max. This latter session was not exhaustive.

The anaerobic capacity was determined before, at 2 weeks, and 4 weeks into the training, and after the training. VO_2 max was determined before, at 3 weeks, 5 weeks, and after the training.

Discussion

The main finding of this study was that 6 weeks of aerobic training at 70% VO_2 max improved the VO_2 max by $5 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ in moderately trained young male students but that the anaerobic capacity, as judged by the maximal accumulated oxygen deficit, did not change.

The second finding was that 6 weeks of training using high-intensity intermittent exhaustive exercise improved VO_2 max by $7 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ and the anaerobic capacity by 28%.

These results therefore support our hypothesis that the higher the anaerobic energy released during each training session, the higher the increase in anaerobic capacity after the training period.

Further information

https://youtu.be/fn3Yr-LS_I0 'VO2 Max Test - What to Expect'

<https://runnersconnect.net/is-vo2-max-worth-spending-for/>

<https://www.topendsports.com/testing/anaerobic-capacity.htm>

<https://www.youtube.com/watch?v=uvzf-qdM9fs> 'Anaerobic threshold'

Research notes:

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