HIIT Background & Physiology

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Introduction

- Pre the 1970's, athletic coaches generally used continuous practicing to get better at a sport (10,000hrs etc)
- But when ad-hoc changes in training were introduced, with intervals of higher intensity activity and lower intensity recovery, better athletic progressions were seen
- These increases in athletic ability led to the research of interval and HIIT training benefits vs. traditional sub-max & continuous training at high volumes

The ‘Tabata’ study

- In Tabata's 1996 study, the researchers found that athletes who used a 20:10 x 8 routine five days a week for six weeks improved their maximum aerobic capacity by 14% and improved their anaerobic capacity by 28% compared to a control study of traditional aerobic training of running at 70% of aerobic capacity for 60 minutes for six weeks showed an improvement in aerobic capacity of 9.5% and no effect on anaerobic capacity.
- Dr. Tabata's Team found that as well as improving your aerobic and anaerobic capacity it is very effective in lowering the ratio of lean body mass to fat without compromising your muscle size.

HIIT definitions

"HIIT involves repeated short-to-long bouts of high intensity exercise interspersed with recovery periods" (Billat, 2001)

"Repeated bouts of short to moderate duration exercise (10sec-5mins) completed at an intensity that is greater than the anaerobic threshold" (Laursen & Jenkins 2002)

"High Intensity Interval Training (HIIT) is defined as 'near maximal' efforts generally performed at an intensity that elicits 80% (but often 85–95%) of maximal heart rate" (Weston et al, 2014)

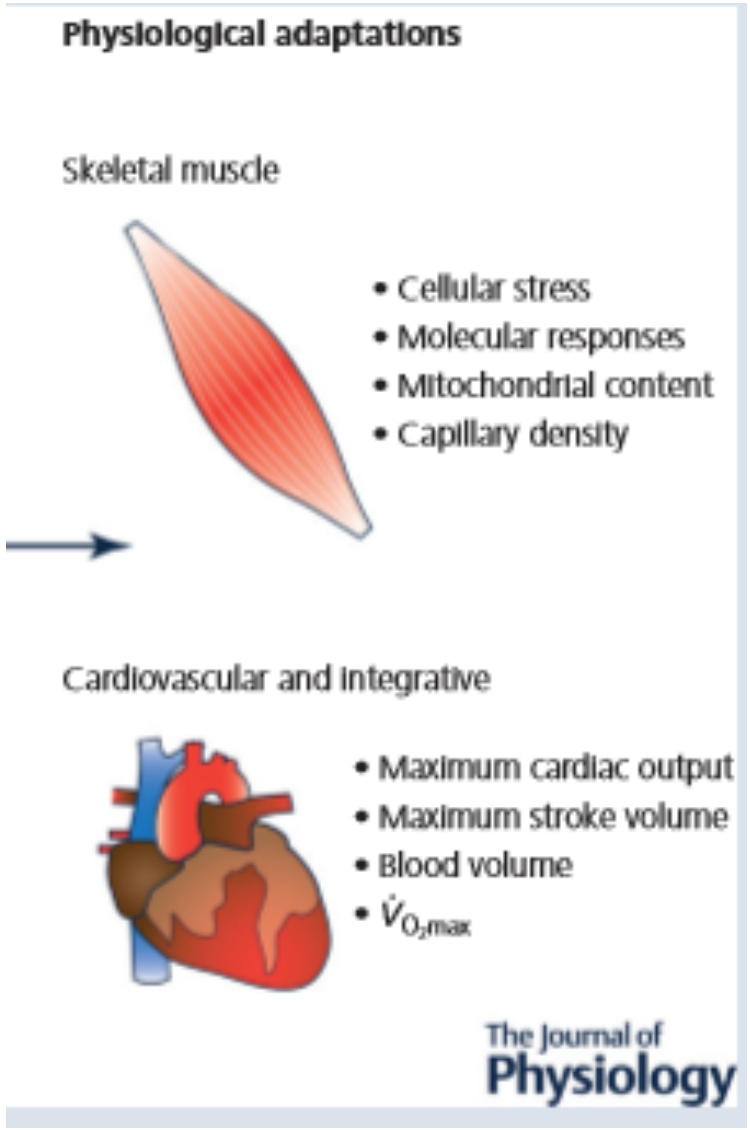
Benefits

- Health benefits:
  - Weight control through increased metabolism (see EPOC ppt)
  - Improved blood lipid profile
  - Decreased diabetes risk
  - https://www.youtube.com/watch?v=v7-h_w7bJrU

- Fitness benefits:
  - Increased aerobic fitness
  - Increased anaerobic fitness
  - https://www.researchgate.net/publication/14310387_Effects_of_moderate-intensity_endurance_and_high-intensity_intermittent_training_on_anaerobic_capacity_and_VO2maxAnti-aging?

Physiological adaptations to HIIT

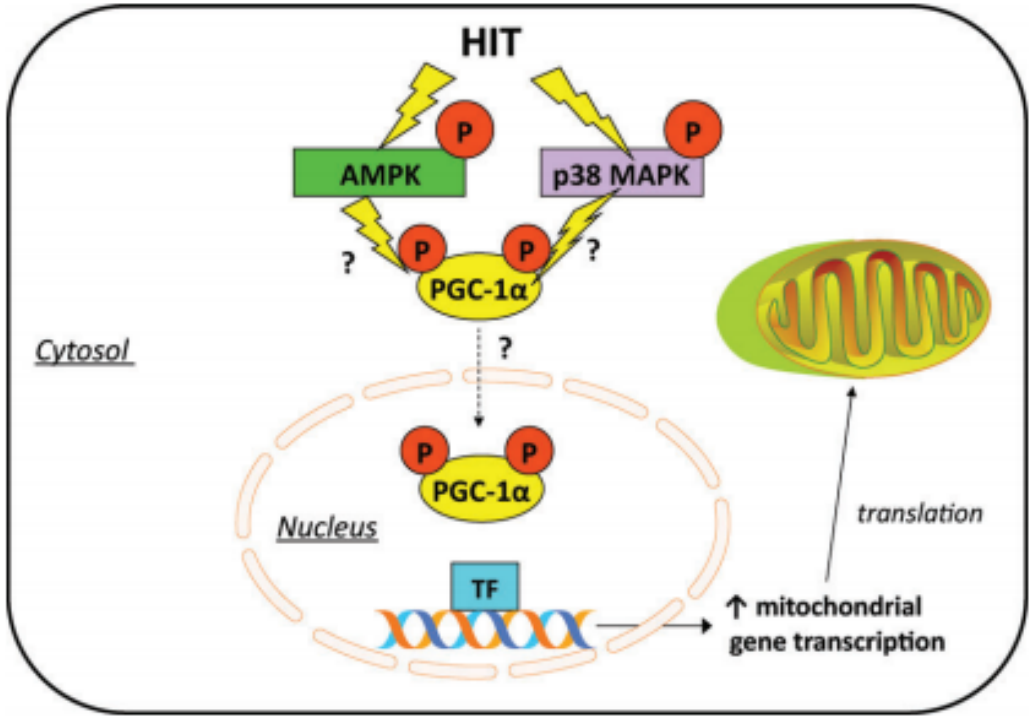
- Increased VO_2max utilisation stimulus & O_2 transportation stress.
- Increased cardiac output & stroke volume stress
- Increased size of motor unit & muscle fibre recruitment stress.
- Increased oxidative metabolism of carbohydrate & fats.
- Increased mitochondrial biogenesis & mRNA expression (critical to development of the body's systems)



Bucheit & Laursen (2013)

Adaptations cont.

- The main adaptation to HIIT is Mitochondrial Biogenesis. Enhancing the matrix's size within the mitochondrion so that more O_2 can be metabolised
- This occurs due to increased concentrations of citrate synthase (CS) and succinate dehydrogenase (SDH) enzymes
- This is made possible by complex aerobic specific gene expressions (PGC-1α mRNA)
- HIIT acts as an accelerator in developing aerobic metabolism to phosphorylase more O2



MacInnis & Gibala (2017)

Long-term cardiovascular response to HIIT

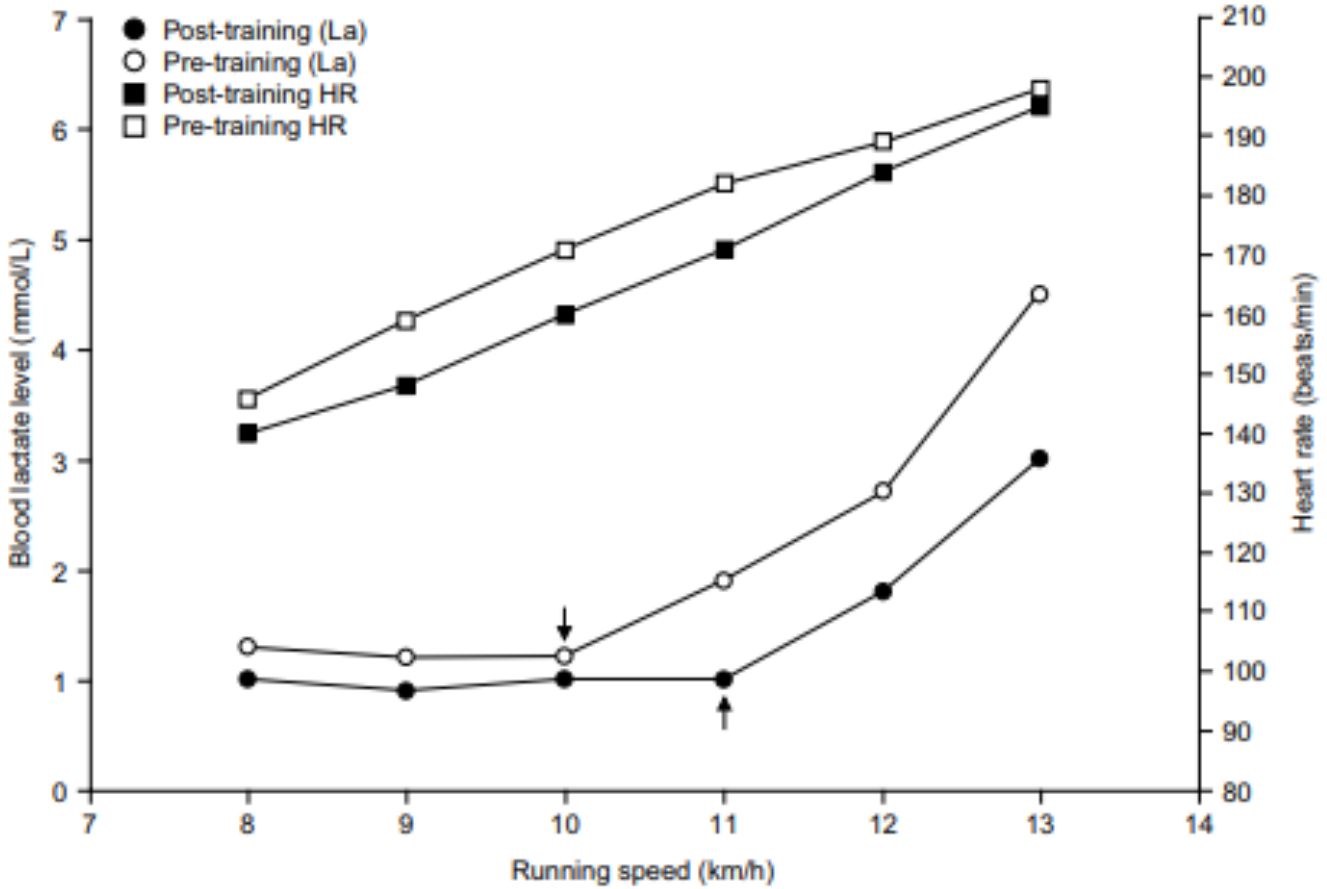
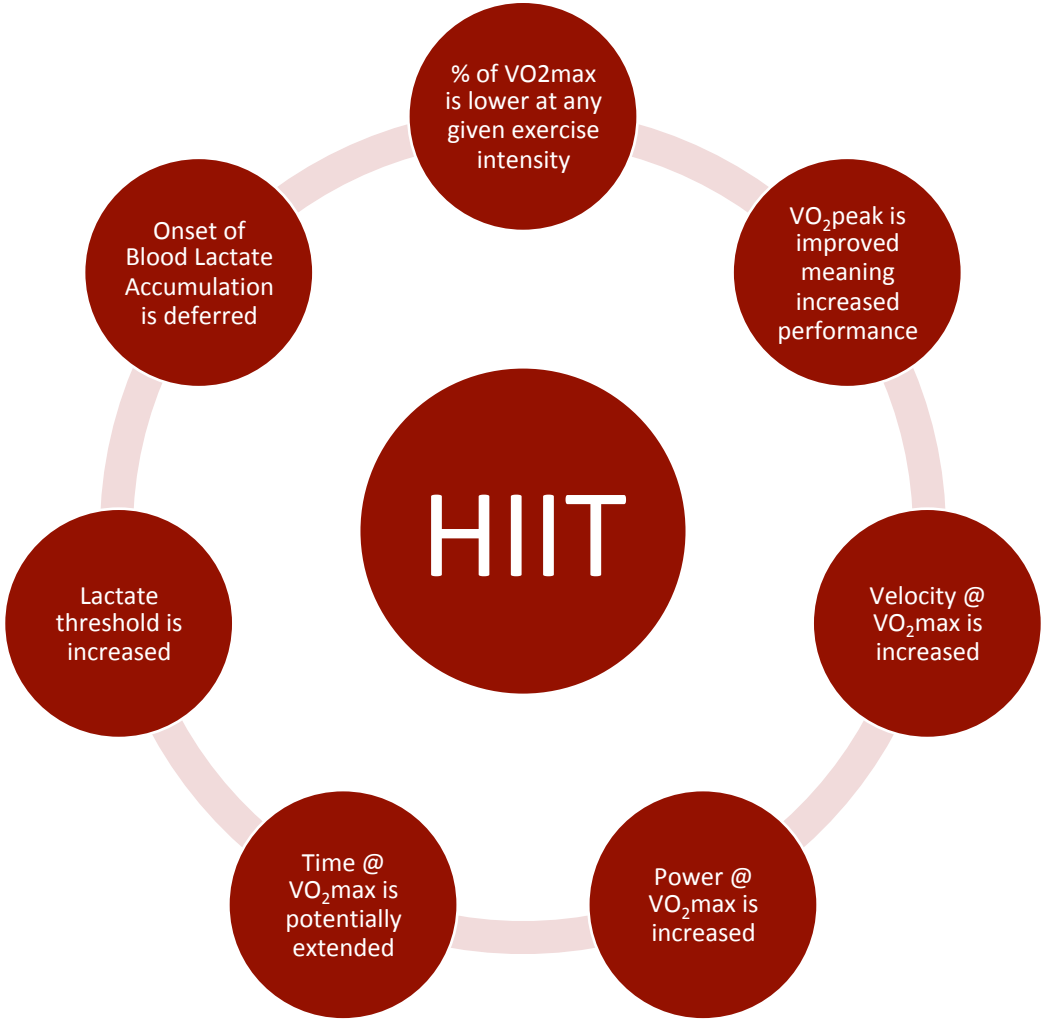


Fig. 2. The effect of 6 weeks of endurance training on blood lactate levels and heart rate response to incremental exercise in a typical individual. The vertical arrows denote the lactate threshold determined before and after training (from Carter et al.,[20] with permission).

This chart shows that at any given running speed, heart rate and blood lactate is reduced following a HIIT training regime

Jones & Carter (2000)

Physiological metric components of HIIT



Downsides of HIIT

- Possible cause of ‘rhabdomyolysis’ (death of muscle fibres) https://www.telegraph.co.uk/health-fitness/body/hiit-fitness-scenes-biggest-fad-harm-good/
- Poor technique
  - Acute injury
  - Chronic injury

Ultimate goal of HIIT / Metabolic training

(Depending client's ultimate goal)

- Highest workload/intensity possible in given timeframe
- Highest Kcal expenditure in given timeframe
- Highest EPOC in given timeframe (see EPOC ppt)

References

- Bucheit, M., Laursen, P.B. (2013a) High-Intensity Interval Training, solutions to the programming puzzle Part I: Cardiopulmonary Emphasis. *Sports Medicine*, 43, 313-338.
- Jones, A.M., Carter, H. (2000) The Effect of Endurance Training on Parameters of Aerobic Fitness, *Sports Medicine*, 29 (6) 373-386.
- MacInnis, M.J., Gibala, M.J. (2017) Physiological adaptations to interval training and the role of exercise intensity. The Journal of Physiology, 595 (9), 1-9.