CHRONIC ADAPTATIONS TO TRAINING
What you need to know...

Cardiovascular adaptations to aerobic training
Respiratory adaptations to aerobic training
Muscular adaptations to aerobic training
Chronic adaptations to anaerobic training
What are chronic adaptations?

Acute: immediate, short-term

Chronic: long-term

Chronic adaptations

• Long-term muscular, skeletal, circulatory and respiratory responses
• Develop over a minimum of 6 weeks, but most evident after 12 weeks of training
Factors

What impacts on chronic adaptations to training?

• Type and method of training
  • Aerobic v. anaerobic
  • F__________, d__________ and i__________ of training
  • Individual capacities and hereditary factors
Cardiovascular Adaptations to Aerobic Training

Enables more efficient and greater delivery of __________ to the working muscles

This helps to decrease the risk of CV disease and other health related illnesses
Cardiac hypertrophy

Heart rate

Arterio-venous oxygen difference

Increased blood volume, haemoglobin and myoglobin levels

Lower blood pressure

MUST KNOW THESE!!
Cardiac Hypertrophy

Hypertrophy = __________ in size

Sustained __________ training results in enlargement of the heart muscle

In particular, left ventricle size/volume increases

Increases stroke volume

• Blood pumped each __________
Heart Rate

**Cardiac Output:** amount of blood ejected from the LV in one minute

**Stroke Volume:** amount of blood ejected from the left ventricle with each beat (contraction) of the heart

Heart rate lowers at rest and during sub-maximal exercise

- A trained athlete needs __________ beats of the heart to pump out the __________ amount of blood
- The heart does not have to work as hard to supply the required blood and oxygen
- The heart works more efficiently
Arterio-Venous Oxygen Difference

a-VO2 diff. increases

Trained athlete is able to absorb more ___________ from their blood

More oxygen is been taken from the arteries, therefore the oxygen level difference between the arteries and veins increases

A greater uptake of oxygen occurs

This results from

- Increase in myoglobin
- Increase in mitochondria
Increased Blood Volume, Haemoglobin and Myoglobin Levels

Regular, sustained aerobic training may increase total blood amount

**Haemoglobin:** transports oxygen throughout blood vessels
- Increased level in trained athlete

**Myoglobin:** transports oxygen so it can be used by mitochondria
- Increased level in trained athlete
Respiratory Adaptations to Aerobic Training

Respiratory = lungs

Increase oxygen supply from the lungs to working muscles
Respiratory Adaptations to Aerobic Training (cont.)

- Increased lung ventilation
- Increased maximum oxygen uptake
- Increased lactate inflection point (LIP)

**MUST KNOW THESE!!**
Increased Lung Ventilation

Training improves **tidal volume**: amount of air ___________ and ___________.

Reduces the amount of respirations needed per minute as the lungs become more efficient

- A larger volume of oxygen is supplied with the same number of breaths

Improved pulmonary diffusion

- Blood is able to extract oxygen from alveoli (lungs)
Increased Maximal Oxygen Uptake

Regular, sustained aerobic training program increases VO2 max

Due to:

• Increase oxygen supplying __________
  • Increased cardiac output
  • Increased haemoglobin
  • Increased a-VO2 difference
• Improved ability of muscles (myoglobin and mitochondria) to use oxygen
Increased LIP

LIP = ______________ ______________ ______________

• At exercise intensities beyond the LIP blood lactic acid concentration increases
• Beyond the lactate threshold/LIP the athlete has to stop or reduce muscle effort

Trained athletes can increase their tolerance to lactic acid/lactate accumulation
• Because of greater oxygen delivery and extraction (usage)
• Able to work harder for longer
Muscular Adaptations to Aerobic Training

Occur best with continuous training or high repetition weight training
Muscular Adaptations to Aerobic Training

Increased oxygen utilisation
  • Increased ________ and _________ of mitochondria
  • Increased myoglobin stores

Increased muscular fuel stores

Increased oxidation of glucose and fats

Decreased utilisation of the lactic acid system

Muscle fibre type adaptations
Increased Oxygen Utilisation

Increased size and number of mitochondria
• Site of ___________ production
• Increases capacity to breakdown and use CHO & fat

Increased myoglobin stores
• Attracts oxygen from blood into muscle
• Increases stores mean an increase in oxygen coming into muscle
Increased Muscular Fuel Stores

Aerobic training leads to an increase in the storage of glycogen, free fatty acids and triglycerides in the muscle
Increased oxidation of glucose and fats

Capacity of muscle fibres to breakdown CHO and fats using oxygen is increased

Increased storage and breakdown of fats allows glycogen to be spared/saved for later on

- Delays time of glycogen depletion
- Can exercise for a longer period of time
**Decreased Utilisation of the Lactic Acid System**

Enhanced capacity of the muscles to aerobically metabolise (breakdown) CHO and fats means there is less reliance on the lactic acid system (anaerobic breakdown).

Therefore athlete can work at a higher intensity before reaching LIP/lactate threshold.
Muscle Fibre Adaptation

Slow-twitch: aerobic/endurance activities

Fast-twitch A (partially aerobic)

Fast-twitch B (purely anaerobic): anaerobic/powerful activities

Some fast-twitch A fibres can take on characteristics of slow-twitch fibres as a result of aerobic training

• Thus, help improve aerobic performance
Chronic Adaptations to Anaerobic Training

Anaerobic training effects are best developed through

- Speed training
- Fast interval training
- Plyometric training
- Circuit training
- Weight training

Greatest adaptations occur at the muscular level
Chronic Adaptations to **Anaerobic** Training

Muscle hypertrophy

Increased muscular stores of ATP & PC

Increased glycolytic capacity

Cardiac hypertrophy (cardiovascular adaptation)

**MUST KNOW THESE!!**
Muscle Hypertrophy

Increased size of muscle
- Fast-twitch: high load, low rep
- Slow-twitch: lower load, high rep

Greater increase in size in males
- Due to testosterone
Increased Muscular Stores of ATP & PC

Increase in amount of ATP & PC

Increase also in enzymes that break down and rebuild ATP

Results in increased capacity of ATP-PC system

• Important for activities requiring __________, __________ and __________
Increased Glycolytic Capacity

Anaerobic training helps to enhance muscle _______ of glycogen

Also an increase in enzyme concentration responsible for breakdown of glycogen

• Therefore, quicker and larger breakdown of glycogen without oxygen (lactic acid system)
Anaerobic training increases the _______ of the heart
  • Of left ventricle

Allows a more forceful _______ to take place