eduqas
Part of WJEC

OVERVIEW of Exercise physiology, training and performance.

How do I prepare to perform on the international stage?

Overview Exercise physiology, training and performance

A. Overview Short term effects of exercise on the cardiovascular system

- There are two circulatory systems; pulmonary and systemic, their functions are transportation and removal of nutrients, oxygen, carbon dioxide and waste products.
- The cardiac cycle consists of two phases, diastole (relaxation phase) and systole (contraction phase).
- One cardiac cycle (heart beat) takes on average 0.8seconds
- Venous return is the volume of blood returning back to the heart, it is supported by valves and smooth muscle in the veins, musculo-skeletal pump and pressure gradients.
- Starling's Law refers to the increased stroke volume, due to increased filling of the heart.
- Cardiac values at rest and at different intensities, the relationship between Cardiac Output, Heart rate and Stroke Volume (Q=HR×SV).
- At rest Q=5 l/min compared with up to 35 l/min when exercising.
- The bodies transport system consists of arteries, veins, and capillaries that vasodilate or constricts to maintain increase or decrease blood pressure.
- Blood pressure at rest 120/80mmHg. It tends to be the systolic pressure that increases significantly compared with the diastolic. Aerobic exercise increases blood pressure to 180/85mmHg whereas strength training can increase both up to 240/160mmHg.
- It is important to note that aerobic exercise causes the lowest increases to blood pressure and are therefore the safest for those with cardiac problems.
- Control of heart rate is carried out in the Cardiac Control Centre (CCC) found in the Medulla Oblongata of the brain; this is part of the Autonomic Nervous System (ANS). The (ANS) has two sub-divisions, the Sympathetic Nervous System (SNS) and the Parasympathetic Nervous System (PNS).

- When our bodies are at **rest** the parasympathetic nervous system is in control of the heart rate compared with the sympathetic nervous system when exercising.
- The cardiac control centre (CCC) has three ways of regulating or controlling heart rate; neural (various receptors), hormonal (adrenaline/noradrenaline), intrinsic l (Starling's Law).
- Redistribution of blood to muscles during exercise (blood shunting) is caused by vasomotor control.

B. Overview Short term effects of exercise on the cardiorespiratory system

- Two of the major functions of the respiratory system are to:
  - Provide oxygen (O_2) to the working muscles
  - Remove carbon dioxide (CO_2) from the body
- Mechanics of breathing influenced by the diaphragm and intercostal muscles.
- The main function of the respiratory system is gaseous exchange. This refers to the process of Oxygen and Carbon Dioxide moving between the lungs and blood (between the alveoli and capillaries).
- This occurs because of the process of diffusion. Diffusion occurs when molecules move from an area of high concentration to an area of low concentration until equilibrium is reached.
- The rate of inspiration and expiration is controlled by the respiratory control centre (RCC) found within the medulla oblongata in the brain.
- The respiratory values vary depending upon intensity and duration of exercise.
- ME=TV×Bf
- As with the control of heart rate, breathing rate is controlled by:
  - Chemoreceptors (detect chemical changes)
  - Proprioceptors (detect movement)
  - Thermoreceptors (detect temperature change)

C. Overview long term adaptations of exercise on the cardiovascular system

After a period of prolonged aerobic training (up to 18 weeks) adaptations to the bodies system include: -

- **Musculo-skeletal;** mobility at joints, increased bone density, muscular hypertrophy, efficiency of muscle fibre types, increased force and length of contractions and capillarisation, increases in myoglobin and mitochondria in the muscle cell.
- **Cardiorespiratory;** changes to resting values of Bf, TV, diffusion rates, capillarisation. and haemoglobin content. Values of ME and diffusion when exercising.
- **Cardiovascular;** changes to resting values of SV, HR, BP, (bradycardia, hypertrophy) compared with the changes when exercising,
- Increased **elasticity (vasomotor control) of arteries and arterioles** (allows greater volume of oxygenated blood to pass through the vessels).
- Increased **CP** and **glycogen** stores and increased **tolerance to lactic acid.**
- Increased capacity of the training zones and energy systems.
- Higher VO_2 max and an increase in anaerobic threshold.

D. Overview of Preparation and training

- Fitness tests; monitor our progress, often after a period of training; identify strengths and weaknesses; set goals; comparisons; normative tables; elite athletes.
- Select appropriate tests that are reliable and valid for specific components of fitness.
- Standardise all the testing procedures, in order to produce the most accurate results possible.

- Differences between Field and Lab tests.
- Understanding VO_2Max testing.
- Continuous - Submaximal aerobic method of training med intensity and long duration.
- Interval – Maximal effort high intensity, short duration reps sets and recovery time.
- Fartlek - Usually used for games players because of the varying speeds, distances.
- Plyometrics – develops power and uses eccentric muscular contractions.
- Weight - used to develop strength, power or muscular endurance. To develop strength high weight (80-100% 1 rep max) should be used with1-6 repetitions with 3-4 min recovery. To develop power high weight (70-90% 1 rep max) should be used with 2 - 8 repetitions carried out as fast as possible with 3-4 min recovery. To develop muscular endurance a medium to low weight should be used (40-60% of 1 rep max) with 10-20 repetitions with only a 1-2 minute recovery.
- Circuit - Circuit training can be adapted to meet the needs and the goals of the individual.
- The main principles of training that develop sporting performance are specificity, progressive overload (progression and overload) and variance.
- Progressive overload uses Frequency, intensity and duration.

- Periodisation split into Preparatory phase (pre-season), Competitive phase (in season), Transition phase (off season).
- Within the training year (Macrocycle) there is mesocycles and microcycles. A microcycle is usually between 1 to 14 days. A mesocycle is usually between 2 weeks to 6 months. A macrocycle is usually between 1 to 4 years.
- The aim of periodisation is to peak for a specific competition and develop a specific component of fitness. As the macrocycles progresses then volume of training is reduced with greater emphasis on intensity specific to the event or components of fitness.
- Periodisation is more problematic for team games where there is such a long competitive season and with so many components of fitness and skills to develop.

E. Overview of energy systems, diet and recovery

- The primary source of energy for their training and competing regimes would come from carbohydrate.
- Carbohydrate are generally the main source of energy fuelling exercise of a moderate to high intensity, with fat providing energy during exercise that occurs at a lower intensity.
- The glycaemic index is the rate at which carbohydrate releases energy (glucose) into the bloodstream.
- Carbo-loading is a diet or process of increasing carbohydrate consumption and storage of glycogen usually prior to an endurance event.
- EPOC is the repaying of energy after anaerobic exercise.
- There are two components of oxygen debt. Alactic and Lactacid. Alactic replenishes the CP stores (takes approx 4 mins to replenish 97% of the CP). Lactacid primarily replenishes the stored glycogen and removes lactic acid.
- Higher levels of aerobic fitness can result in quicker repayment of oxygen debt.
- There are a number of methods to speed up the recovery process including: - cool down, ice baths, correct nutrition and hydration, compression clothing and massage.
- Carbohydrates are the main source of fuel during moderate to high intensity exercise.
- Carbohydrates require approximately 15% less oxygen to be metabolised.
- During rest and low intensity exercise fats are the main source of energy.
- As exercise intensity increases then more carbohydrates are used as fat usage decreases.
- During anaerobic exercise CP and glycogen (carbohydrate) are the main source of energy.
- A higher the individual's aerobic fitness (VO_2 max) then the longer the fats will be metabolised, sparing important carbohydrate stores.

- The higher degree of anaerobic fitness means greater CP and glycogen stores which allows an individual to exercise at a high intensity for a longer period of time.
- The glycaemic index is the rate at which carbohydrates releases energy (glucose) into the bloodstream.
- High GI carbohydrates such as sugars release energy the fastest, which is beneficial during exercise and just after exercise.
- Low GI carbohydrates release their energy slowly which is beneficial 3 hours prior to exercise and within 30 minutes after intense exercise.
- A mixture of low, medium and high GI foods, are consumed after intense exercise to refuel the bodies depleted glycogen stores.
- Protein and fluids are also essential for growth and repair and re-hydration during recovery.
- There tend to be three stages to carbo-loading; depletion, tapering, loading.
- Sports supplementation is also called **ergogenic aids**.
- The most common supplements of protein, caffeine and creatine all have different effects on the body.
- Proteins are required for growth and repair.
- Caffeine's main physiological impact is the maintenance of alertness in the brain.
- Sports people who take creatine do so to improve strength, however there are no long term studies to look at the physiological impact of the supplementation.
- Doping means athletes taking illegal substances to improve their performances.
- The most commonly used substances are androgenic agents such as anabolic steroids.

- Human growth hormone can promote weight loss and increase muscle size.
- Blood doping is the misuse of certain techniques and/or substances to increase one's red blood cell mass, therefore increase stamina and performance.
- Erythropoietin (EPO) is the most common synthetic oxygen carrier.