Exercise Physiology
-Diet, Nutrition and Their Effect on Physical Activity and Performance

Healthy Balanced Diet

A diet that helps to maintain or improve overall health and provides the body with essential nutrition

The **government recommends** that a 19-50 year old in the UK should consume…

- 2,550 calories in a day for a man
- 1,940 calories in a day for a woman

The **typical diet** should consist of…

- 55% carbohydrates
- 15% protein
- 30% fats
- 5 x portions of fruit and veg

Macronutrients

Those required in large quantities in the diet to sustain natural bodily function and to help us grow, develop and repair

3 types – Carbohydrates
- Fats
- Protein

Carbohydrates

Essential part of a diet for energy production, cell division, active transport and formation of molecules

2 types – Complex
- Simple

Complex

Starches such as rice and potatoes which are stored as glycogen in the liver and muscles

Simple

Sugars such as fruit and honey which circulate in the blood stream as glucose

Protein

These are found in most foods but in large quantities in milk, eggs, meat and soya

Athletes have far higher protein requirements than their sedentary counterparts to build new muscle cells and compensate for the increased muscle breakdown during and after intense activity

Fats

These are an essential part of our diet, this helps the body to absorb certain vitamins

The main types of fat found in food are saturated and unsaturated

Saturated Fats

Found in foods from animal sources including meat, dairy products as well as some plant foods like coconut oil

Foods high in saturated fat
- Fatty cuts of meat
- Butter, cheese, cream
- Biscuits, cakes

Unsaturated Fats

Found in foods that are typically liquid at room temperature

Foods high in unsaturated fat
- Olive and Sunflower oil
- Fish oils

Water

Vital for life and efficient function of many systems within the body

Micronutrients

Help to provide the building blocks to cell regeneration and catalysts to metabolism in the body

2 types – Vitamins
- Minerals

Minerals

Required in small quantities to maintain healthy body functions

They are important for effective nerve transmission, breakdown of foods into unstable forms of energy, creation of enzymes and the development of bone and teeth
They include calcium, iron and phosphorus which are found in meat, cereals, pulses and nuts

Vitamins

Essential organic nutrient which are required in small quantities to maintain healthy body functions

2 types – Fat Soluble
- Water Soluble Vitamins

Fat Soluble

Stored in the body and found mainly in fatty foods and animal products
e.g vegetable oils, dairy, eggs

Vitamin A – antioxidant and important for eye health, cell and bone growth

Vitamin D – important for bone health and protects against cancer and heart disease

Vitamin E – antioxidant and important for eye and immune system health

Vitamin K - important for blood clotting and bone health

Water Soluble Vitamins

Not stored and require regular intake, found in fruit, vegetables, grains, milk and dairy

Vitamin C – important for skin, blood vessel, tendon, ligament and bone health

Vitamin B – Important for the breakdown of food, haemoglobin formation and the skin, eyes and nervous system

Fibre

Important component of a balanced diet for the normal function of the large intestine

A high-fibre diet can reduce cholesterol, risk of diabetes and obesity

Found in foods such as
- Cereals and Bread
- Lentils
- Fruit and Vegetables

Energy Intake, Expenditure and Balance in Physical Activity and Performance

Calorie

The amount of energy required to raise 1 gram of water at 1 °c

To maintain our weight, daily consumption should be the same as the amount we expend

2,550 calories a day for a man
1,940 calories a day for a woman

Energy Expenditure

The amount of basal metabolic rate, thermal effect of food and energy expended during physical activity

The more accurate an individuals energy expenditure is calculated the more precisely a diet can be designed to provide correct energy intake

Energy Expenditure Formula
= BMR x Physical Activity Level (PAL)

Metabolic Equivalent Value (MET)

The ratio of a performers working metabolic rate to their resting metabolic rate

The body typically uses 1kcal per kilogram of body mass per hour at rest, which is equivalent to an oxygen uptake of 3.5ml/kg/min, therefore sitting quietly and relaxed has a MET of 1

PA guidelines in America labels activities with…

-3 METs as light
3 – 5.9 METs as moderate
6+ METs as vigorous

Basal Metabolic Rate (BMR)

The minimum amount of energy required to sustain essential physiological function at rest, which can account for as much as 75% of total energy expenditure

Basal Metabolic Rate Formula

= (4.35 x weight in lbs) + (4.7 x height in inches) – (4.7 x age)

Resting Metabolic Rate

The lowest rate of energy expenditure needed to sustain the body's essential physiological functions not including sleep

Thermic Effect of Food (TEF)

The energy required to eat, digest, absorb and use food taken in, which accounts for. Very small percentage of the total energy expenditure

Thermic Effect of Food Formula

= BMR x 0.1

Energy Balance

The relationship between intake and energy expenditure

Too little energy in or too much energy out leads to weight loss

Energy Intake

The amount of total energy consumed from food and beverages which is measured in joules or calories

Performance Enhancing Drugs

Ergogenic Aids	World Anti–Doping Association (WADA)
A substance, object or method used to improve or enhance performance	A large organisation that aims to lead a world wide ban on illegal performance enhancing drugs

Pharmacological Aids

Anabolic Steroids	Erythropoietin (EPO)	Human Growth Hormone (HGH)
A synthetic steroid hormone which resembles testosterone in promoting the growth of muscles	Produced in the kidneys which promotes the production of red blood cells	Copies natural growth hormones for growth and repair
- It affects performance as it allows muscles to become bigger so they are stronger - Can be taken through tablets, creams or solutions - Risks can be irritability, aggression and mood swings	- Athletes are able to compete for longer as more oxygen is available for the body	- Helps to improve fatigue, growth and repair of muscles - Risks can conclude abnormal bone ad muscle development, enlargement of the vital organs and increased risk of certain cancers

Physiological Aids

Blood Doping	Intermittent Hypoxic Training	Cooling Aids
A volume of blood is removed from the athlete and the red blood cells are frozen around 4 weeks prior to competition Through training the body naturally replenishes the lost blood There is an increase in total blood volume, red blood cell count and oxygen – carrying capacity. An athletes performance increases intensity and duration of performance before fatigue	Interval training with work intervals performed under hypoxic conditions This increases stamina and endurance, supports optimism blood flow, lowers blood pressure and encourages growth and development of nervous tissue	Pre – Event Injury Treatment Post – Event

Nutritional Aids

59% of athletes use nutritional aids, they are often referred to as supplements. Many athletes take different supplements to help with recovery or to help increase their calorie intake

Cooling Aids

Pre - Event	Injury Treatment	Post - Event
Help to reduce the chances of thermal strain and the cardiovascular drift e.g ice vest, cool towel	Numbs the nerve endings and reduces the swelling through arterioles vasoconstriction e.g ice pack deep freeze	Makes the blood vessels constrict flushing the lactic acid built up in the muscles e.g ice bath

Once out of the cooling methods the vessels open and flood the muscles with nutrients to help repair

Endurance Training

It is recommended an athlete who trains at a moderate intensity for around one hour a day consumes 5-7g of carbohydrates per KG of body weight (10-12g for high intensity)

Pre – Event Meal	During Event	Post – Event Meal
1-4g per KG of complex or low glycemic index	30-60g of fast digesting carbohydrates to maintain blood glucose levels and preserve muscle glycogen stores	1-1.5 per KG of carbohydrates per hour trained, should be consumed within 30 minutes of finishing the event Moderate and fast digesting carbohydrates will promote faster recovery

Strength Training

5-6 small meals per day with up to 30% lean protein intake
Complex carbohydrates with limited fat intake

Pre – Training Meal	Post – Training Meal
30-60 minutes before training a small meal is recommended with equal amounts of fast digesting carbohydrates and protein	Within 2 hours a meal consisting of fast digesting carbohydrates and protein should be consumed

Day	Glycogen Loading
1	Glycogen – depleting bout of endurance exercise
2 - 3	High protein, high fat diet
4	Glycogen – depleting bout of endurance exercise
5 - 7	High carbohydrate diet while training is tapered or reduced to resting

Hydration

All levels of dehydration decreases performance, losing 2% of body weight in sweat can cause up to 20% decrease in performance due to…
- Decreased heart regulation and temperature increase
- Increased blood viscosity
- Increased heart rate
- Increased fatigue
- Decreased cognitive function and skill level

3 Types of Hydration; Hypotonic Solution (Water) , Isotonic Solutions (Energy drinks) and Hypertonic Solutions (Soda)

Creatine Supplementation

Creatine	Creatine Monohydrate
Produced naturally in the body from amino acids and can be consumed by eating meat	Can increase muscle stores of phosphocreatine by up to 50% allowing performers to train at a higher intensity for longer

Caffeine	Bicarbonate	Nitrate
A stimulant used to increase the central nervous system and the breakdown of fat as a fuel for aerobic energy production	An alkaline which acts as a buffer to neutralise. Rise in lactic acid associated with intense anaerobic activity	Inorganic compounds which dilate blood vessels, reducing blood pressure and increase blood flow to the muscles, often found in root vegetables

Key Words

Hypoxia	Buffering Capacity	OBLA
A condition where the body is subject to an inadequate oxygen supply to maintain normal function	The ability to reduce the negative effect of hydrogen ions on muscular contractions	Onset of Blood Lactate Accumulation The point where there is a dramatic rise in blood lactate levels causing the onset of fatigue