Westwood Massage

The effects of exercise on the body

Short term effects

When we begin to exercise the body has to respond to the change in activity level in order to maintain a constant internal environment (homeostasis). Here are the changes which must take place within the muscles, respiratory and circulatory system:

Circulatory System

- The release of adrenaline (often before exercise even begins) causes the heart rate to rise
- This increases Cardiac Output the volume of blood the heart pumps in a period of one minute increases from the typical 5 litres per minute, to up to 40 litres per minute, during strenuous exercise
- Venous return increases due to the higher Cardiac Output
- Increases in Lactic Acid (produced during the early anaerobic (without oxygen) phase of exercise), Carbon Dioxide (due to increased rates of energy production) and temperature all act as stimuli to the cardiac control centre which responds by further increasing the heart rate
- Oxygen levels within the blood decrease which causes increased diffusion at the lungs
- Blood pressure increases, thus increasing flow rate and the speed of delivery of oxygen and nutrients to the working muscles
- Vasodilation (opening of blood vessels) and vasoconstriction (constriction of blood vesels) ensure blood is directed to areas that need it (muscles, lungs, heart) and away from inactive organs
- Short-term changes in blood flow. At rest, the muscles require only about 15 to 20 per cent of the total amount of blood circulating through the body. During exercise the hardworking muscles demand more oxygen from the cardiovascular system, up to 80 per cent. In response, blood is shunted away from the digestive organs, kidney and liver and redirected to the skeletal muscles. Blood flow to the skin also increases. The blood vessels serving the skin dilate to allow more blood to the surface of the body. This helps to cool the body down during exercise
- Your blood pH the level of acidity in your blood becomes more acidic. Your body uses by-products of carbon dioxide to buffer the hydrogen ions in your bloodstream. Hydrogen ions are electrically charged particles in your body. The greater the number of hydrogen ions, the higher the acidity. Because you breathe faster during

cardiovascular exercise, you expel carbon dioxide faster than you would normally. This gives the hydrogen ions time to accumulate.

Respiratory System

- Changes in the concentration of carbon dioxide and oxygen in the blood are detected by the respiratory centre which increases the rate of breathing
- The intercostals (between the ribs) muscles, diaphragm and other muscle which aid the expansion of the thoracic cavity work harder to further increase the expansion during inhalation, to draw in more air.
- Respiration increases to provide oxygen and remove carbon dioxide, this will:
- Increase breathing rate by about three times the normal rate.
- increase tidal volume by five times the normal rate.
- increase blood supply to and through the lungs.
- increase oxygen up take.

Muscles

- The higher rate of muscle contraction depletes energy stores and so stimulates a higher rate of energy metabolism.
- The body's energy stores are slowly depleted
- Oxygen can now be diffused into the muscle from the capillaries more quickly due to the decreased oxygen concentration in the muscle.
- Increased circulatory flow
- Increased muscle pliability
- Greater range of motion
- Micro-tearing to the muscles
- Delayed onset muscle soreness (D.O.M.S)

During intense exercise the body's temperature rises. Messages are sent from the brain to the skin to make it sweat. Sweat is formed by sweat glands under the skin. Losing heat through sweating is caused by the evaporation of sweat from the skins surface. Blood is diverted to the capillaries just below the skin. This causes the skin to redden.

Blood pooling effect after exercise

When you exercise, blood is diverted from non-essential organs, such as those involved with your digestive and reproductive systems, and into your working muscles. This is termed blood pooling and ensures that your working muscles get as much oxygen as they need. Once you have finished your strenuous exercise, it is important to encourage the pooled blood to move out of the muscles and back into general circulation. This is commonly achieved by performing a cool-down consisting of light cardiovascular exercise and stretching. Blood left pooling in muscles is linked to the onset of post-exercise muscle soreness.

During exercise, your muscles aid the amount of blood returned to the heart by contracting with more force around the blood vessels. This causes the blood to easily resist the forces of gravity and return quickly to the heart for re-oxygenation and re-circulation. When you stop

exercising quickly, the muscles are no longer contracting against your blood vessels, gravity causes the blood to pool in the lower extremities. When this occurs, you may feel faint or dizzy or experience a loss of consciousness. The purpose of a brief cool-down after cardiovascular exercise is to slowly return your heart to its resting state. By slowly bringing your heart rate back down, you can avoid blood pooling in the lower extremities because the muscles of your legs are still contracting and contributing to venous return. A cool-down also helps to avoid rapid changes in blood pressure. Always engage in a 5-10 minute cool down of light cardiovascular exercise such as walking or cycling on a stationary bike.

Delayed onset muscle soreness (**DOMS**), also called muscle fever, is the pain and stiffness felt in muscles several hours to days after unaccustomed or strenuous exercise. The soreness is felt most strongly 24 to 72 hours after the exercise. It is thought to be caused by eccentric (lengthening) exercise, which causes micro-trauma (minor tears) to the muscle fibres. After such exercise, the muscle adapts rapidly to prevent muscle damage, and thereby soreness, if the exercise is repeated. Delayed onset muscle soreness is one symptom of exercise-induced muscle damage. The other is acute muscle soreness, which appears during and immediately after exercise.

Long term effects of exercise

Regular exercise results in adaptations to the circulatory, respiratory and muscular systems in order to help them perform better under additional stress. Here are the changes which must take place within the muscles, respiratory system and circulatory system:

Circulatory System

- The cardiac muscle surrounding the heart hypertrophies, resulting in thicker, stronger walls and therefore increases in heart volumes. The more blood pumped around the body per minute, the faster Oxygen is delivered to the working muscles.
- The number of red blood cells increases, improving the body's ability to transport oxygen to the muscles for aerobic energy production.
- The density of the capillary beds in the muscles and surrounding the heart and lungs increases as more branches develop. This allows more efficient gaseous exchange of Oxygen and Carbon Dioxide. Existing capillary's will also open wider
- The resting heart rate decreases in trained individuals due to the more efficient circulatory system.
- The accumulation of lactic acid is much lower during high-levels activity, due to the circulatory system providing more Oxygen and removing waste products faster.
- Arterial walls become more elastic which allows greater tolerance of changes in blood pressure.
- Blood pressure decreases by up to 10 mmHg. An mm Hg is a unit used for measuring pressure levels
- Blood volume increases. The body produces a greater number of red blood cells in order to keep the muscles supplied with oxygen during heavy exercise.

Respiratory System

- The respiratory muscles (Diaphragm/intercostals) increase in strength.
- This results in larger respiratory volumes, which allows more Oxygen to be diffused into the blood flow (VO2 max)
- An increase in the number and diameter of capillaries surrounding the alveoli leads to an increase in the efficiency of gaseous exchange.
- Increased ventilation
- Elevated oxygen diffusion rate

Muscle

- Increased numbers of mitochondria (the cells powerhouse) means an increase in the rate of energy production.
- The muscles, bones and ligaments become stronger to cope with the additional stresses and impact put through them.
- The amount of myoglobin within skeletal muscle increases, which allows more Oxygen to be stored within the muscle, and transported to the mitochondria.
- Muscles are capable of storing a larger amount of glycogen for energy.
- Enzymes involved in energy production become more concentrated and efficient to aid the speed of metabolism.

Skeletal system

- Bone calcium increases
- Synovial fluid increases, the movement of joints stimulates the secretion of synovial fluid. With regular exercise this becomes les viscous (more fluid) and the range of movement at the joint increases as connective tissue around the joint improves its flexibility.
- Ligaments increase their ability to cope with loads through the increase in collagen fibres which are produced by fibroblasts (cells within the connective tissue of the ligament)
- Hyaline cartilage - this is the cartilage that cover the ends of bones, also called Articular cartilage, which protects them. Regular exercise can increase its thickness.
- Increase in bone strength and density

Energy systems

- Increased aerobic and anaerobic enzymes
- Elevation of fat usage as an energy source