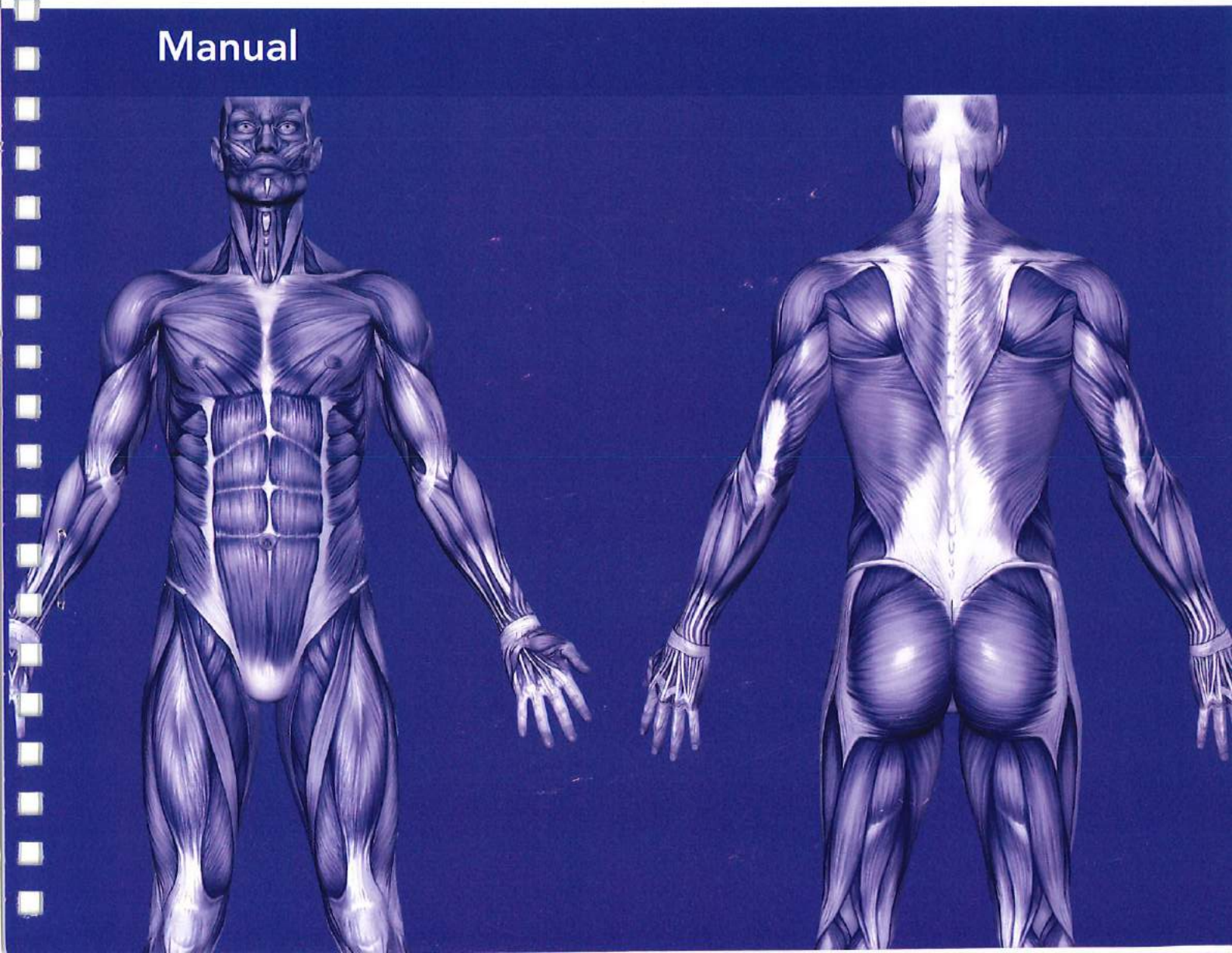
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Level 2 Mandatory Units

Manual



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Manual
Level 2 Mandatory Units

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Anatomy and physiology for exercise

Introduction

This unit explores anatomy and physiology for exercise, covering: the structure and function of the skeleton, muscles and muscle actions, energy systems, the cardiorespiratory system and the nervous system, within each of the sub sections listed above the implications for special populations are examined.

Bones and joints

Introduction

In this section, we will look at the structure and function of bones and joints in the skeleton, as well as how shape and structure (ie, form) relates to how this part of the body works (ie, function).

The aim of this section is to understand how the skeletal framework is constructed and how the joints allow specific ranges of movement.

Objectives

By the end of this section, the learner should be able to:

- describe the basic function of the skeleton
- identify the structures of the axial skeleton
- identify the structures of the appendicular skeleton
- explain the classification of bones
- explain the structure of a long bone
- explain the stages of bone growth
- describe posture, in terms of: curves of the spine, neutral spine alignment, potential ranges of motion of the spine and postural deviations
- describe the classifications of joints
- describe the structure of synovial joints
- describe the types of synovial joint and their range of motion
- describe joint movement potential and joint actions.

Overview of the skeleton

The framework of the human body is constructed of bones, joints and cartilage and is called the skeletal system.

Without this framework, we would be unable to perform movements such as walking, squatting or any type of exercise.

Skeleton structure

The human body is made up of 206 bones, this section will focus on only about 30 of these, which are the major bones associated with the spine and the upper and lower limbs.

The skeleton is divided into two parts:

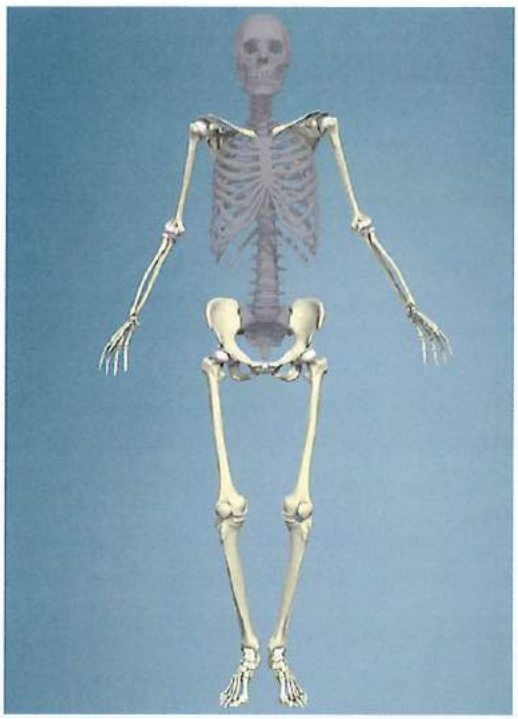
1. axial skeleton – the skull, ribs, sternum and spine (un-shaded area in left-hand image)
2. appendicular skeleton – upper and lower limbs, plus the bones forming the 'girdles' (un-shaded area in the right-hand image), which connect the limbs to the axial skeleton. These girdles are the pelvic (hip) girdle and the pectoral (shoulder) girdle.

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1. Axial skeleton



2. Appendicular skeleton



Skeleton functions

The skeleton has five main functions.

1. Movement – the skeleton provides a series of independently movable long bones that act as levers. Muscles attach via tendons to these bones and when they contract, they pull on the bones/levers, causing movement.

2. Storage – bones serve as storage areas for mineral salts, such as calcium and magnesium phosphate, both of which are essential for bone growth and health. Bone owes its hardness (ie, compression strength) to these mineral deposits. A deficiency in these minerals can contribute to the bones becoming weaker and brittle (a condition known as osteoporosis).

3. Protection – the skeleton protects the delicate internal structures and vital organs. For example, the skull protects the brain, the ribcage protects the heart and lungs, the vertebral column protects the spinal cord that runs down the middle of it and the pelvis protects the abdominal and reproductive organs.

4. Shape/structure – the skeleton gives the body its characteristic shape and provides a framework for attachment of muscles to the body. There are three main body types, or somatotypes, each with its own characteristics. They include:

   - ectomorph – typically tall and thin, with narrow shoulders, hips and chest
   - endomorph – rounded appearance, with wide hips and narrow shoulders
   - mesomorph – muscular physique, with wide shoulders and narrow hips.

   Note: Somatotypes are looked at again in the 'Principles of exercise, fitness and health' chapter.

5. Production – the bone marrow that is contained within certain bones constantly produces red and white blood cells.

   Red blood cells contain haemoglobin, which facilitates gaseous exchange, the exchange of oxygen and carbon dioxide.

   White blood cells are dedicated to defending the body against infection, disease and foreign materials.

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Gender differences of the skeleton

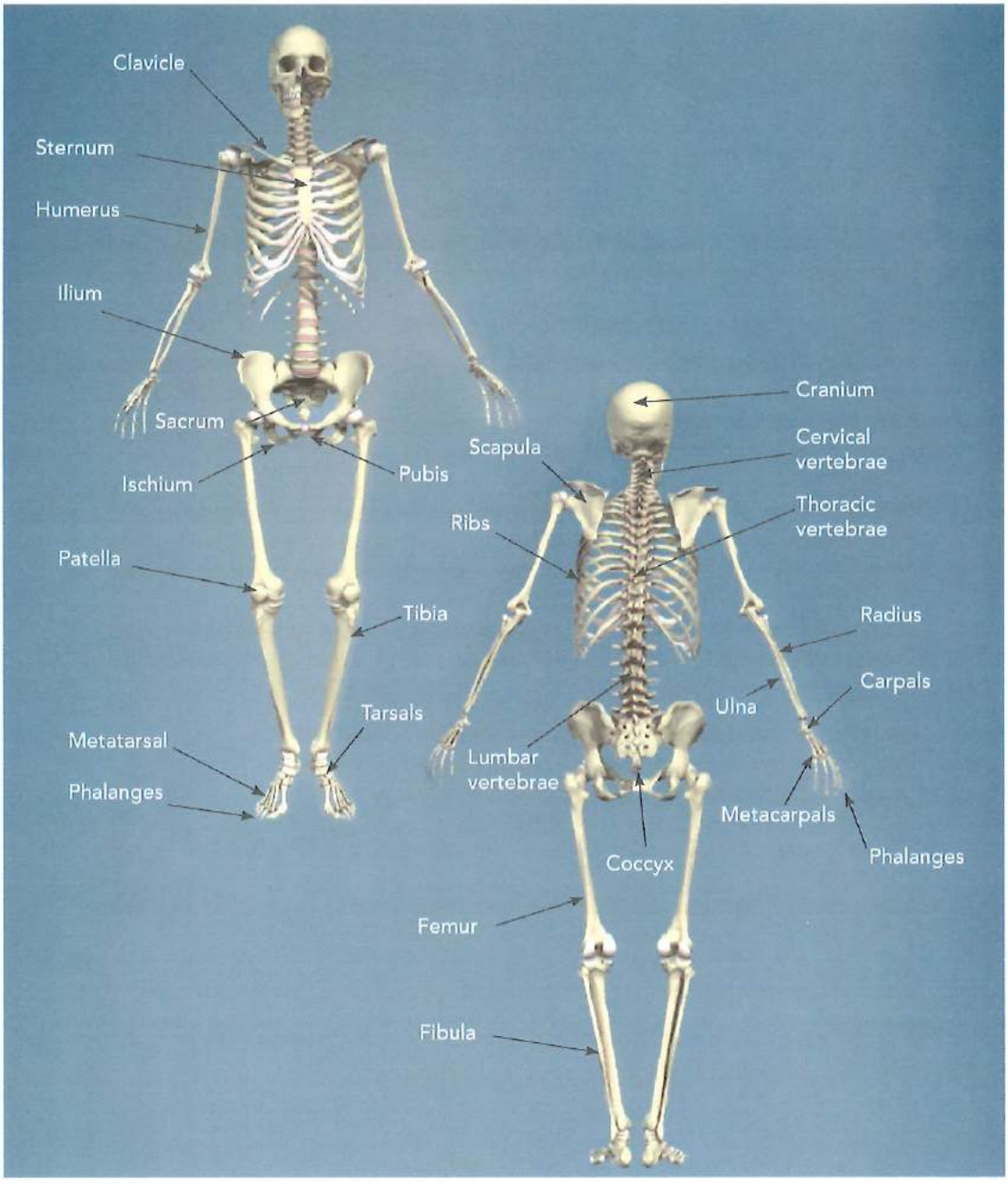
There are only minor differences between the male and female skeleton. Generally, male bones tend to be heavier than the corresponding bones of females. Commonly, females have a greater carrying angle at the elbow joint, a smaller femoral head at the hip joint and a wider pelvis to accommodate childbirth.

While the alignment of the female pelvis is necessary for childbirth, it is not the best alignment for performing exercises involving the legs. This is because a wide pelvis makes the position of the hip joints wide, which makes the femurs slope inwards to compensate. This wider pelvis and alignment of the knees may cause the knees to roll inwards during some exercises. This angle between the hip joints and the knees is often referred to as the 'Q angle'. In contrast, the narrower male pelvis allows more vertical femurs – an alignment that is much more efficient for leg exercises.

The main structures of the skeleton and their characteristics

The major bones

The images on this page illustrate the major bones in the skeleton.



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The main structures of the skeleton are:

- pectoral, or shoulder, girdle
- upper limbs
- pelvic, or hip, girdle
- lower limbs
- vertebral column, or spine.

The pectoral, or shoulder, girdle

The pectoral, or shoulder, girdle is composed of a double set of two bones on the right and left sides of the body. The clavicles are slender, doubly curved long bones that run horizontally across the upper chest and can be felt just below the neck.

Try this ...

Run your fingers along the base of your neck. There you can feel the clavicles running horizontally.



Each clavicle articulates with a scapula in a gliding synovial joint at the shoulder. They also articulate with the sternum in the chest to form a synovial saddle joint, the joint has a cartilaginous disc that absorbs considerable stress (eg, when falling on the shoulder). In fact, this joint is so strong that the clavicle itself is much more likely to break than the joint dislocate.

The scapulae are roughly triangular-shaped, thin flat bones that partially cover the back of ribs 2–7. The posterior surface of each scapula has a raised ridge along its length that ends in a large bony process called the acromion process. This articulates with the clavicle and is called the acromio clavicular joint (AC joint). It can be felt at the top of the shoulder and is the point of contact of each scapula with the rest of the central skeleton.

Each scapula is anchored in place by the many muscles of the back and shoulder joint, giving incredible mobility to the whole shoulder girdle and the associated upper limbs.

The diagram shows that there is a depression – the glenoid cavity – laterally at the top of the scapula. This forms the socket that the head of the humerus fits into, forming a synovial ball and socket joint.

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The shoulder girdle and upper limb

Clavicle



This bone gets its name from the Latin word clavicula (meaning little key) because the bone rotates along its axis like a key when the shoulder is abducted (arm lifted out to the side). This is the most commonly broken bone in the body.

Scapula



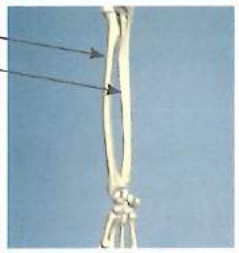
This is often referred to as the shoulder blade and has two unique motions – first, it moves sideways around the ribs in the protraction and retraction movements and second, it rotates in the abduction and adduction movements.

Humerus



This upper arm bone is pronounced in the same way as the word 'humorous' (as in 'funny') – and it is the ulna nerve running down to the elbow that can be knocked and is described as hitting the 'funny bone'.

Radius and ulna



The radius is named after the round, disc-like head that connects it to the humerus. This round head of the radius rotates (or pivots) at the elbow to enable the body to perform palm-up and palm-down motion without any movement at the elbow. Try this: hold your arms out in front with your palms down, so that the 'u'lna sits 'u'nderneath the palm radius. The radius rotates to turn the hand over. The ulna only flexes and extends, because it is a hinge joint.

Carpals



Try remembering these as the little 'c'luster of 'c'arpal bones lying between the wrist and fingers. The number of bones and flexibility between these bones makes human hands very flexible.

Meta carpals

Meta is the Greek word for 'after' or beyond — and the 'meta' carpals come 'after' the carpals. It is easy to confuse carpals and metacarpals (in the hands) with tarsals and metatarsals (which are equivalent bones of the feet), just remember that 't'oes go with 't'arsals). The large number of bones and joints in the hands and feet means that these structures are extremely flexible and offer great dexterity.

Phalanges

These are the small bones at the ends of the fingers after the metacarpals.

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The pelvic, or hip, girdle

The pelvic girdle has the same function as the shoulder girdle. However, because the pelvis supports the weight-bearing lower limbs, this joint must provide greater stability. The trade-off for this stability is a reduced range of motion, particularly at the ball and socket hip joint, when compared with the ball and socket joint at the shoulder.

The female pelvis is a slightly different shape to the male pelvis. This is the most significant difference between the skeletons of women and men. The female skeleton is designed primarily to allow for childbirth, so the hole in the middle of the pelvic bones is slightly wider than the male and the gap filled by the cartilage of the pubis symphysis is also bigger.

The pelvic girdle and lower limbs		
Pelvis		Comprising two upper hip bones (ilium) connected at the back with the sacrum and at the front with the pubis symphysis (a small piece of cartilage that joins the two halves) and the ischium in the lower pelvis. Functionally, it is the primary means of transmitting the body's weight to the lower extremities.
Femur (thigh bone, upper leg)		The femur (thigh bone) has a ball and socket joint at the junction with the pelvis and a hinge joint at the junction with the knee. The socket is much deeper than that of the shoulder, which means that it is much more stable. This is an important feature, given its weight-bearing function.
Tibia and fibula (lower leg)		The brother and sister of the lower leg (just like the ulna and radius in the lower arm), the two bones are called the tibia and fibula. The fibula is commonly broken in sport because it is a relatively thin bone in comparison to the tibia. It also lies on the outside of the leg and so is particularly vulnerable in sports where there is contact with the lower limb, such as football and kickboxing.
Tarsals		Similar to the little cluster of bones in the hand (carpals), this is the little cluster of bones in the foot (tarsals). These bones allow great flexibility in the foot (eg, being able to walk on pebbles).
Meta-tarsals		Again, similar to the hand bones (metacarpals), the meta't'arsals are found in the 't'oes.
Phalanges		These are the small bones at the end of the metatarsals.

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The vertebral column, or spine

The spine is the main foundation or starting point in the framework of the body. The head sits on top of this column and the ribs surround it, protecting the organs inside.

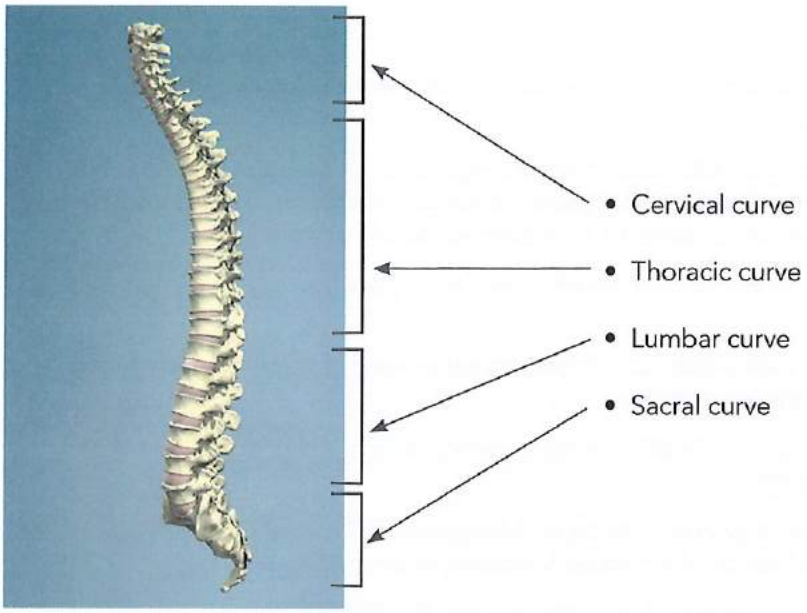
The shoulder girdles are suspended from this framework and lead into the arms. At the bottom of the spine is the pelvis, which leads down to the lower limbs. The vertebral column is made up of individual bones called vertebrae. The names of the vertebrae indicate their location along the length of the vertebral column. There are 33 vertebrae in total.

The vertebral column, or spine			
Cervical vertebrae (7 bones)			Situated in the neck, the first vertebra is called the atlas bone. The atlas bone supports the skull and forms a pivot joint with the second vertebrae, which is called the axis. This pivot joint allows us to turn our heads from side to side.
Thoracic vertebrae (12 bones)			The 12 thoracic vertebrae form joints with the ribs to produce the ribcage, which protects the heart and lungs, as well as the abdominal organs, from injury. They are intermediate in size between those in the cervical and lumbar regions and they get larger as they progress down the spine.
Lumbar vertebrae (5 bones)			These vertebrae are largest of all. This area is most often the culprit in lower back pain, due to the amount of movement that takes place here.
Sacral vertebrae (5 bones fused) Coccygeal (pronounced 'coxygeal')			The sacral vertebrae are fused to form the sacrum, which joins together the two halves of the pelvis. The coccyx is represented by 3–5 vertebrae, which are themselves fused and attached to the bottom of the sacrum.

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Anatomy of the normal spine

A 'normal' spine has four natural curves, which are named after the vertebrae that form them.



These curves centre the skull over the rest of the body, enabling a person to walk more easily and maintain an upright posture. They also reduce the amount of impact through the skeleton by dispersing shock and protecting the brain from shock waves that occur from movement.

The spine is a flexible structure that affords the following movements:

- flexion and extension
- rotation
- lateral flexion and lateral extension.

The various sections of the spine produces the following movements in varying degrees, as follows:

- cervical – the most mobile part of the spine
- thoracic – less mobile than the cervical
- lumbar – very limited range of movement
- sacral – no movement possible
- coccyx – no movement possible.

Structure of the spine

Each vertebra has a hole in the body of the bone to allow the spinal cord to pass through. One of the central roles of the bones of the vertebral column is to protect the spinal cord.

In between each vertebral body lies an intervertebral disc (we have super-imposed a disc in the right-hand picture). In the middle of each intervertebral disc is a soft, jelly-like nucleus. As well as preventing the vertebrae from rubbing against each other, this disc also acts as a shock-absorber against the impact of daily activities.

Single vertebral body



Spinal cord



Vertebral column



Intervertebral disc



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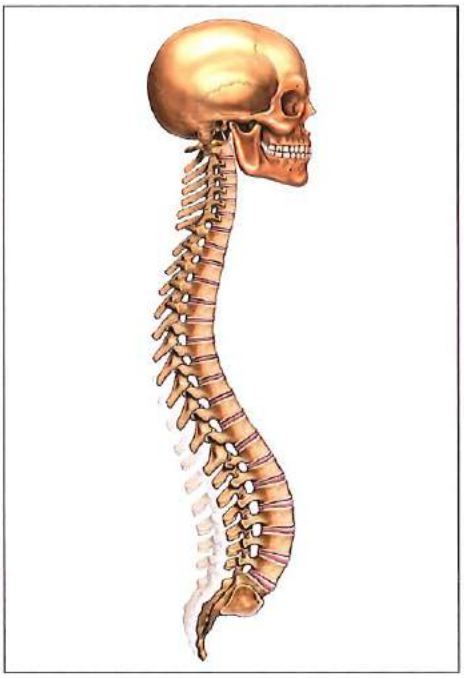
Exaggerated curvatures of the spine

Genetics and lifestyle factors can cause curvature of the spine to become exaggerated or excessive, which gives a distorted appearance to an individual's posture. This, in turn, may lead to additional problems and symptoms, in the form of stiffness, tenderness, back pain and a lack of mobility. Factors relating to spine curvature include:

- fashion (eg, high heels): this can cause shortening of the calf muscles, hamstrings and increased curvature of the lower spine (lordosis)
- work/school (eg, poor positioning of work desk and chair, driving, poor positioning while operating a checkout or computer, carrying heavy bags, etc.): these activites can stretch the upper back muscles and shorten the upper chest muscles, which leads to an increased 'hunch' or kyphosis
- emotional state: lack of confidence, stress, low self-esteem, etc. may affect the way an individual holds their posture
- sport: sports such as golf, tennis or rowing may lead to over development of certain muscle groups on one side of the body, thereby affecting posture
- hereditary conditions: conditions such as scoliosis may be inherited, as may other conditions that affect muscles (eg, muscular dystrophy)
- injuries: soft tissue strains and sprains may lead to changes in posture. The development of scar tissue may reduce flexibility of muscles and range of movement, leading to postural changes
- age: growth spurts, puberty, the menopause and osteoporosis can all affect connective tissue and bone structure, which may affect posture
- pregnancy: the weight of the baby, increasing body size and relaxing of spinal ligaments can lead to an exaggeration of spinal curvature during pregnancy
- disability: some factors of an individual's disability can lead to poor posture
- obesity: distribution of body fat on certain parts of body and increasing body size can affect the shape of the spine.

Note: Any exaggerated curvatures of the spine are referred to as kyphosis, lordosis or scoliosis, depending on the direction of the curve. Each condition is characterised by a distinct spinal curvature.

Lordosis



This is an exaggerated inward curvature of the lumbar spine that gives the lower back a hollowed appearance and can sometimes make the buttocks appear more prominent.

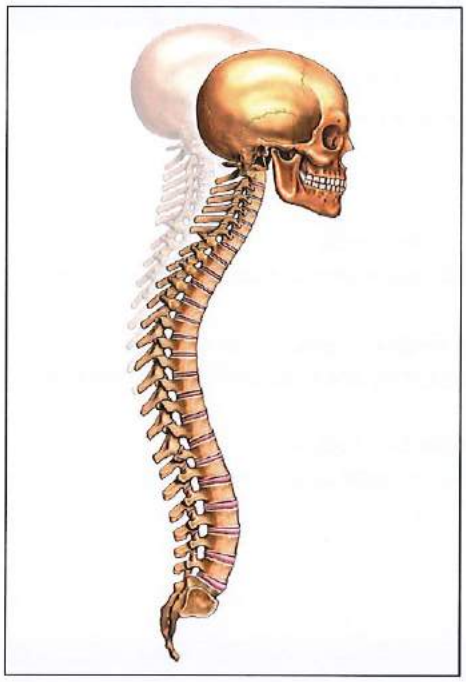
Lordosis can be caused by poor posture, and can also be brought about by development problems during childhood or pregnancy.

A number of muscles are affected by lordosis.
These muscles include:

- erector spinae (shortened)
- gluteus maximus (lengthened)
- hamstrings (usually overactive to substitute for weaker gluteals)
- hip flexors (shortened)
- transverse abdominis (weakened)
- rectus abdominis (lengthened).

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Kyphosis



Kyphosis is where an individual has an exaggerated rounding or hump in the thoracic vertebrae, giving a slouched appearance, often with the head jutting forwards.

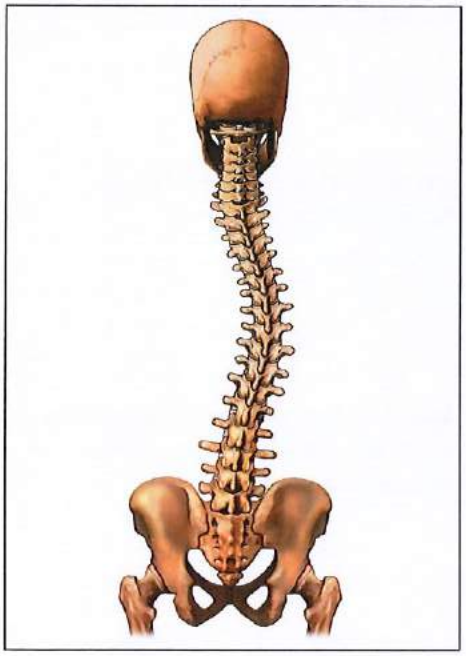
This may result from a variety of causes, such as:

- genetics
- lifestyle factors that have led to bad posture (eg, sitting for long periods of time with bad posture in front of a computer)
- structural deformity of the spine that may occur at birth (a congenital defect) or as a result of degenerative disease, such as arthritis or prolapsed discs.

Whatever the cause of the kyphosis, the result is excessively shortened or lengthened muscles in the front and back of the upper body. The main muscles affected include:

- pectorals (shortened)
- trapezius (lower and middle sections lengthened, upper section shortened)
- rhomboids (lengthened).

Scoliosis



Scoliosis is a lateral, or sideways, curvature of the spine. It gives the appearance of an S-shape, rather than a straight line, when observed from the front or the back. Some of the bones in the spine may also rotate slightly, giving the appearance of unevenness in the waist or the shoulder.

Scoliosis is most commonly caused by a congenital defect (ie, something one is born with), but at times it can result from poor posture. This type of posture is not easy to correct and would require working with a specialist such as a physiotherapist rather than an exercise instructor.

Key points of the skeleton

- The skeleton is divided into two parts: the axial skeleton (skull, ribs and spine) and the appendicular skeleton (upper and lower limbs, and the bones of the shoulder and hip girdles).
- The main functions of the skeletal system are movement, shape, protection, mineral storage and blood cell production.
- Joints connect bones and are held together by connective tissue, which is vulnerable to hormonal influences during pregnancy and the menopause.
- The spine is a flexible column of 33 individual bones, comprising 7 cervical, 12 thoracic, 5 lumbar, 5 (fused) sacral bones and 4 (fused) coccygeal bones.
- Normal cervical, thoracic and lumbar curvatures of the spine are affected by genetics and lifestyle factors, which can exaggerate the curve.

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Bone

Bone is a type of connective tissue. Connective tissue comes in all sorts of shapes and sizes. It is defined as a tissue that connects, supports, binds or separates other tissues or organs.

The main types of connective tissue are:

- bone – bone has a compact part in the middle and a spongy part at the ends
- connective tissue (such as ligaments and tendons) – the collagen fibres that make up these structures are well organised and can withstand a lot of force
- cartilage – there are different types of cartilage. The cartilage that lines the end of the joints is a network of fibres, tougher than those of ligaments and tendons and they are embedded in a gel-like substance that also makes them good at absorbing shock
- blood – strange though it might seem, blood is also a type of connective tissue
- lymph – a type of connective tissue that is an important part of the immune system circulating disease-fighting cells.

Types of bone

Bones can be classified into the following five types:		
Long bones		Long bones have greater length than width and are slightly curved for strength, which helps to absorb the stress of the body. Examples of long bones include the femur and tibia.
Short bones		Short bones are somewhat cube-shaped and nearly equal in length and width. Examples include the carpals (wrist).
Flat bones		Flat bones are generally thin and afford considerable protection for internal organs and extensive areas for muscle attachment. Examples include the pelvis and sternum.
Irregular bones		Irregular bones have complex shapes. Examples include the bones of the spinal column and certain facial bones.
Sesamoid bones		Sesamoid bones are bones that are embedded in a tendon. Examples include the patella.

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Bone growth

Bone is a living tissue with its own blood supply and is constantly being reshaped and remodelled.

Birth to age 25 (approximately)

When a human being is conceived, groups of cells crowd together in the shape of a bone and secrete a cartilage matrix. Just eight weeks after conception, the main bones have already formed in cartilage and connective tissue membranes. In the middle of these cartilage 'bones', some of the cells expand in size and then burst. The cell contents stimulate the cartilage on the outside to turn into bones. This makes it harder for nutrients to get into the bone, causing the cells inside start to die and form small cavities in the middle of the bone. A nutrient artery penetrates the bone, bringing blood and nutrients into the disintegrating cartilage (nutrients such as calcium give the bone resilience, and magnesium gives the bone its hardness). These nutrients 'wake up' the bone-building cells (osteoblasts), which start laying down a bone matrix over what is left of the cartilage. As the process continues to the end of the bone, bone-clearers, called osteoclasts, start to clear up this matrix in the middle of the bone, creating a cavity for bone marrow. They achieve this thanks to an epiphyseal plate (growth plate), which is a highly active area of cartilage and bone manufacture. There is an epiphyseal plate at each end of the bone. This plate is surrounded by several active cells. On one side of the plate (nearest the end of the bone), cartilage is constantly being produced. On the other side of the plate (the one nearest the centre of the bone), osteoblasts are laying down bone matrix on top of this cartilage. This whole process just keeps moving forwards, with calcified bone being cleared up by the osteoclasts behind and the osteoblasts constantly building new bone over the new cartilage. The result is that the bone is continually growing. Long bones continue to grow until around age 18 but keep maturing until approximately the age of 25. The epiphyseal plate then fades, leaving a bony structure called the epiphyseal line. When this line appears, it shows that the bone has stopped growing. This process is known as ossification.

Remodelling

Throughout our lives, osteoclasts (bone-clearers) remove old bone and osteoblasts (bone-builders) lay down new bone tissue. Bone growth, development and remodelling are dependent on the balanced action between these two cells. Weight-bearing physical activity is a very important part of this process because the bones respond to the pulling effects of the muscles by laying down new bone. This means that the body is very cleverly and constantly adapting to its needs. Long periods of non-weight-bearing activity, as in older age or periods of inactivity due to a fall or injury, mean that the bone is not being stimulated to lay down new bone, and therefore can become more fragile.

As weight-bearing activity is the key to this process, activities such as swimming and cycling, in which the body is supported by the water or bicycle, are less effective.

Factors affecting bone growth and remodelling

Growth spurts

Growth spurts are times when bone growth quickens due to an increase in hormonal activity. Growing pains are often experienced at this time, as muscles, ligaments and tendons are a little slower to adapt to the changes in size. Co-ordination can also be affected at this time, as a child may have biomechanical problems adapting to their change in size. The significance of this is that growing bone is vulnerable to damage. Excessive exercise of the wrong type in childhood can therefore be very damaging to the development of the skeleton.

Older age

As we get older, minerals tend to be lost in the bones and we may start to suffer from a degenerative process called osteoporosis, in which the bones begin to get thinner and more fragile. One of the main causes of osteoporosis is a reduction in the amount of the hormone oestrogen in the body, which can lead to bone demineralisation, or osteoporosis.

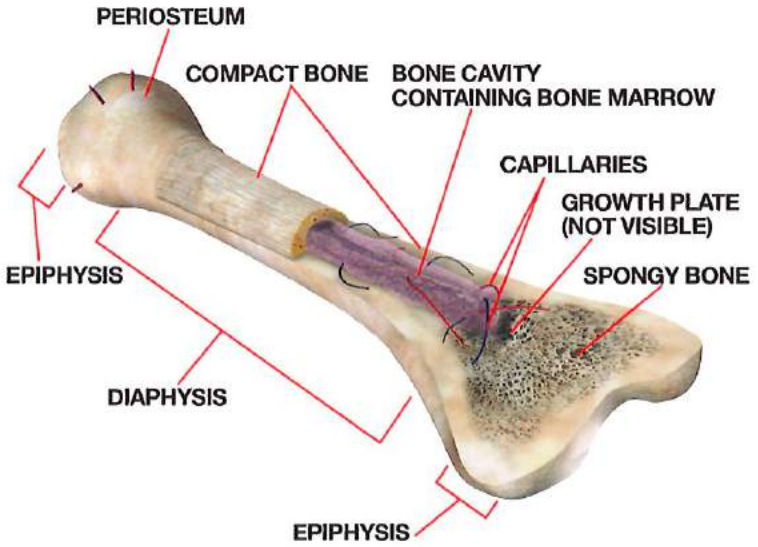
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Diet

Calcium has a vital role in the body, as it is used, among other purposes, in muscle contractions and in the sending of nerve signals around the body. When calcium levels drop in the body, this is instead taken from the bone, which may result in a weakening of the bone. It is therefore essential that adequate levels of calcium are included in the diet. Vitamin D is also needed, as without it, calcium cannot be absorbed into the body.

Bone structure

A long bone comprises:



- diaphysis – shaft of the bone, made of compact bone, dense and very strong
- periosteum – a hard, protective fibrous sheath around the bone (but not over the ends). It contains a rich supply of blood vessels that brings nutrients for bone cells and takes away waste matter
- epiphysis – the ends of the bone made of cancellous, or spongy, bone tissue designed to withstand compression forces
- epiphyseal plates (growth plates) – these separate the shaft from the ends of the bone. These are the areas of growing tissue in children and adolescents and are the weakest areas of the growing skeleton. When growth is complete, the growth plates close and are replaced with solid bone. They remain vulnerable to damage until this time
- medullary cavity (middle of the bone) – this contains bone marrow (site of production of red and white blood cells)
- capillaries – supply blood to all parts of the bone
- articular cartilage – covers the top of each epiphysis. It is tough, smooth and helps to reduce friction between the bones, as well as providing shock absorption for the joint.

Including weight-bearing exercise as part of a programme for those vulnerable to bone thinning (such as the older adult, after periods of inactivity and those with disabilities) can increase bone density and offset some of the bone changes that come with old age and other conditions. It is worth noting that osteoporosis can also occur in girls, particularly if they have inadequate nutrition or overtrain, which can cause them to miss menstrual cycles.

Key points of bone

- There are various types of bone, including: long, short, flat, irregular and sesamoid.
- Bone growth results from a process called ossification, which is not completed until around the age of 25.
- Bone remodelling happens throughout life. It is stimulated by weight-bearing activity and affected by several factors, such as growth spurts, older age, diet, hormonal status, injury and disability.
- Long bones have a diaphysis, periosteum, epiphysis, epiphyseal plates, medullary cavity, capillaries and articular cartilage.
- Regular weight-bearing activity can increase bone density and help to offset the natural decrease in bone density that occurs with age.

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Joints

Joints form the connection between bones. A joint, or articulation, occurs where a bone meets a bone and are connected and held together by connective tissue.

Connective tissue

Ligaments – these attach bones to bones. Ligaments play a key role in stabilising joints. Over stretching of the ligaments is described as a 'sprain'.

Tendons – these attach muscles to bones. Over stretching of muscles and tendons is described as a 'strain'.

Cartilage

Cartilage lines the ends of the bones in the joint area and prevents them from rubbing against each other and wearing bones down. Cartilage also provides shock-absorption, particularly in the lower limb joints.

Note: It should be noted that hormonal influences during pregnancy and the menopause have an effect on connective tissue.

The joint is given stability by a number of factors, including the joint capsule, the surrounding ligaments whose job is to bind bone with bone and the nearby muscles and tendons.

A sound understanding of joint structure, as well as the factors that influence joint mobility, is essential for the practice of safe and effective exercise.

How the components fit together

When a muscle contracts (shortens), it pulls on the tendon attached to the bone and creates movement. If humans didn't have skeletons, our bodies would be just blobs of muscle and fat and we would be unable to move.

Joints come in three basic types:

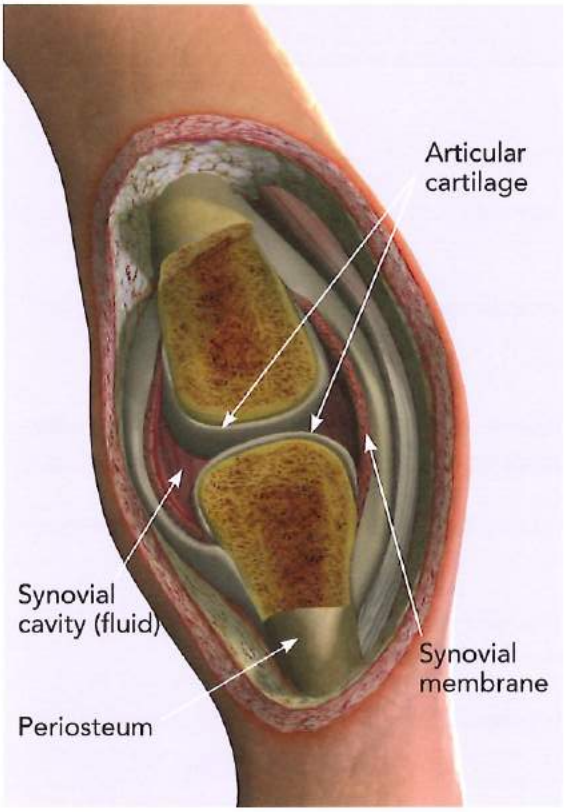
1. Immovable (fibrous) joints – where bones are joined together by fibrous connective tissue. An example of this type of joint are the bones of the skull, which are given added connective strength by the dove-tailed edges.

2. Slightly movable (cartilaginous) joints – where the bones are tightly connected by cartilage or fibrous cartilage. Good examples of this type of joint are the connections between the vertebrae and also the pubis symphysis, which joins the two halves of the pelvic bones.

3. Freely movable (synovial) joints – where the ends of the bones are covered with cartilage and are connected by a fibrous capsule. Inside the capsule is a synovial membrane. This is the most common type of joint, and examples include the hip and shoulder joints.

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Synovial joints



As synovial joints are the joint type you will come across most, it is important to explore this joint type in more detail.

A synovial joint is surrounded by a sleeve-like capsule (referred to as the 'joint capsule') that encloses the joint cavity and is attached to the outside of the bone (periosteum). The inner layer of the joint capsule is formed by a synovial membrane, which secretes synovial fluid. This fluid helps to lubricate the joint and provides nourishment for the articular cartilage on the ends of the bones. Cartilage is a tough, smooth tissue that helps to reduce friction between the bones and provides shock-absorption to the joint.

Types of synovial joint

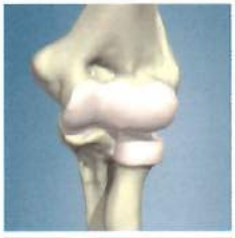
There are six types of freely movable (synovial) joint:



1. Gliding joint – where movement is over relatively flat surfaces (eg, the carpals, tarsals and the AC joint in the shoulder).



2. Hinge joint – where movement is possible in one plane only (eg, the elbow or knee).



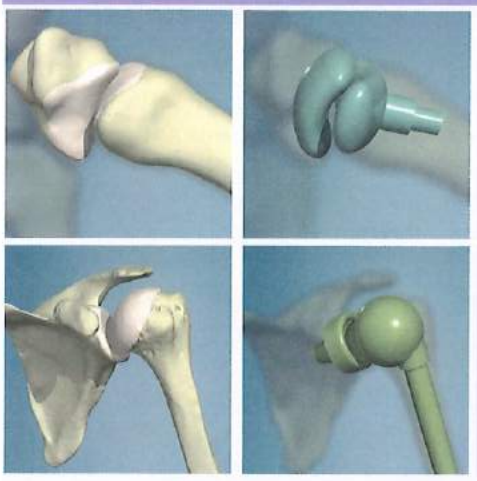
3. Pivot joint – where movement is purely rotational (eg, the articulation of the radius and the ulna allow the body to pronate and supinate the forearm as the bones rotate around each other).



4. Condyloid joint – where movement occurs in two planes (eg, in the wrist between the ulna, radius and carpals).

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Types of synovial joint



5. Saddle joint – similar to a condyloid joint but the surfaces are concave and convex (eg, at the base of the thumb).
6. Ball and socket joint – where movement occurs in three dimensions (eg, in the shoulder and hip joints).

Special populations and joints

Children

Growing bone is not completely ossified until early adulthood, making it vulnerable to damage. Common fractures and tears can occur through heavy, strenuous or highly repetitive exercise. These could not only affect the growth and development of the bone, but also the stability of the joints.

Pregnancy

It should be noted that during pregnancy the effects of the hormone relaxin will have a significant effect on the stability of synovial joints. Joints will have a greater range of movement than normal and will be less stable. The less stable joint combined with a decrease in motor skills (caused by a change in the centre of gravity) will necessitate an avoidance of high-impact and quick-twisting movements. It should be noted that many of the physiological changes of pregnancy can remain for up to six months after childbirth. It is therefore advisable to re-introduce regular, more vigorous training gradually.

Ageing

With age, changes occur in the bones, joints and connective tissue. Decreasing levels of the hormone oestrogen (in females) and increased inactivity can both affect bone remodelling. The articular cartilage becomes thinner. Changes to the synovial membrane occur and secretion of synovial fluid, which lubricates the joint, diminishes. Ligaments tend to shorten and lose some flexibility. Tendons become weak, less elastic and lose their ability to withstand excessive stress. Overall, joints become stiffer and less flexible with age. It should be noted that one of the key long-term joint adaptations to exercise is an increase in the strength of ligaments and tendons, which can help to offset these inevitable changes.

Disability

Individuals with disabilities may have limitations specific to their disability, and these should be carefully considered prior to exercising.

Key points of joints

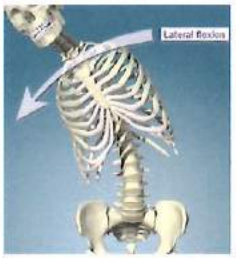
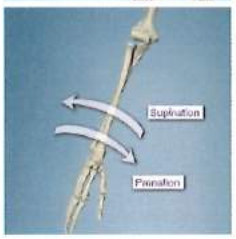
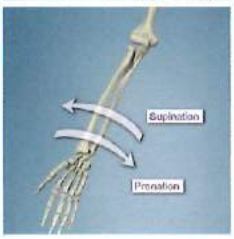
- There are three basic types of joint: immovable/fibrous, slightly moveable/cartilaginous and freely movable/synovial.
- Synovial joints comprise: a joint capsule, synovial membrane, synovial fluid and articular cartilage.
- There are six types of synovial joint: gliding, hinge, pivot, condyloid, saddle, and ball and socket.
- Long-term exercise can increase the strength of ligaments and tendons, thereby making the joint more stable.
- There are specific changes to the joints that should be considered for special populations.

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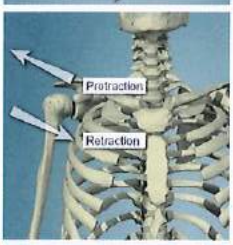
Joint movements

To perform exercises in a safe and effective manner, it is important to understand what movements are possible at specific joints. Joint movements are determined from the standard anatomical position. This position is assumed when standing erect with the feet and palms facing forwards and arms at the side.

For most movement, there is a corresponding opposite movement (eg, flexion decreases the angle at the joint, while extension increases it). The table below covers all the main movement terms.

Joint movement terms			
	**Flexion** To reduce the angle at the joint or to bend a limb (eg, bending the arm at the elbow)		**Extension** To return from flexion, increase the angle at the joint or to straighten a limb (eg, extending the arm or straightening the leg)
	**Elevation** To lift or raise a joint (eg, lifting the shoulders)		**Depression** To drop or lower a joint (eg, dropping down the shoulders)
	**Adduction** To bring towards or across the midline of the body (eg, drawing the leg across the body)		**Abduction** To take away from the midline of the body (eg, raising the arm or leg out to the side)
	**Lateral flexion** To bend sideways with the trunk or neck (eg, standing side bends or tilting the head)		**Lateral extension** To straighten from a sideways bending movement (eg, returning to the natural, upright anatomical position after performing a side bend of the trunk)
	**Horizontal flexion** A forward movement in a horizontal plane (eg, drawing the arm across the body as in a pec dec exercise)		**Horizontal extension** A backward movement in a horizontal plane (eg, swinging the arm away from the body)
	**Pronation** To turn the palm down		**Supination** To turn the palm up

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Joint movement terms			
	Plantar flexion To point the toes away from the body (eg, upward movement of a standing calf raise)		Dorsi flexion To pull the toes towards the body (eg, digging the heel in the ground)
	Protraction The shoulders are drawn forwards, rounding the shoulders		Retraction The shoulders are drawn back, as if to pull the shoulder blades as close together as possible and push the chest forward
	Rotation A rotary movement, turning the thoracic spine to the side as in trunk twists		Circumduction Circular movement of the body (eg, with the arm)

Anatomical terminology

To distinguish between different parts of the anatomy, it is useful to know the standard terms used to identify certain positions or body areas. Some of these terms are found within the names of muscles and body areas, thereby giving some direction as to where they are.

Most common anatomical terminology	
1. Anterior	an anatomical term associated with the front of the body (eg, the quadriceps are anterior muscles, as they are at the front part of the thigh).
2. Posterior	an anatomical term associated with the back of the body (eg, the hamstrings are a posterior muscle, as they are at the back part of the thigh).
3. Superior	an anatomical term associated with the upper part of the body (eg, the superior vena cava returns the blood to the heart from the upper half of the body).
4. Inferior	an anatomical term associated with the lower part of the body (eg, the inferior vena cava returns blood to the heart from the lower half of the body).
5. Medial	an anatomical term associated with the inside part of the body, or towards the midline (eg, the vastus medialis is the middle muscle of the quadriceps).
6. Lateral	an anatomical term associated with the outside part of the body, or away from the midline (eg, the vastus lateralis is the outside muscle of the quadriceps).
7. Distal	an anatomical term associated with the parts of the body farthest away from the trunk (eg, the knee is more distal than the hip).
8. Proximal	an anatomical term associated with the parts of the body closest to the trunk (eg, the ankle is more proximal than the toes).
9. Superficial	an anatomical term associated with the parts closer to the surface of the body (eg, the rectus abdominis is a superficial muscle, as it is close to the surface).
10. Deep	an anatomical term associated with the parts farthest away from the surface of the body (eg, the transverse abdominis muscle).

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Standard anatomical position

It is also important to use standard terms when describing body movements. Movements are always defined from the same starting point, known as the standard anatomical position. In this position, a person is standing straight, with the feet facing forwards, palms facing forwards and arms by the sides of the body. When working through the individual joint movements, it is important to remember that they all start from this position.

Joints and their movements

Shoulder

The shoulder area is probably the most complicated of all moving parts of the skeleton because it is actually made up of several joints that allow the varied range of movements. This area therefore tends to be described as the shoulder girdle, which is made up of joints between the:

- clavicle (which articulates with the scapula)
- scapula (which articulates with both the clavicle and the humerus head)
- head of humerus (which articulates with the scapula to form a ball and socket joint).

How shoulder structure affects function



The glenoid fossa (or the socket part of the ball and socket) is very flat. In fact, it is hardly a socket at all. This flatness means that the ball (head of the humerus) is able to move around without being constrained by sitting in a deep socket (such as the hip).

The shoulder is made up of a combination of three joints. The interaction between these joints provides a wide range of movement.



Finally, the shoulder is surrounded by many ligaments and muscles that pull in different directions and therefore help to stabilise the shoulder joint – these are known as the rotator cuff muscles.

The joint actions of the shoulder joint are: flexion, extension, abduction and adduction.
The movements at the shoulder girdle are: protraction, retraction, elevation and depression.

Elbow





The elbow is formed by the articulation between the humerus and the ulna. It is a hinge joint. The joint actions possible at the elbow joint are flexion and extension.

The ulna and the radius also articulate with each other near the elbow joint, as well as near the wrist. When the radius passes over the ulna, which is fixed, pronation and supination of the forearm occur.

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Wrist



The wrist is a condyloid joint in which the bottom two ends of the ulna and radius meet. These bones in turn articulate with the carpal bones nearest to them.

The joint actions possible at the wrist joint are flexion, extension, abduction and adduction.

Hip

The hip joint is a straightforward ball and socket joint. It is worth noting that as all the joints in the lower limbs are weight-bearing, they need to have more stability. Therefore, the range of movement at most of these joints is less than their equivalent upper body joint.

The hip involves only one articulation between the head of the femur (ball) and the acetabulum (socket) that sits in the pelvis. The joint actions possible at the hip are flexion, extension, abduction, adduction, rotation and circumduction.

Key features of the hip joint include			
	A much deeper socket in comparison to the glenoid fossa of the shoulder.		Strong surrounding ligaments.
	A snug fit between the ball and the socket.		A strong, big and powerful array of muscles to provide greater stability.

Knee



The knee is a hinge joint involving the lower end of the femur, the higher end of the tibia and the patella. The fibula runs down along the same length as the tibia and adds strength to the lower leg. The image shows the knee joint without the patella.

The joint actions possible at the knee joint are flexion and extension.

Ankle



The ankle is a hinge joint and is made up of the lower (distal) part of the tibia and fibula and the talus bone of the ankle. The ankle is similar to the wrist joint, whereby bones in the feet move to provide other movements, but there are only two movements available at the actual ankle joint.

The joint actions possible at the ankle joint are plantar flexion and dorsi flexion.

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Vertebral column

As discussed earlier, the vertebral column is made up of a series of 33 individual bones. The joint actions possible in the vertebral column include:

Cervical vertebrae
Actions: flexion and extension, rotation, lateral flexion and extension.

Thoracic vertebrae
Actions: rotation, flexion and extension, lateral flexion and extension.

Lumbar vertebrae
Actions: flexion and extension

The sacral and coccygeal vertebrae are fused, so movement does not occur in these sections of the spine.

Key points of joint movements

- The structure of the joint dictates which movements are possible.
- For most joint movements, there is an opposite joint movement.
- To provide safe and effective exercise, it is important to understand which movements are possible at specific joints.

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Muscles and muscle actions

Introduction

As an exercise instructor, it is important to have an understanding of a muscle's action on a joint. This section will explore the structure, function and joint movement brought about by muscle contractions. Knowledge of muscle function allows for the planning, performance and evaluation of safe and effective exercise.

Objectives

By the end of this section, the learner should be able to:

- identify the three types of muscle tissue
- define the characteristics and functions of the three types of muscle tissue
- describe the basic structure of skeletal muscle
- name and locate the anterior skeletal muscles
- name and locate the posterior skeletal muscles
- describe the structure and function of the pelvic floor muscles
- describe the different types of muscle action
- identify the joint actions brought about by specific muscle group contractions
- identify skeletal muscle fibre types and their characteristics
- describe the life course of the musculoskeletal system, including relevant tendon, ligament, muscle, joint and bone mineral density changes, and their implications for exercise, plus specific implications for working with:
  - young people in the 14–16 age range
  - antenatal and postnatal women
  - older people (50 plus).

Overview of muscles

It is estimated that there are up to 650 skeletal muscles in the human body, making up about 30–50% of body weight. As well as skeletal muscles, there are also other types of muscles within the body that are just as important to maintain body functions.

Types of muscle

There are three types of muscle that can be found around the body. The three types of muscle are involuntary, voluntary and cardiac.

Involuntary muscle

Involuntary muscle is also known as visceral or smooth muscle. Similar to cardiac muscle, it contracts under unconscious control. It contracts in response to stimulation by nerves or chemicals, such as hormones, which circulate around the body. Examples of involuntary muscles can be found in the urinary and respiratory systems and the gastrointestinal tract.

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Voluntary muscle

This is the type of muscle encountered most frequently during exercise. It is also known as striated, striped or skeletal muscle because it is attached to the skeleton. This type of muscle is under our conscious control, hence the term 'voluntary' muscle. It is stimulated by the nervous system and when the muscles contract, they shorten and create movement on the bones to which they are attached. Examples of voluntary muscles include the biceps and quadriceps.

Cardiac muscle

Cardiac muscle is a type of involuntary muscle found in the walls of the heart. However, unlike other involuntary muscles, it is striated. It is stimulated by electrical patterns that create a co-ordinated contraction of the heart muscle to propel blood out of the heart and around the body. Although it is classified as involuntary, it has a different structure to other involuntary muscle cells found in the urinary, respiratory and intestinal tracts.

Muscle function

Muscles have four main functions:

Producing movement

Skeletal muscle is attached to the skeleton; therefore, when a muscle contracts, it brings about movement of the body. This helps us to carry out our day-to-day activities and exercise.

Stabilising the body

The contractions of the skeletal muscle help hold the body in a certain position, such as when we are standing or sitting still.

Storing and moving substances within the body

Cardiac muscle helps to move blood around the body. Other types of involuntary muscle can be found in the walls of blood vessels and the gastrointestinal tract, where smooth muscle will push food and substances through the digestive system.

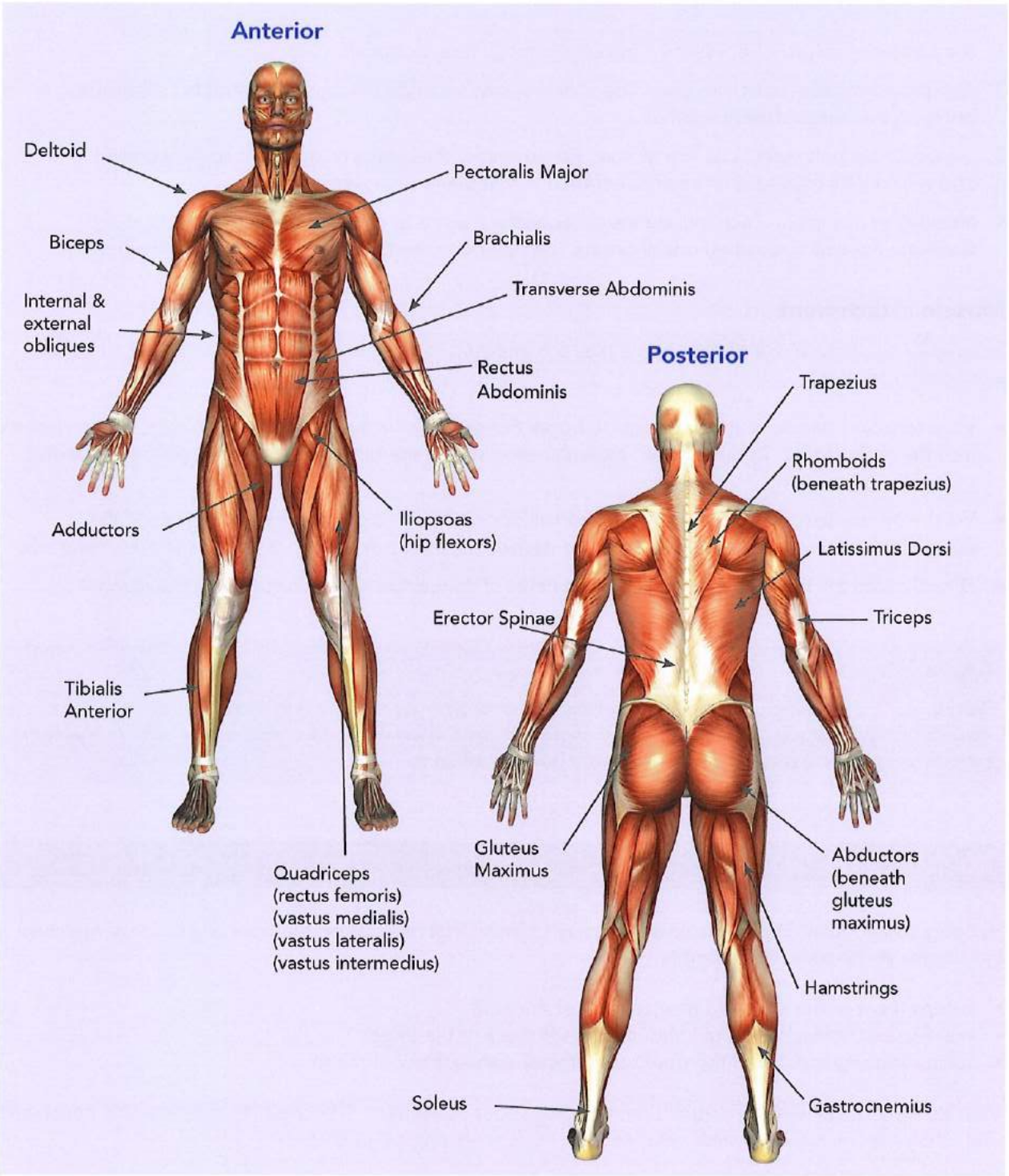
Generating heat

The heat generated by muscle is used to help maintain body temperature. For example, shivering is a series of involuntary contractions of skeletal muscle that significantly increases the rate of heat production.

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The skeletal muscle system

While the heart is arguably the most important muscle in the body, it is actually the skeletal muscles that will be the most familiar. The image below shows the major muscles of the body.



Key points of muscles

- There are three types of muscle: involuntary, voluntary and cardiac.
- Muscles have four main functions: producing movement, stabilising the body, storing substances and generating heat.

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Skeletal muscle

Muscle action

There are four key points relating to muscle action:

1. A muscle can only pull (ie, exert a contracting force); it cannot push.
2. A muscle crosses at least one joint. This is demonstrated when the muscle contracts or shortens, bringing the bones closer together.
3. A muscle can only work in its line of fibre. For example, the biceps muscle runs up and down and will only be able to shorten and lengthen in that plane of movement.
4. Muscles work in pairs. Each muscle has an opposite muscle to allow movement to occur at the skeleton. For example, when one shortens, the other one lengthens to bring about movement.

Muscle attachment

Muscles bring about movement because they are attached to bone in the following three ways to exert a contracting force:

- Via a tendon – tendons attach muscle to bone. For example, in a biceps curl, the biceps tendon inserts into the radius bone. To bring about muscular contraction, the biceps tendon must pull on the radius to flex the elbow joint.
- Via the fibrous tissue of other muscles called an aponeurosis – a good example of this is in the abdominals, where all the muscles attach at the front of the trunk to form the abdominal aponeurosis.
- Directly onto the bone via the muscle fascia (layer of connective tissue surrounding the muscle).

Key point

Remember that muscles can only perform their functions by contracting and thereby 'pulling' on the various bones to produce a change in the angle at a joint. If a muscle does not cross a joint, movement cannot occur, as it is the joint that acts as the pivot or fulcrum.

Muscle group actions

To bring about movement, muscles work in pairs. Notice that muscles on the front of a limb are matched by muscles at the back. For example:

- biceps (front of the arm) and triceps (back of the arm)
- quadriceps (front of the thigh) and hamstrings (back of the thigh)
- rectus abdominis (front of the trunk) and erector spinae (back of the trunk).

Muscles work by generating contractions to bring about movement. The opposite movement is generated when the other muscle contracts, returning the bone to its original position.

If this was not allowed to happen, we would only be able to move in one direction. The main muscle responsible for creating the movement is known as the prime mover, or agonist, while its opposite muscle is known as the antagonist, which relaxes in order for movement to occur. A sit-up exercise is a good example of this, as the prime mover is the rectus abdominis and the antagonist is the erector spinae.

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When performing an exercise, other muscles may also join in and assist the prime mover; these muscles are called synergists. For example, when performing a leg curl, if the workload is heavy, the gastrocnemius will assist the hamstrings (prime mover) to perform knee flexion.

Muscles can contract statically to fix parts of the body to maintain a correct or stable position. When a muscle performs this function, it is called a fixator.

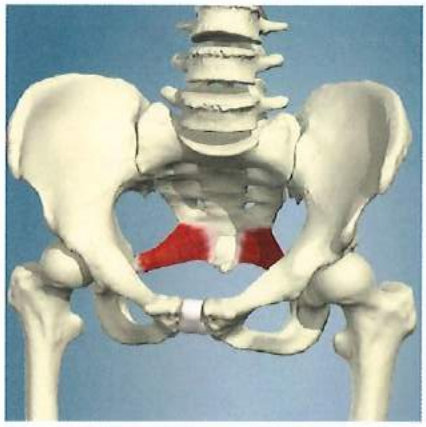
A biceps curl can be used to illustrate the different roles of the muscles and muscle groups:

- the prime mover is the biceps
- the antagonist is the triceps
- the fixator is the deltoid
- the synergist is the brachialis.

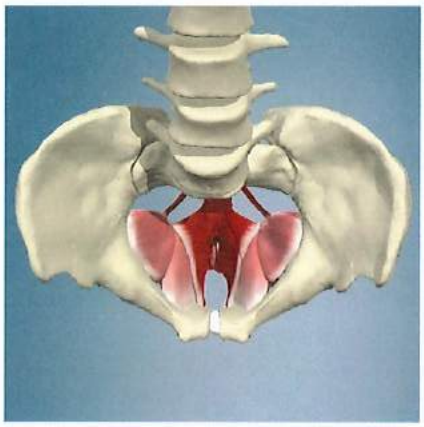
Pelvic floor muscles

The pelvic floor is a double-layered (superficial and deep layer) broad sling of muscle from the pubic bone at the front to the base of the spine at the back of the pelvis. Comprising: the coccygeus (deep muscle) and the levator ani (superficial muscle). It consists of both fast- and slow- twitch muscle tissue – a point that should be taken into consideration for effectively exercising these muscles.

Coccygeus



Levator ani



The pelvic floor provides:

- stability of the pelvic girdle
- support for the organs of the pelvis and abdominal contents, as well as for the foetus when pregnant
- continence control of urine and faeces
- reflex activity to counteract changes in abdominal pressure (ie, coughing, sneezing, nose blowing, vomiting and forced expiration).

During childbirth, the pelvic floor muscles have the ability to stretch considerably to allow for childbirth. However, this can leave them weakened afterwards.

Pelvic floor muscles can become weak and sag not only from childbirth but through lack of exercise, the menopause or simply due to the ageing process. However, in the same way as one would train any other muscle group, it is also possible to train these muscles through repetition to improve and maintain their ability to effectively support the pelvis.

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Special populations and muscles

Children

Strength naturally increases with age because of body growth and development of the neuromuscular system. However, it should be noted that the muscular system does not always develop at the same rate as the skeleton. This can make the muscular system of children susceptible to damage.

Pregnancy

Exercise can help to relieve some of the symptoms of pregnancy. It can help a pregnant woman to carry increasing weight during pregnancy, prepare for the physical stress of labour and birth and help get the body back into shape after birth. Remember that the hormone relaxin affects the stability of synovial joints. Therefore, it is advisable to ensure that stretching exercises are limited to passive, static, short-held stretches. Supine exercises should be avoided at certain times during pregnancy, as they can reduce blood supply to the baby and mother. It should be noted that many physiological changes that occur during pregnancy can remain for up to six months after the baby is born.

Ageing

Muscle loses size and strength as we get older, and this can contribute to fatigue, weakness and reduced tolerance to exercise. This is caused by a number of factors working in combination, including:

- muscle fibres reduce in number and shrink in size
- muscle tissue is replaced more slowly and lost muscle tissue is replaced with a tough, fibrous tissue, making it less flexible
- changes in the nervous system cause muscles to have reduced tone and ability to contract.

Disability

When training individuals with a disability, an instructor must consider the specific implications that the individual's disability may present in terms of their muscular system.

Key points of muscle action

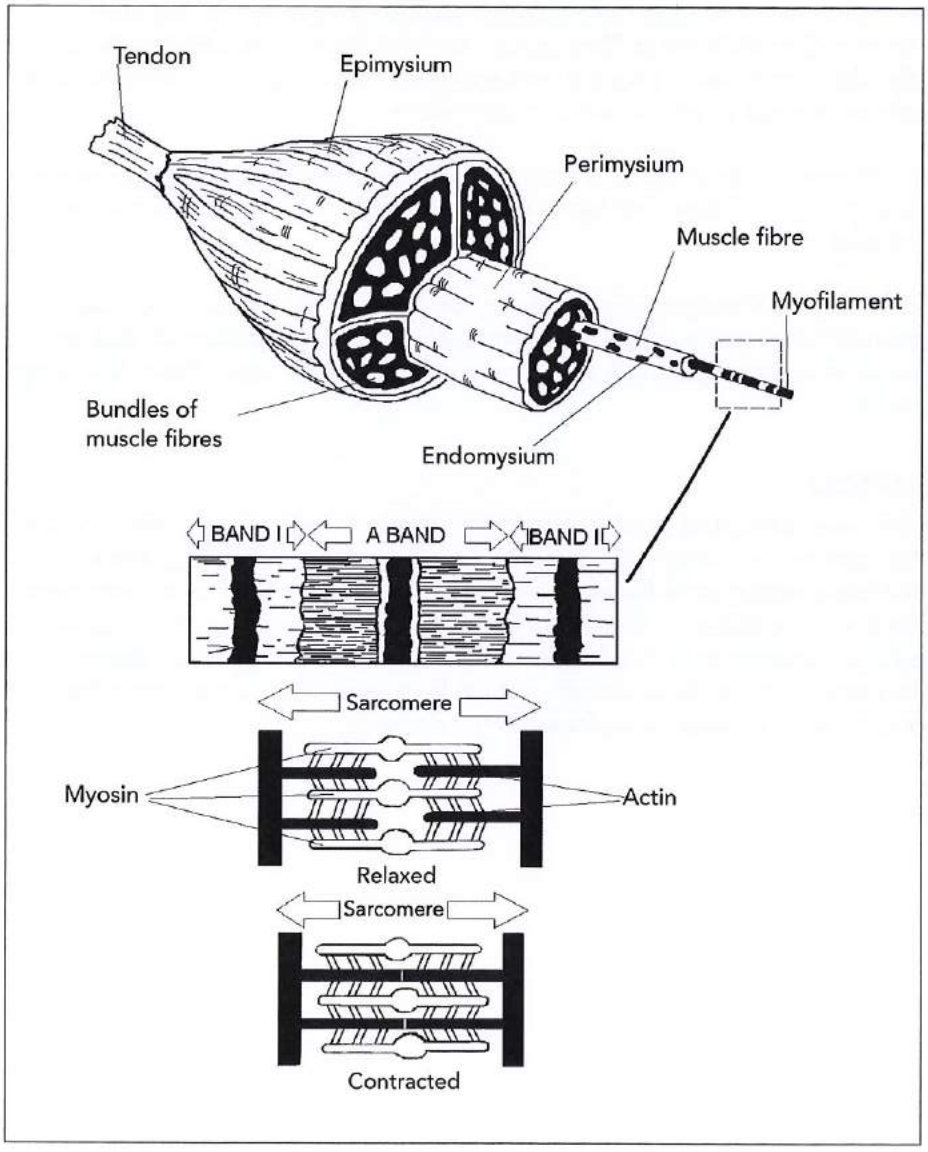
- A muscle can only pull across the joint(s) it crosses and in its line of fibre.
- Muscles work in pairs.
- Muscles attach to bone via a tendon, onto the aponuerosis of other muscles or directly onto the bone.
- Prime mover (or agonist) is the main muscle responsible for the movement.
- Antagonist is the muscle which produces the opposite movement to the prime mover.
- Fixator muscles help fix the body in the correct position to allow other movements to take place.
- Synergist muscles help the prime mover to achieve its goal.
- There are specific changes to muscles for special populations.

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Muscle structure

A muscle is a highly organised structure. Looking at a muscle in cross-section (see below) shows the following (large to small) components:

- Fascia – the entire muscle is surrounded by a broad protective fibrous sheath called the epimysium.
- Bundles of muscle fibres (fascicles) – muscle is composed of bundles of muscle fibres that are surrounded by another layer of fascia called the perimysium.
- Muscle fibre – each individual muscle fibre is surrounded by a thin layer of fascia called the endomysium. A single muscle fibre is composed of groups of myofibrils.
- Myofibrils – these consist of a series of thick and thin protein filaments called actin and myosin. The myosin filaments are thicker and darker in colour than the actin filaments and have small projections called cross bridges that connect to the actin. The actin filaments are thin and overlap the myosin filaments. The arrangement of these filaments gives skeletal muscle its striated, or striped, appearance.
- Sarcomere –the smallest functional unit of a myofibril. Sarcomeres occur as repeating units along the length of a myofibril.



See the nervous system section for an explanation of motor unit recruitment.

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Muscle fibre types

Skeletal muscles are made from several different types of fibre and vary in two ways; colour and speed of contraction.

For this reason, muscle fibres tend to be divided into two types:

1. slow-twitch fibres (red-coloured) – these are also known as type I or slow oxidative fibres
2. fast-twitch fibres (white-coloured) – these are also known as type II or fast glycolytic fibres.

1. Type I (slow oxidative)

These fibres are red because they contain a large amount of myoglobin (a substance that can store oxygen) and red blood cells. They also contain large numbers of mitochondria (the principal sites of energy generation within cells), capillaries (tiny blood vessels) and endurance enzymes. The fibres are characterised as being slow to contract and slow to fatigue. They are recruited for lower intensity, longer-duration types of activity. Thus, they are best equipped for endurance or aerobic work. Type I fibres are sometimes referred to as slow-twitch muscle fibres.

2. Type IIb (fast glycolytic)

These white fibres can contract rapidly and with high force but also fatigue rapidly. They tend to be recruited for higher-intensity, shorter-duration activity. They contain low numbers of mitochondria and capillaries and high levels of glycolytic enzymes so they are best equipped for strength or anaerobic work. Type II muscle fibres are sometimes referred to as fast-twitch muscle fibres.

Generally, muscles tend to be composed of both types of fibre. The percentage of each fibre type varies from muscle to muscle and person to person. Research has shown that muscle fibre composition is, to a large extent, genetically determined.

Although there are two distinctive muscle fibre types, the human body has an amazing ability to adapt to any additional stress placed upon it. For example, when an activity requires a rapid contraction, but also needs a small supply of oxygen, an intermediary muscle fibre type is available for the job. This is known as a type IIa – fast oxidative glycolytic.

Type IIa (fast oxidative glycolytic)

These muscle fibre types can often be associated as an intermediate muscle fibre. They are pink in colour and have a stronger and quicker contraction, using a higher force than the slow-twitch type but less strong, rapid or intense than the fast-twitch muscle fibres. They also have larger amounts of mitochondria and capillaries than the fast-twitch muscle fibres, so therefore have the ability to work under endurance for a small period of time. They are predominantly recruited to assist slow-twitch muscle fibres during the harder stages of endurance events or to assist fast-twitch muscle fibres when the activity performed requires a few additional repetitions (eg, during a muscular endurance activity).

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Special populations and the muscular system

Children

Genetically, children inherit from their parents the proportion of each type of muscle fibre in their body. Muscle growth does not keep up with bone growth, which can sometimes make children appear clumsy and awkward. Muscle growth varies in children depending on age, gender and body type.

Pregnancy

Pregnancy has an effect on the muscular system in relation to the laxity of each muscle. The hormone relaxin is responsible for increasing the pliability of muscle connective tissue, especially in the later stages of pregnancy. Instructors may need to be aware that this may have an effect on balance and co-ordination, as well as increasing flexibility. Therefore, it is beneficial that short maintenance stretches are used during this time, as opposed to development stretches, to avoid damaging connective tissue.

Ageing

From the age of 40, the muscular system starts its decline. This degeneration results in a reduction in the number of muscle fibres and muscle fibre size, replacement of muscle tissue with noncontractile fibrous tissue and a reduction of motor units and neurons. The resulting loss of muscle mass leads to a reduction in power, strength and endurance. This in turn leads to a progressive reduction in the level of support afforded to the skeleton and gradual changes in posture. The accompanying weaknesses will have an impact on motor skills, especially co-ordination and balance, thereby increasing the chance of a fall.

Disabilities

There are a range of medical conditions and disabilities that have an impact on the function of the muscular system.

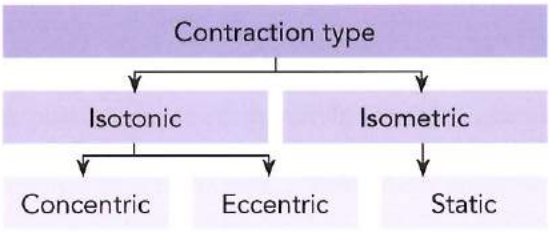
Key points of muscle structure

- The structure of a muscle from largest component to smallest is: fascia, bundles of muscle fibres, muscle fibre, myofibril, sarcomere, myosin filament and actin filament.
- Muscles are always in a slight state of tension.
- Muscles are linked to the nervous system by nerves.
- Slow-twitch, type I, slow oxidative fibres are best equipped for endurance work. They are slow to contract and slow to fatigue.
- Fast-twitch, type IIa, fast glycolytic fibres are best equipped for strength work. They are fast to contract and fast to fatigue.
- Fast-twitch, type IIb, fast glycolictic muscle fibres are best equipped for work that requires a high force quickly. They contract with high force rapidly but fatigue rapidly.

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Types of muscular contraction

Muscle work is classified according to the type of contraction. There are three basic types of muscle contraction: concentric, eccentric and static.



Concentric contractions

When a muscle contracts, develops tension and shortens, a concentric contraction takes place. An example of this is raising the body from the floor in a press-up. This involves concentric contractions of the pectoralis major and triceps. Getting out of a chair also involves a concentric contraction of the quadriceps. In a weight-training context concentric contractions are the lifting, positive or hard work phase of the exercise.

Eccentric contractions

When a muscle contracts, develops tension and lengthens at the same time, an eccentric contraction takes place. An example of this is sitting down slowly in a chair, which involves eccentric contractions of the quadriceps. The quadriceps lengthen against a resistance (body weight) under control, to enable one to sit on the chair, rather than relax, which would result in falling into the chair. In a weight-training context, it is the lowering, negative or easier phase of the exercise. The eccentric phase often gets neglected, with people expending lots of effort to raise the weight and letting gravity do all the work on the lowering.

Controlled lowering of the weight in the eccentric phase can bring good improvements in muscular fitness. However, with improvement comes an increase in the likeliness of muscular soreness. Delayed onset muscle soreness (DOMS) is pain in the muscles following a workout that has been too challenging. This often occurs 12–72 hours after the workout.

Examples of eccentric contractions using the above exercises include:

- Biceps curl – eccentric contractions of the biceps occur as the weight is lowered towards the ground under control.
- Sit up – eccentric contractions of the rectus abdominis occur as the trunk is lowered towards the ground.
- Lying sideways leg lift – eccentric contractions of the hip abductors occur as the leg is lowered.

Isotonic contractions

Together, concentric and eccentric contractions are also often referred to as isotonic contractions. Isotonic means movement that is occurring as a result of the contraction, with one bone getting closer or further away from another bone depending upon the contraction.

Isometric contractions

When a muscle contracts and develops tension, and the muscle length remains the same (and therefore no movement occurs at the joint), a static, or isometric, contraction is taking place. An example of this is during a press-up. If the body is raised to the halfway point and the position is then held, only static contractions are taking place in the pectorals and triceps. If an arm is raised and held out, a static contraction of the deltoid will be taking place.

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The influence of gravity on muscle contraction

Gravity influences the muscle contraction. An example of this is in a curl up. In this exercise, a person lies on the floor with their legs bent and curls up by contracting the abdominal muscles to flex the spine. Here the force of gravity is acting on the upper body, trying to pull it back down to the floor. The movement is therefore taking place against gravity. A concentric contraction occurs as the trunk is raised, and an eccentric contraction occurs as the trunk is lowered.

However, if a person stands upright and performs a similar movement (flexion of the spine), the movement will be taking place with gravity and thus the exercise would involve other muscle groups (erector spinae working eccentrically on the lowering and concentrically on the raising) and would be totally ineffective for the abdominals. By changing the body position in relation to gravity, both the emphasis of the exercise and the muscle groups involved have been completely changed.

Levers and biomechanics

This factor can also affect how hard a muscle needs to work to achieve a contraction. The longer the lever, the more muscular effort is required to bring about the contraction. An example of this is when performing an abdominal curl. If the arms are raised above the head, the lever (from the pivot point – hips – to the tips of the fingers) is lengthened. If the hands were to the side of the head, the pivot is shorter.

Valsalva effect

Valsalva effect is the technical term for holding one's breath at the wrong time during an exercise (forced expiration against a closed mouth and nose). This results in decreased return of blood to the heart, reduced cardiac output and abnormal elevation of blood pressure. It is recommended to exhale during the lifting phase and inhale during the lowering phase of the exercise to keep the blood pressure response under control.

Key points of muscle contraction

- There are three types of muscle contraction: concentric, eccentric and static.
- A concentric contraction is when a muscle shortens against a resistance.
- An eccentric contraction is when the muscle lengthens against a resistance.
- Together, concentric and eccentric contractions are referred to as isotonic contractions.
- An isometric or static contraction is when a muscle is actively engaged in holding a static position.
- Gravity and lever length influence muscle contraction.
- Breathing out during the lifting phase and in during the lowering phase of an exercise is recommended to avoid the Valsalva effect.

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Muscle group actions on the joint(s)

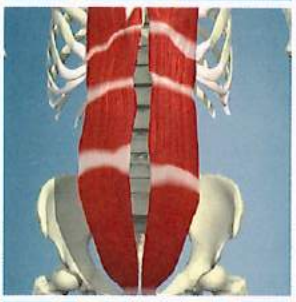
To evaluate whether an exercise is safe or effective, an instructor needs to be aware of the movements that are possible at various joints in the body and to understand the muscles or muscle groups responsible for producing these movements.

The attachment where a muscle starts is called the origin and the point where it ends is called the insertion. Recognising where muscles cross the joint(s) and where a muscle starts and finishes helps determine the actions brought about by that muscle contracting. The table below highlights the start and finish point of a muscle, the joint(s) crossed and the main action brought about by the contraction.

Summary of the actions of the upper limb muscles			
Biceps		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Scapula Radius Elbow and shoulder Vertical Flexes the elbow Supinates forearm Biceps curls
Triceps		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Scapula and humerus Ulna Elbow and shoulder Vertical Extends the elbow Triceps dips
Deltoid		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Clavicle and scapula Humerus Shoulder Three sets of fibres running vertically Abducts the arm and assists in shoulder rotation and flexion Dumbbell lateral raise
Latissimus dorsi		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Lumbar and sacral vertebrae, thoracic vertebrae 7–12 Humerus Shoulder Diagonal Adducts, extends and inwardly rotates the shoulder Lat pulldowns
Pectoralis major		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Clavicle and sternum Humerus Shoulder Horizontal Horizontal flexion Adduction and inward rotation of the arm Press-up and pec dec

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Summary of the actions of the upper limb muscles			
Trapezius		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	7th cervicle vertebra and all thoracic vertebrae Clavicle and scapula Shoulder girdle Three different directions Upper fibres elevate the shoulders and extend the next. Middle fibres retract the scapula. Lower fibres depress the scapula. Shoulder shrugs
Rhomboids		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	7th cervicle vertebra and thoracic 1–5 Scapula Shoulder girdle Diagonal Retracts the shoulder girdle and rotates scapula (internally) Pulling shoulder blades together for posture

Summary of the actions of the trunk/core muscles			
Transverse abdominis		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Iliac crest, lumbar fascia and cartilage of interior six ribs Xiphoid process, linea alba and pubis Lumbar vertebrae (fibres run horizontally) Horizontal Compress the abdomen Pull the abdomen in for posture and spine support The plank
Rectus abdominis		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Pubis Ribs Thoracic and lumbar vertebrae Vertical Flexes the thoracic and lumbar spine Curl-ups
Erector spinae		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Sacrum, ilium to thorax Ribs, vertebrae to occipital bone (base of skull) Vertebrae Vertical Extends the spine Rotates the thoracic spine Dorsal raises, side twists

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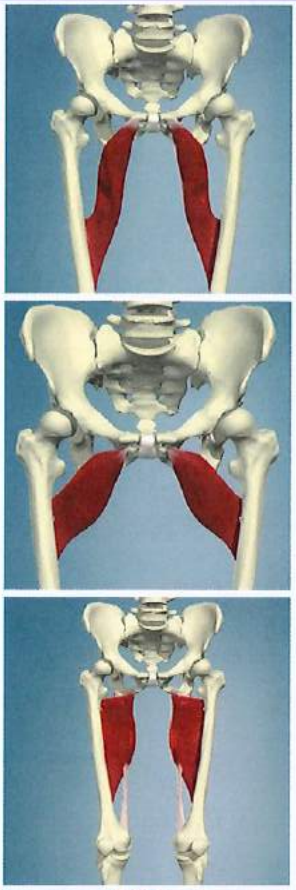
Summary of the actions of the trunk/core muscles

External obliques		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Lower ribs Ilium Vertebrae Diagonal Laterally flexes the thoracic spine Rotates the thoracic spine Oblique curls
Internal obliques		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Ilium Lower ribs Vertebrae Diagonal Laterally flexes the thoracic spine Rotates the thoracic spine Lying side bends

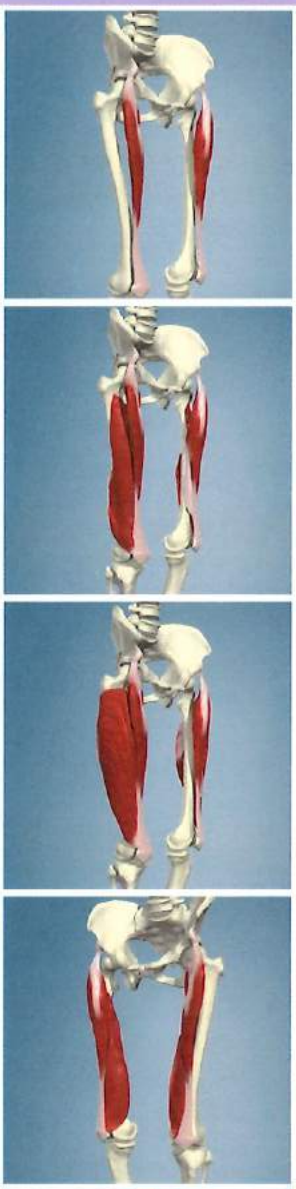
Summary of the actions of the lower limb muscles

Iliopsoas (hip flexors)	 	Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	All lumbar vertebrae and ilium Femur Hip Vertical Flexes the hip Kicks
Gluteus maximus		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Ilium and sacrum Femur Hip Diagonal Extends and outwardly rotates the hip Kick backs and squats
Abductors		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Ilium and sacrum Femur Hip Vertical Abduct and inwardly rotates the hip Side leg lifts and stabilising the pelvis in other exercise such as walking

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Summary of the actions of the lower limb muscles			
Adductors		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Pubis and ischium Femur Hip Diagonal Adducts and outwardly rotates the hip Kicking across the body and stabilising the pelvis
Hamstrings		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Ischium Tibia and fibula Hip and knee Vertical Extends the hip Flexes the knee Hamstring curls

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Summary of the actions of the lower limb muscles			
Quadriceps		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Femur and ilium Tibia Knee and hip Vertical Extends the knee (rectus femoris also flexes the hip) Leg extensions
Gastrocnemius		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Femur Calcaneus Ankle and knee Vertical Plantar flexes the ankle (also assists in the knee flexion) Heel raises

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Summary of the actions of the lower limb muscles			
Soleus		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Fibula and tibia Calcaneus Ankle Vertical Plantar flexes the ankle Heel raises
Tibialis anterior (or Anterior tibialis)		Origin: Insertion: Joint(s) crossed: Direction of fibres: Action: Exercise example:	Tibia 1st metatarsal Ankle Vertical Dorsiflexes the ankle Heel digs

Key points of muscle group actions

- Recognising the joint(s) crossed, where a muscle starts and finishes and the direction of the fibres helps to determine the actions brought about by that muscle contracting.
- Front of body muscle groups: biceps, deltoids, pectoralis major, transverse abdominis, rectus abdominis, obliques (internal and external), adductors, iliopsoas, quadriceps and tibialis anterior.
- Back of body muscle groups: triceps, trapezius (upper/mid/lower), rhomboids, gluteus maximus, erector spinae, latissimus dorsi, abductors, hamstrings, gastrocnemius and soleus.

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Energy systems

Introduction

The term 'energy' means different things to different people. For example, a physicist might say that it's 'the capacity for doing work' and start talking about mechanical, chemical and electrical energy.

The following section aims to provide the learner with an understanding of how chemical (food) energy is converted into usable fuel and how energy for the body is used within the muscles. The way in which energy is produced varies depending on the activity being performed. This section should help in assessing which energy systems are used when performing physical activities or sports.

Objectives

By the end of this section, the learner should be able to:

- describe how carbohydrates, fats and proteins are used in the production of energy/adenosine triphosphate
- explain the use of the three energy systems during aerobic and anaerobic exercise.

Energy

In order for the body to function, it needs energy – even at rest. When someone begins exercising, the body must start producing energy at a faster rate than it does at rest. As the muscles contract more frequently, the heart beats faster, pumping blood around the body. All these processes require energy.

Energy sources

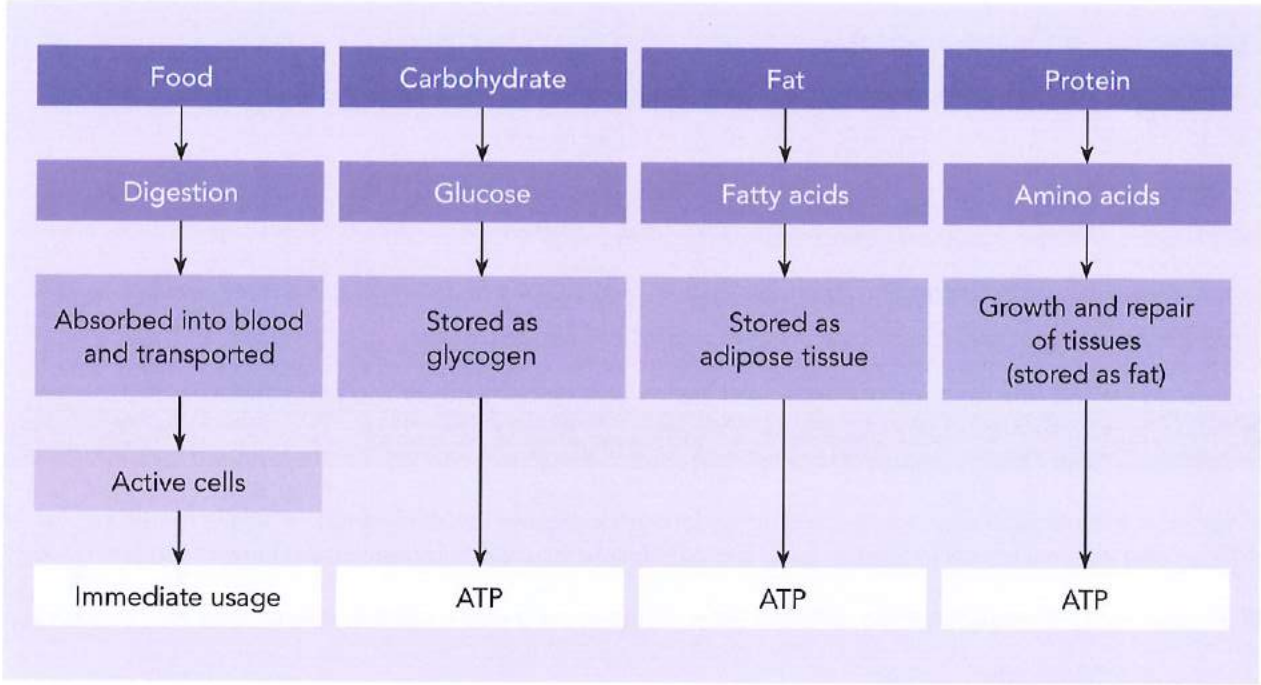
Energy comes from the food we eat, including:

- Carbohydrate – this is stored in our muscles and liver cells in the form of glycogen. Glycogen is broken down into glucose, the fuel that can be used by all tissues in the body. Carbohydrate should provide around 50 to 60 % of total energy.

- Fat – this is stored beneath the skin (adipose tissue), where it serves not only as a fuel store but also as insulation to prevent heat loss. Fat is composed of triglyceride molecules that are broken down in to fatty acids to release energy. Fats should provide about 30% of total energy.

- Protein – this is used as a building material for the growth and repair of tissues of the body. As such, it is not stored in the body in the same way as fat and carbohydrate, unless there is excess, when leftover protein will be converted to fat and stored. Protein can be broken down to amino acids to provide energy. This, however, only occurs during prolonged endurance events (eg, long distance swimming or cycling). Protein should provide around 10 to 15% of total energy.

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Note: As fitness professionals, it is important to be aware of the limitations concerning the nutritional advice given to clients. The information passed on must be based on widely accepted healthy eating guidelines that are already in the public domain. It is not the role of an instructor to recommend specific diets, supplements or eating plans. In doing so, the instructor has gone beyond the limit of their professional ability and will be contravening the Register of Exercise Professionals' (REPs') code of ethical conduct and may not be covered by insurance.

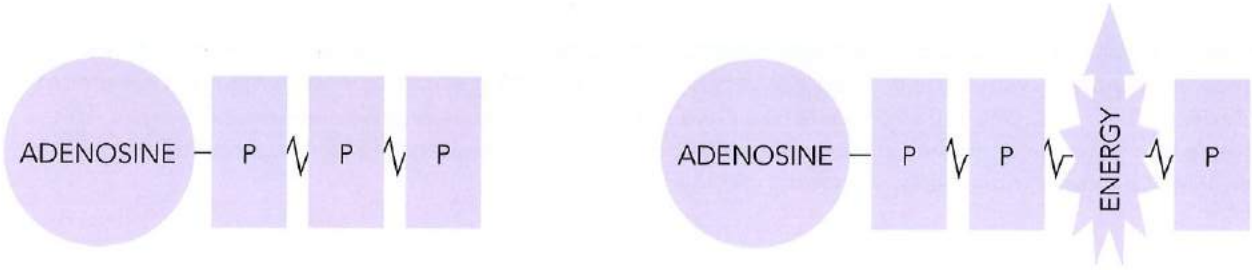
What is energy?

The ATP/ADP cycle

Energy is released in the body by the breakdown of carbohydrates, fats and proteins to produce adenosine triphosphate, or ATP. ATP is often referred to as the body's 'energy currency', because it is the only currency the body accepts to provide energy. All forms of biological work (digestion, production of hormones, transmission of nerve impulses, manufacture and repair of tissues, etc) within the body require energy in the form of ATP.

ATP consists of a substance called adenosine and three phosphate groups. Special high-energy bonds exist between the phosphate groups. Energy is released by breaking one of the phosphate bonds. In a muscle cell, the breakdown of ATP results in mechanical work (muscle contraction) and heat. This explains why one feels warmer during exercise.

When ATP loses one of its phosphate bonds, energy is produced, which is then converted to ADP (adenosine diphosphate), as shown in the diagram below. Once this has occurred, ADP is resynthesised back into ATP by a process called 'coupled reactions', which is a bit like a shuttle system. This process is called the ATP cycle, and is important for the constant generation of energy within the body. If this process stops, so does life as we know it!



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Key points of fuels for exercise

- Carbohydrate is broken down to glucose in the body to provide energy.
- Fat is broken down to fatty acids in the body to provide energy.
- Protein is broken down to amino acids in the body that can provide energy in extreme circumstances.
- The breakdown of all three fuels in the body produces ATP.
- Energy is produced when ATP loses one of its phosphate bonds. When this occurs, ATP becomes ADP.
- ADP is resynthesised to ATP by a process called 'coupled reactions'.

Energy systems

When someone begins exercising, the energy demand increases suddenly and the body's stored supply of ATP is used within a couple of seconds, so more fuel must be quickly broken down to produce further ATP.

ATP can be resynthesised in three different ways. These are referred to as the 'energy systems', including:

- phosphocreatine (PC) system
- lactic acid system
- aerobic system.

The PC and lactic acid systems are termed 'anaerobic' because ATP is produced very quickly without the presence of oxygen. The third energy system (aerobic) produces ATP more slowly in the presence of oxygen.

1. Phosphocreatine energy system

The phosphocreatine (PC) system utilises a fuel called creatine phosphate to make ATP. Creatine phosphate is a high-energy compound that is stored in limited amounts within the muscle. When the high-energy phosphate bond in creatine phosphate is broken down, the released energy is immediately used to resynthesise ATP. This means that as rapidly as ATP is broken down for muscular contraction, it is reformed by the bonding of ADP and freely available phosphate (P) within the muscle cell.

ADP + P (+ energy from creatine phosphate) = ATP



This system is used for instantaneous bursts of activity lasting for just a few seconds. It is an energy system that is predominantly used in explosive sports, such as the long jump, shot put or 100m sprint. In a similar way, this system is used for everyday activities, such as when dashing for the bus or train. The phosphocreatine system can be thought of as a back-up system to ATP, as it helps to regenerate ATP from ADP immediately.

From an exercise point of view, the major limitation of the phosphocreatine system is that the stores of creatine phosphate within the muscles are very limited (only lasting seconds, when working at maximum intensity). After this, creatine phosphate must itself be regenerated (taking two minutes or longer). This means that other fuels, such as glycogen and fat, must then supply energy for the regeneration of ATP. When this happens, other energy systems take over.

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2. Lactic acid energy system

The lactic acid system utilises glycogen in the absence of oxygen to make ATP. Glycogen is stored in limited amounts within the muscle and is broken down to pyruvate and then to ATP. This process is called 'anaerobic glycolysis' and a by-product of this is lactic acid. Lactic acid formation can pose a significant problem in performance conditions because high levels can lead to muscle fatigue, usually referred to as 'feeling the burn'.

The lactic acid system provides energy for very quick bursts of high-intensity activity, lasting on average less than a minute (at maximum effort). This energy system is used when weight-training and performing a set of 8–12 repetitions to failure, or running 400 metres.

There are two major limitations of the lactic acid system. First, like creatine phosphate, the store of glycogen in the muscles is limited. Second, with continuous high-intensity exercise, the rapid conversion of glycogen to ATP without oxygen produces a build-up of lactic acid in the muscles. If the rate of lactic acid production exceeds its rate of removal, muscles become fatigued and muscle contraction is impeded.

To avoid fatigue, exercise intensity must be reduced so that the lactic acid can be carried away from the muscles by the bloodstream to the liver, for conversion back into glucose or to be used by other cells receiving a sufficient supply of oxygen. This slowing down also means more oxygen is available to the muscles. This is termed repaying the 'oxygen debt'.

3. Aerobic system

The aerobic production of ATP takes place in the presence of oxygen using a mixture of glucose and fatty acids as the fuels. Amino acids can also be used when carbohydrate stores are low, such as during prolonged events.

This process occurs within specialised structures in the muscle cell called mitochondria (often referred to as the 'powerhouse' of the cell) that contain special enzymes needed by the cell to use oxygen.

Note: Enzymes are proteins that accelerate chemical reactions within a cell.

As previously explained, glycogen is stored in limited amounts within the muscle and is broken down to pyruvate prior to ATP. The aerobic system allows this process to occur in the presence of oxygen; therefore instead of forming lactic acid, other by-products such as carbon dioxide and water are formed. This is a cyclical process and is more efficient at producing ATP. This is called aerobic glycolysis.

The aerobic energy system is used for sustained activity lasting more than 90 seconds (eg, swimming, cycling, walking, the 10,000 metres, exercise to music and circuit weight-training).

A key adaptation to regular aerobic training is that the body becomes more efficient in mobilising, transporting and oxidising fatty acids. This is because the body develops a greater number of mitochondria and fat-oxidising enzymes. Consequently, the body becomes more efficient at burning fat. This is one reason why aerobic exercise can help to control or lose body fat.

For endurance activities, this improved utilisation of fat is important because glycogen is in much shorter supply than fat. By using more fatty acids, glycogen stores can last longer.

However, the main limitation of the aerobic system is that it is slow to engage. This is because of the complex series of chemical reactions involved and the fact that it takes a couple of minutes for the heart to increase the delivery of oxygen-rich blood to the exercising muscles. During anaerobic work, creatine phosphate or glycogen must be converted very quickly into energy to meet the exercising body's demands. The cost of this fast-delivery service is that this service is limited. The cost of aerobic energy production is that it is a very slow-delivery service; however, it is still about 20 times more efficient in terms of energy production.

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Energy system	Fuel used	Rate of ATP production	Capacity of energy system	Main use
Phosphocreatine	Creatine phosphate (stored in the muscle)	Very rapid	Very limited ATP production	Very high-intensity, short-duration activities lasting up to 15 seconds
Lactic acid	Glycogen (stored in the muscle and liver)	Rapid (by-product is lactic acid that can lead to muscular fatigue)	Limited ATP production	High-intensity, short-duration activities lasting 30–40 seconds
Aerobic	Glycogen fatty acids (stored in the adipose tissue)	Slow (by-products are carbon dioxide and water)	Unlimited ATP production	Moderate to vigorous intensity, long-duration activities lasting for more than 90 seconds

The higher the exercise intensity, the more dependent the body is on glycogen. The type of fuel used by the body depends upon the exercise duration, intensity and type.

While it is convenient to explain these energy systems in isolation, when exercising, energy will be derived from all three systems. However, the emphasis will change according to the intensity of the activity relative to the person's fitness level.

Sports that involve short, sharp, intense bursts of activity, such as jumping, sprinting and throwing, are predominantly anaerobic. Sports that involve sustained rhythmical movements for long periods, such as cycling, swimming, rowing and skiing, are predominantly aerobic. However, most sports are a mixture of both anaerobic and aerobic. For example, netball, football, rugby, hockey, volleyball and basketball entail short bursts of high-intensity activity interspersed with longer periods of low to moderate intensity activity.

Energy systems and special populations

Children

Children utilise more mitochondria in their muscles and therefore are able to utilise oxygen more effectively. They have a high anaerobic threshold, so as long as they are working at an appropriate intensity, they are able to keep going. However, they naturally have limited supplies of muscle and liver glycogen, as well as smaller stores of anaerobic fuel and the capacity to use it. This limits their anaerobic capacity and they are not able to tolerate short bursts of energy or exercises/activities that require high intensity and short repetitions. However, this does improve as they get older.

Pregnancy

There is a gradual increase in energy expenditure as pregnancy advances. Pregnant exercisers use more carbohydrates than fat during moderate exercise. Therefore, blood sugar levels can fall quickly. It should be noted that blood glucose can be reduced after strenuous exercise, especially in the later stages of pregnancy.

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Ageing

The ability of skeletal muscle to produce energy becomes less efficient with age. Although resting levels of ATP and creatine phosphate are similar in the young and old, active levels decline in older people, suggesting that they are less able to regenerate ATP. Additionally, the enzymes responsible for energy release reduce in concentration and effectiveness, thus contributing to reduced energy production.

Disability

There are a range of medical conditions and disabilities that have an impact on the function of the energy systems specific to the individual.

Key points for energy systems

- The phosphocreatine system is an anaerobic system that uses creatine phosphate, which is stored in the muscles in limited supplies (enough for up to 15 seconds of high-intensity work).
- The lactic acid system is an anaerobic system that utilises glycogen, which is stored in the muscles (in limited amounts) and the liver.
- Glycogen supplies within the muscles are sufficient for high-intensity exercise lasting for a short period of time (30–40 seconds at maximal effort).
- A by-product of the breakdown of glycogen is lactic acid. High levels of lactic acid within the muscles can lead to muscular fatigue.
- The aerobic system uses mainly glycogen and fatty acids that are oxidised within the mitochondria.
- The by-products of aerobic energy production are carbon dioxide and water.
- The predominant energy system used in exercise is determined by the intensity, duration and type of activity.
- There are specific changes to the energy system for special populations.

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The cardiorespiratory system

Introduction

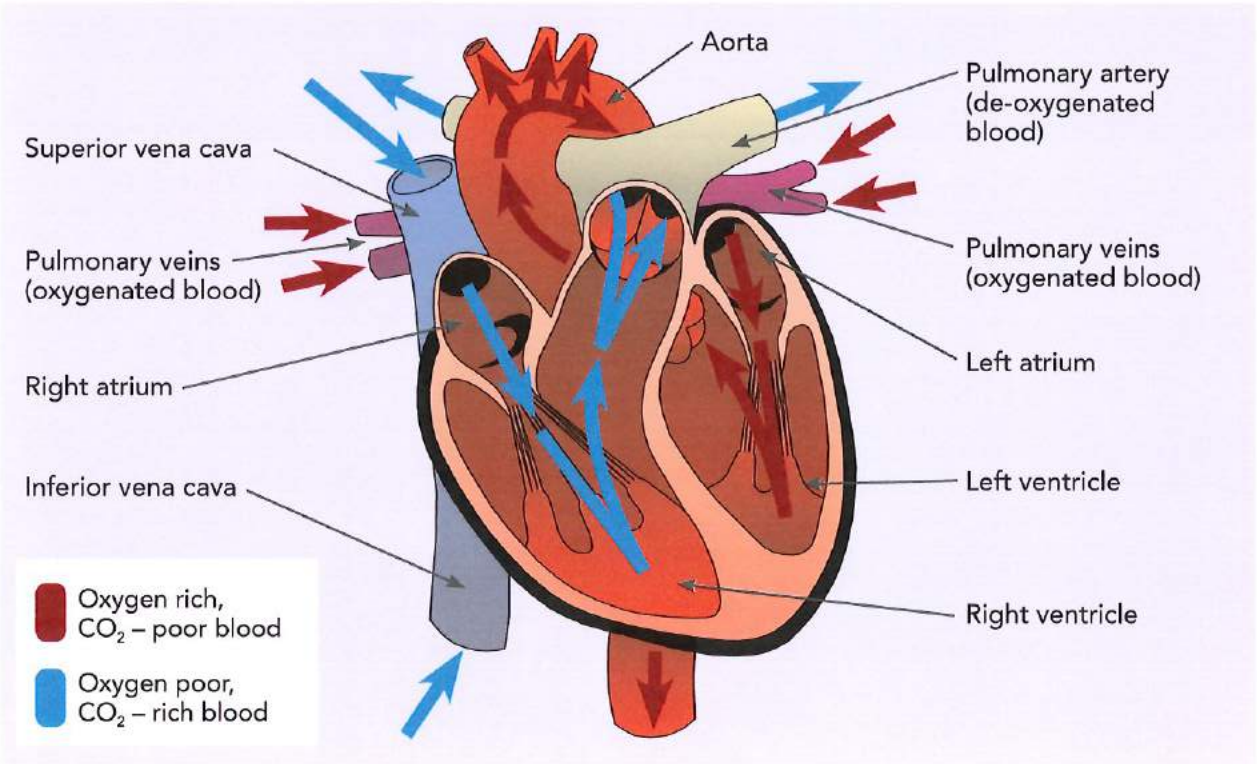
The term 'cardiorespiratory', as it sounds, refers to the heart (cardio) and lungs (respiratory). In this section, we will explore the heart, lungs, as well as the cardiovascular (heart and blood vessels) system. Take a deep breath, and in many respects that is exactly what this section is about, the journey of that breath of air through the body during rest and exercise.

Objectives

By the end of this section, the learner should be able to:

- identify the location and describe the function and structure of the heart
- describe how blood moves through the four chambers of the heart
- describe systemic and pulmonary circulation
- describe the structure and function of blood vessels
- define blood pressure
- identify blood pressure classifications
- identify the location, function and structure of the lungs
- identify the main muscles involved in breathing
- describe the passage of air through the respiratory tract
- describe the process of gaseous exchange of oxygen and carbon dioxide in the lungs.

The heart



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The heart is located posterior to the sternum, just left of centre in the chest. It is about the size of a clenched fist and is responsible for pumping blood around the body. The heart consists of four chambers: two upper atria and two lower ventricles. The walls of the four chambers are made of cardiac muscle, called the myocardium. Coronary arteries, which surround and pierce the heart, deliver oxygen-rich blood to the myocardium, which is necessary for the muscular contraction of the heart.

As illustrated in the diagram, the atria receive blood from the body or lungs and the ventricles pump blood to either the body or lungs.

The left atrium receives oxygenated blood from the lungs via the pulmonary veins. The left ventricle pumps oxygenated blood through the aorta (the largest artery in the body) to the rest of the body. The walls of the left ventricle are thicker than those of the right. This enables the left ventricle to contract more forcefully than the right. Two large veins (inferior and superior vena cava) return de-oxygenated blood from the body to the right atrium. When the right ventricle contracts, de-oxygenated blood is pumped to the lungs.

Heart valves between the atria and ventricles, aortic and pulmonary arteries determine the pathway of blood through the heart and stop the backward flow of the blood.

The cardiac cycle

The cardiac cycle is the sequence of events in one beat of the heart (the alternate contraction and relaxation of the heart). The contraction phase is called systole, which causes a volume of blood to be pumped to the arteries. When the heart relaxes, this is called the diastole and blood flows into the heart from the veins. This cycle of events helps to keep the blood moving from the veins through the heart and to the arteries.

Heart rate

A healthy adult has a resting heart rate of between 60–80 beats per minute (bpm), whereas a well-conditioned individual tends to have a resting heart rate of around 35–50 bpm. The heart is a muscle and, just as skeletal muscles get stronger when exercised, so does the heart. The muscular walls of the left ventricle can sometimes increase in size, this is called cardiac hypertrophy.

Stroke volume

The stroke volume is the amount of blood pumped by a ventricle per heartbeat. A normal stroke volume at rest is between 70–80ml per beat. In well-trained individuals, the stroke volume at rest is 100–110ml per beat. During exercise, the stroke volume increases. In well-trained individuals, values as high as 200ml per beat have been recorded.

Cardiac output

Cardiac output is the amount of blood pumped out by the ventricles in one minute. During exercise, cardiac output must increase to meet the body's demand for oxygen.

A simple formula enables cardiac output to be determined:

Cardiac output = stroke volume x heart rate

If an average stroke volume is 71ml, and an average resting heart rate is 70 bpm, then:
Cardiac output = 71ml x 70 bpm = 4,970ml per minute, or nearly 5 litres of blood

As previously indicated, a key adaptation to a regular endurance exercise programme is that the resting heart rate decreases and stroke volume increases. For example, a well-trained individual whose stroke volume is 100ml and heart rate is 50 bpm has a cardiac output of:

100ml x 50 bpm = 5,000ml

Cardiac output can be maintained with fewer beats in such individuals.

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Blood pressure

Blood pressure is defined as the amount of pressure that is exerted on the walls of the blood vessels as blood moves through them. This is vital for driving the circulating blood through the blood vessels to the various places in the body, forcing it through the tiny capillaries, and enabling it to move upwards against gravity.

The pressure of blood flowing through the arteries varies is due to the pumping action of the heart. When the heart contracts, blood is pumped out of the heart and into the arteries under the highest pressure. When the heart relaxes, and before it pumps again, the pressure in the arteries is at its lowest. The pumping and relaxing phases of the heart are referred to as 'systolic' and 'diastolic', respectively. Without this pressure, blood would gravitate, or pool, in the lowest parts of the body.

When blood pressure is measured, this measurement records the pressure in the arteries of these two phases. A typical measurement would be: 120/80mmHg.

The first number represents the highest level blood pressure reaches when the heart contracts (systolic) and pumps blood into the arteries. The second number represents the lowest level blood pressure reaches when the heart relaxes (diastolic).

Blood pressure is constantly changing to meet the body's needs. It is normal for it to increase during exercise and to decrease in periods of rest, such as when sleeping. Long-term, regular aerobic exercise can have a normalising effect on elevated blood pressure.

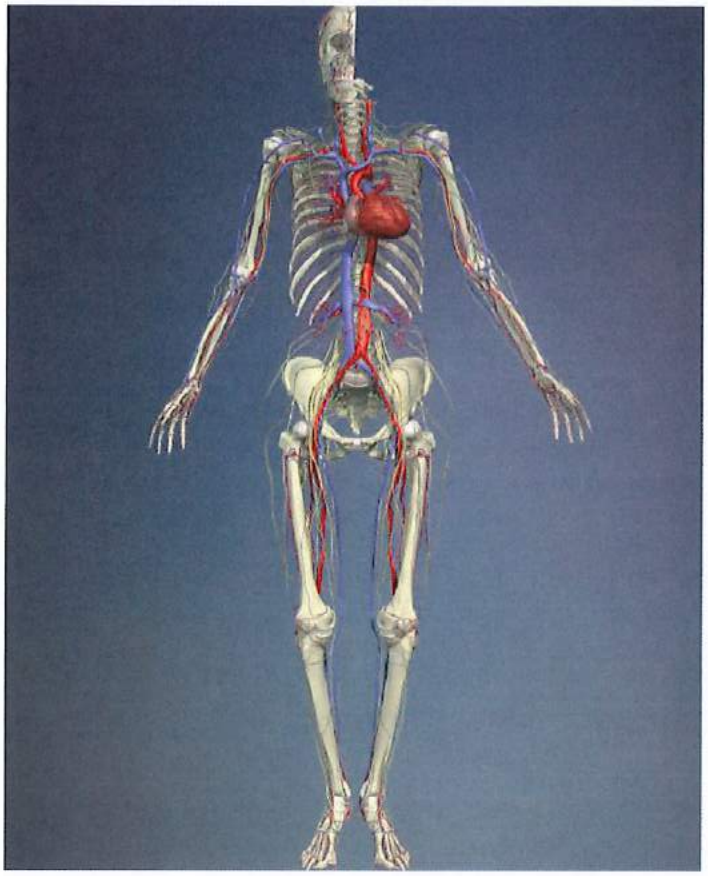
Sources for acceptable ranges of normal blood pressure can be found from the following:
National Institute for Health and Clinical Excellence (NICE)
World Health Organisation (WHO)
American College of Sports Medicine (ACSM)

Key points for the heart

- The heart is a two-sided pump with four chambers.
- The right atrium receives de-oxygenated blood from the veins of the body.
- The right ventricle pumps de-oxygenated blood to the lungs via the pulmonary arteries.
- The left atrium receives oxygenated blood from the lungs via the pulmonary veins.
- The left ventricle pumps oxygenated blood to the body via the aorta.
- The cardiac cycle consists of two phases: systole (the contraction phase) and diastole (the relaxation phase).
- Blood pressure ensures that circulating blood reaches all parts of the body and moves upwards, against gravity.
- Stroke volume is the amount of blood pumped out by the ventricles in one contraction.
- Cardiac output is the amount of blood pumped out by the ventricles in one minute and is a product of heart rate and stroke volume.
- The heart receives oxygen-rich blood from the coronary arteries.
- The heart adapts to regular endurance training by decreasing the resting heart rate and increasing the stroke volume. Hence, the cardiac output can be maintained with fewer beats.

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The vascular/circulatory system



The vascular, or circulatory, system consists of the arteries and veins through which the heart pumps blood throughout the body.

The prime purpose of the vascular system is the transport and exchange of materials (oxygen, carbon dioxide, nutrients, hormones, heat, metabolic waste products and protective white cells) between the blood and tissues, which takes place in the capillaries.

Blood

Blood is a mixture of blood cells carried in a liquid called plasma. Two types of blood cells are particularly important. Red blood cells transport oxygen, and white blood cells are important to the immune system. Blood also carries nutrients, hormones and medicines.

Blood vessels

Arteries

The arteries carry blood from the heart to the capillaries. Arteries become progressively smaller, becoming arterioles as they reach the tissues.

Arteries are characterised by their thick muscular walls, made up of smooth muscle and elastic connective tissue, which assist in the maintenance of blood pressure. Following ventricular contraction, the pressure and recoil of the artery wall contributes to blood pressure. The pressure in the large arteries is very high, but diminishes as the arteries become smaller and get further away from the heart. Without this pressure, blood would gravitate to the lowest parts of the body. Blood pressure enables the circulating blood to move upwards against gravity to supply blood to the brain, as well as forcing blood through the tiny capillaries.

Remember, that in general, the 'A' in arteries is useful to remember as 'Away' from the heart. Arteries transport oxygenated blood away from the heart. The only exception to this rule is the pulmonary artery, which transports de-oxygenated blood to the lungs, but it still carries blood away from the heart.

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Veins

Veins carry blood under low pressure from capillaries back to the heart. Smaller veins are called venules. The walls of veins are made up of smooth muscle and connective tissue. The key ways in which veins differ from arteries are that they have thin fibrous walls and one-way valves at regular intervals to prevent the backflow of blood.

Remember this: the pulmonary vein transports oxygenated blood from the lungs to the heart; all other veins carry de-oxygenated blood.

Venous return is the amount of blood that is returned to the heart by the veins. The heart can only pump the blood that it receives. If venous return decreases, the heart contracts less forcefully, causing a decrease in blood pressure.

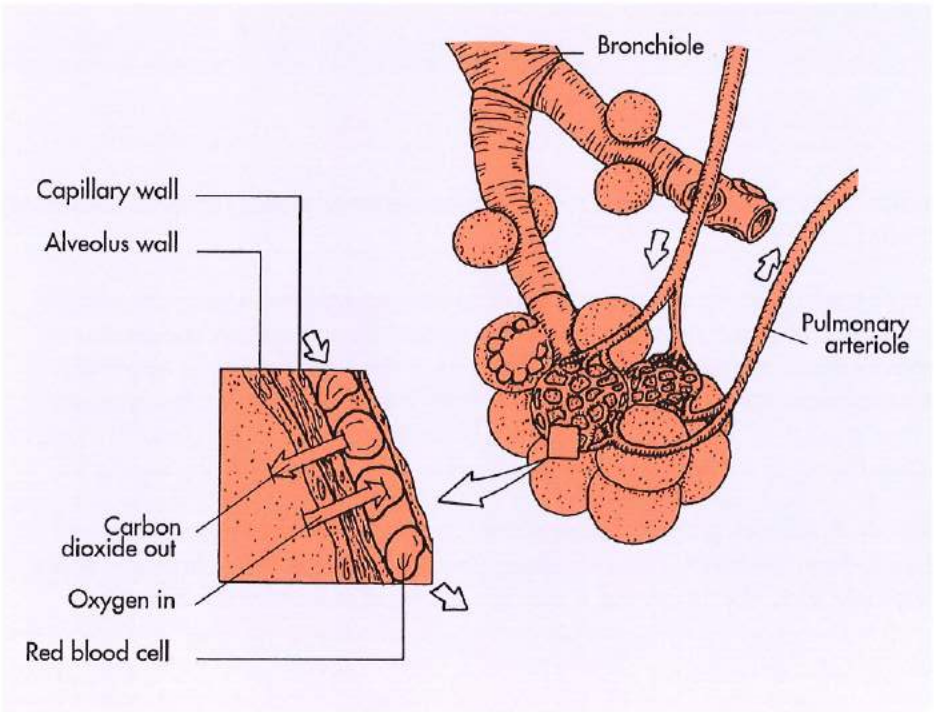
Capillaries

Capillaries carry blood from arterioles to venules. The capillary walls are only one cell thick. It is in the capillaries that the exchange of materials between the blood and tissues takes place. The process by which this exchange occurs is called diffusion.

Recall that the walls of the blood vessels are made from smooth muscle and connective tissue. With increasing age (as well as some illnesses and disabilities), blood vessels become less elastic and therefore less efficient carriers of blood. One example of this is when vessels become susceptible to atherosclerosis. This is when the inner walls of arteries become coated in places with atheromatic plaques: cholesterol-containing material that occludes the vessels, preventing efficient blood circulation. Since the functioning of all tissues is dependent on good blood circulation, these factors have widespread effects on this system.

Diffusion

Diffusion is the movement of molecules from an area of greater concentration to an area of lesser concentration. Within the body, oxygen and carbon dioxide move by diffusion. An example of this is in the lungs, where there is a low concentration of oxygen in the blood of the pulmonary capillaries. The opposite is true for carbon dioxide. In this case, oxygen diffuses into the capillary and carbon dioxide diffuses across the capillary membrane and into the lungs. In each case, the gases move from where there is more to where there is less.



Diffusion that occurs in the exchange of gases (oxygen and carbon dioxide) within the lungs is also known as gaseous exchange.

In the capillaries within muscles, oxygen diffuses from the blood (high concentration) to the tissues (low concentration), while carbon dioxide diffuses from the tissues (high) to the blood (low) to be brought back to the lungs and exhaled.

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Circulation

The vascular system has two major pathways of circulation. These are pulmonary (lungs) and systemic (body).

Pulmonary circulation

Pulmonary circulation is the flow of blood from the right side of the heart to the lungs and then back to the left side of the heart.

The right ventricle pumps de-oxygenated blood via the pulmonary arteries to the lungs. Pulmonary diffusion then takes place in the lungs. Carbon dioxide is exhaled and oxygen is inhaled. This exchange takes place via the pulmonary capillaries. The capillaries unite to form venules and then veins and finally to form the two pulmonary veins from both lungs that return oxygenated blood to the left atrium.

Systemic circulation

Systemic circulation is the flow of blood from the left side of the heart to all parts of the body and then back to the right side of the heart.

The left ventricle pumps blood via the aorta into the arteries, arterioles and capillary networks throughout the body. The capillaries merge to form venules and veins. The veins return blood to the right atrium.

Key points of the vascular system

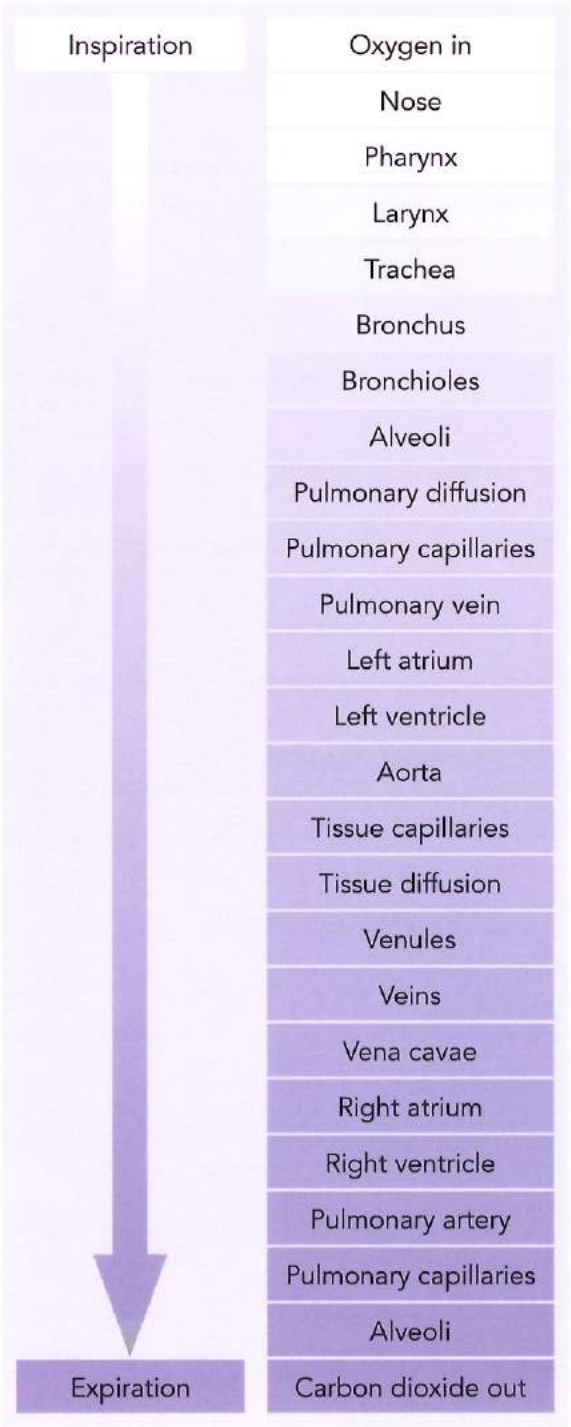
- The vascular system transports and exchanges materials (oxygen, carbon dioxide, nutrients, hormones, heat, etc.) between blood and tissues.
- Arteries have thick muscular walls and, in general, transport oxygenated blood from the heart to the capillaries.
- Veins have thin muscular walls and, in general, transport de-oxygenated blood, under low pressure, from capillaries back to the heart.
- Oxygen and carbon dioxide transfer occurs in the lungs and tissues by diffusion.
- Pulmonary circulation is the movement of blood from the right side of the heart to the lungs and then back to the left side of the heart.
- Systemic circulation is the movement of blood from the left side of the heart to the body and then back to the right side of the heart.

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The respiratory system

The respiratory system is involved in breathing, that is, the movement of air in and out of the lungs. The lungs are located in the chest either side of the heart. They are the site for the exchange of oxygen and carbon dioxide between air and blood. All human cells must obtain oxygen to carry out cell respiration in order to produce ATP (aerobic energy system – see previous unit) and eliminate carbon dioxide, which is its waste product.

The oxygen used by the body is derived from the air we breathe. Pure, dry air contains 78% nitrogen, 21% oxygen and traces of other gases. Normal air usually also contains water vapour, dust pollen, germs, poisonous gases and other pollutants and the carbon dioxide content is near to 0.04%.



Air enters and leaves the respiratory system via the nose or mouth. Nasal breathing is better for the body because air is warmed and filtered in the nasal cavities.

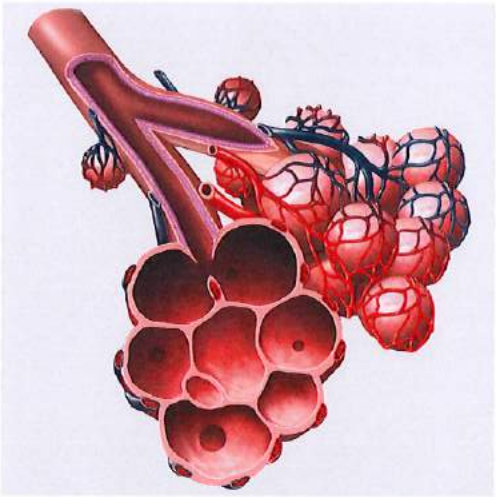
From the nose or mouth, the air then passes through the pharynx, or throat. This lies behind the nose and mouth and both cavities open onto it. From here, it goes to the larynx, often also called the voice box. The cavity of the larynx is separated from the pharynx by a flap, called the epiglottis, which prevents food from entering the trachea, or windpipe, and into the lungs.

The trachea is cylindrical, 10–13cm in length and kept open by a series of rings of cartilage. At its lower end, the trachea divides into two bronchi. One bronchus leads to each lung, and this then breaks up into even smaller bronchioles. The bronchioles terminate in clusters of alveoli (often called air sacs) which are surrounded by pulmonary capillaries, the site of gaseous exchange (pulmonary diffusion).

In the young, these structures are extremely sensitive. Any inhaled debris would usually cause vigorous coughing to expel it. However with age, they become less sensitive, so a coughing reflex may not be initiated in response to inhaled material. This increases the chance of irritants reaching the lungs.

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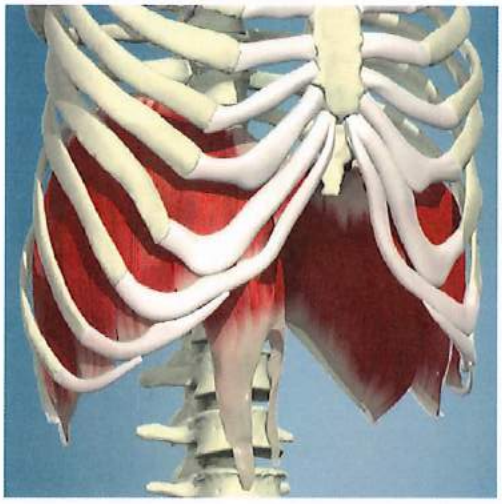
The alveoli



The alveoli are the functional units of the lungs, and there are millions of alveoli in each lung. A network of pulmonary capillaries, in which diffusion takes place, surrounds each alveolus. Carbon dioxide passes through the single cell walls into the alveolus to be breathed out while oxygen passes into the capillary from the alveolus. This oxygenated blood is then collected into veins and returned to the left atrium by the pulmonary vein.

As a person ages, there is a reduction in the number of alveoli. Gradually, they begin to take on a flattened appearance resulting in a reduction in the alveolar surface area available for diffusion to take place.

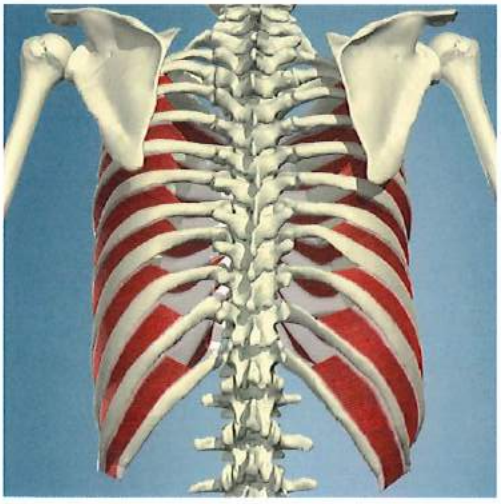
The breathing action



Breathing is the result of the movement of the ribcage and changes in volume and pressure in the alveoli. The main respiratory muscles are the diaphragm and the internal and external intercostals.

The diaphragm is a dome-like muscle situated below the lungs. It flattens when it contracts, increasing the capacity of the chest cavity. At the same time, the contents of the abdomen are pushed downwards, causing a slight forward bulge.

The intercostal muscles are found between the ribs. The external intercostal muscles pull the ribs upwards and outwards. The internal intercostal muscles pull the ribs downwards and inwards.



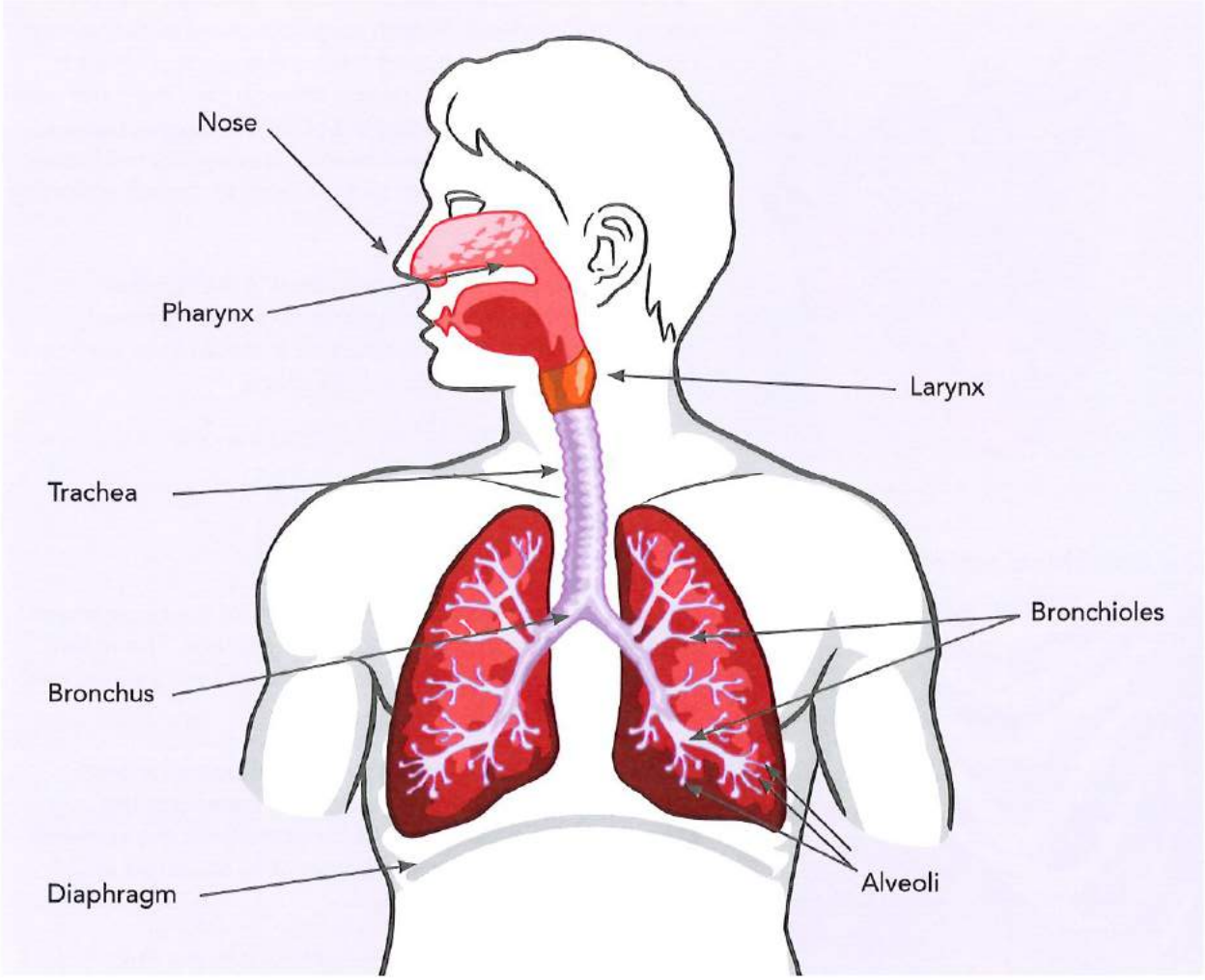
Inspiration, or inhalation, occurs when the diaphragm contracts, moves downwards and expands the chest cavity. The external intercostal muscles pull the ribs upwards and outwards. The alveoli expand and air is taken into the lungs.

Expiration, or exhalation, occurs when the diaphragm and external intercostals relax. As the chest becomes smaller, the lungs are compressed and their elastic connective tissue recoils and compresses the alveoli, forcing air out.

In the young, the chest wall is relatively supple and elastic, thereby providing an efficient breathing action. With increased age, there is a gradual increase in rib calcification and gradual age-related reduction of the respiratory muscles.

As a result of these changes, the process of breathing becomes less efficient. This is particularly apparent in individuals who have been inactive, which we know promotes muscle wastage and weakness.

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The content of exhaled air will change due to the requirements of the body. Oxygen levels will drop to approximately 16% as the body uses oxygen to produce energy via the aerobic energy system. Nitrogen and the other rare gasses remain the same, while carbon dioxide levels increase to 4%, due to the production of carbon dioxide during aerobic energy production.

Breathing goes on continuously and, for much of the time, unconsciously. It is controlled by the respiratory centre of the brain, which responds very quickly to slight changes in the carbon dioxide concentration in the blood. Even a small increase in the carbon dioxide level can greatly increase the volume of air breathed in and out. Lack of oxygen also affects the breathing rate, but this is detected mainly by sensors in the large blood vessels in the neck.

At rest, the breathing rate is normally about 12–14 breaths per minute and the tidal volume (amount of air involved in one normal inspiration and expiration) is about 0.5 litres, or roughly 6–7 litres per minute.

The capacity of the lungs varies in accordance with the size and age of the person. Taller people tend to have larger lungs than shorter people. As we age, the elasticity of the lungs diminishes, thereby reducing their ability to recoil, impairing the lungs' ability to suck in and push out air.

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Key points for the respiratory system

- The pathway by which air travels to the lungs is: nose – pharynx – larynx – trachea – bronchus – bronchioles – alveoli.
- Gaseous exchange occurs in the capillaries of the alveoli. Carbon dioxide is breathed out, and oxygen is taken in.
- The pathway by which oxygen is taken to the heart is: alveoli – capillaries – pulmonary vein – left atrium.
- Oxygen combines with haemoglobin in the red blood cells for transportation. The main respiratory muscles are the diaphragm and intercostals.
- Breathing is controlled by the respiratory centre of the brain and is determined by the concentration of carbon dioxide in the blood.

Special populations and the cardiorespiratory system

Children

Children have a decreased blood volume in comparison to adults. Among other factors, this is one of the reasons why children are less efficient at temperature regulation and heat up faster and overheat more easily than adults.

Children's heart chambers are smaller and less powerful than adults'. For this reason, their maximum heart rate (MHR) is higher and the stroke volume of the heart is less. They are less efficient at processing oxygen and require a high uptake of oxygen for aerobic activity, as well as having a limited ability at working anaerobically.

Pregnancy

Pregnancy also affects the respiratory system.

During pregnancy, blood volume increases by approximately 30%. Blood becomes more dilute, with fewer red blood cells. Stroke volume and cardiac output increase as a result of the extra muscle tissue laid down within the heart (due to the influence of oestrogen). Resting heart rate increases by approximately 10–15 beats per minute, also contributing to increased cardiac output. Blood vessels are dilated by the relaxing effect of progesterone. Venous return can be reduced due to the foetus pressing on the blood vessels of the pelvic area.

The oxygen requirement of the foetus increases gradually to 20% from the 18th week of pregnancy to meet the additional needs of mother and foetus. At this time, carbon dioxide receptors in the brain also become more sensitive. This results in pregnant women becoming more breathless; some may even hyperventilate. Lung volume changes and breathing deepens. The diaphragm is forced up in the later stages of pregnancy, resulting in reduced total lung capacity. The ribs move upwards and outwards by 10–15cm to assist breathing.

During this period, supine hypotensive syndrome occurs when lying on the back. This is when the uterus presses on larger blood vessels, reducing venous return and cardiac output, leading to dizziness, loss of consciousness and a reduction of blood supply to the foetus.

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Ageing

It has been reported that from 30–70 years of age, the cardiovascular system shows a decline of 30%. Certain physiological changes are inevitable with age, but some of the changes that occur are actually due to a lack of activity that often accompanies ageing. Regular exercise can slow the physiological changes of ageing by as much as 50%. It is therefore conceivable that an active 60-year-old can have a more efficient cardiovascular system than an inactive 25-year-old.

Some of the main age-related changes to the respiratory system are as follows:

- decreased cardiac output
- reduction in VO2 max
- decreased maximum heart rate (MHR)
- reduced efficiency of the circulatory and respiratory systems as a result of specific changes to its many components
- increased blood pressure
- reduced tolerance to lactic acid and fatigue.

Disability

There are a range of medical conditions and disabilities that have an impact on the function of the cardiovascular and respiratory systems specific to each individual.

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The nervous system

Introduction

The nervous system acts as the communication system within the human body. It controls the actions of bodily systems by responding to incoming information.

Objectives

By the end of this section, the learner should be able to:

- describe the role and functions of the nervous system
- describe the principles of muscle contraction
- describe the all or none law/motor unit recruitment
- describe how exercise can enhance neuromuscular connection and improve motor fitness.

The nervous system performs three main roles in the body: sensory, integrative and motor. These act to:

- sense changes (sensory) occurring inside and outside the body (eg, the external environment)
- analyse and interpret incoming information (integrative)
- respond to the interpretation made by activating the relevant body system (motor).

For example, by muscles or glands, speeding up breathing rate or controlling simple reflex actions.

These functions of the nervous system ensure that the body maintains balance in order to operate effectively and efficiently. This is known as homeostasis.

To achieve homeostasis within the body, the nervous system is divided into two main sections: central and peripheral.

Central nervous system (CNS)

The central nervous system is the main control centre of the body . This is where all the information that has been sent from the other systems of the body is collected and analysed, in preparation for a response. The central nervous system includes the brain and the spinal cord.

The brain weighs approximately 1.5kg (about 3lbs) and comprises two main lobes, the right and left cerebral hemispheres.

The cerebral hemispheres comprise sensory motor and association areas. The sensory areas are responsible for receiving impulses from the sense organs (eyes, nose, mouth and ears) via the peripheral nervous system. The association areas are connected with memory, thoughts and emotions. The motor areas activate the body systems by sending messages back via the peripheral nervous system.

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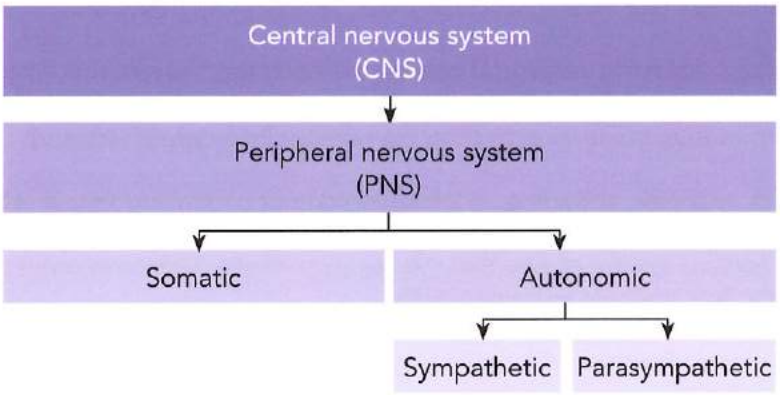
Peripheral nervous system (PNS)

The peripheral nervous system is responsible for all other nerve processes that branch out from the spinal cord and connect with receptors in the muscles, glands, blood vessels and organs.

There are 31 pairs of nerves that extend from the central nervous system. These supply all other parts of the body and form either the somatic or autonomic branches of the peripheral system.

The somatic part of this system is responsible for all voluntary actions, meaning those over which we have direct control (eg, contracting a muscle to lift a weight). The autonomic branch is responsible for all involuntary actions, meaning those over which we have no control (eg, digesting food, reflex actions and cardiorespiratory and gland function).

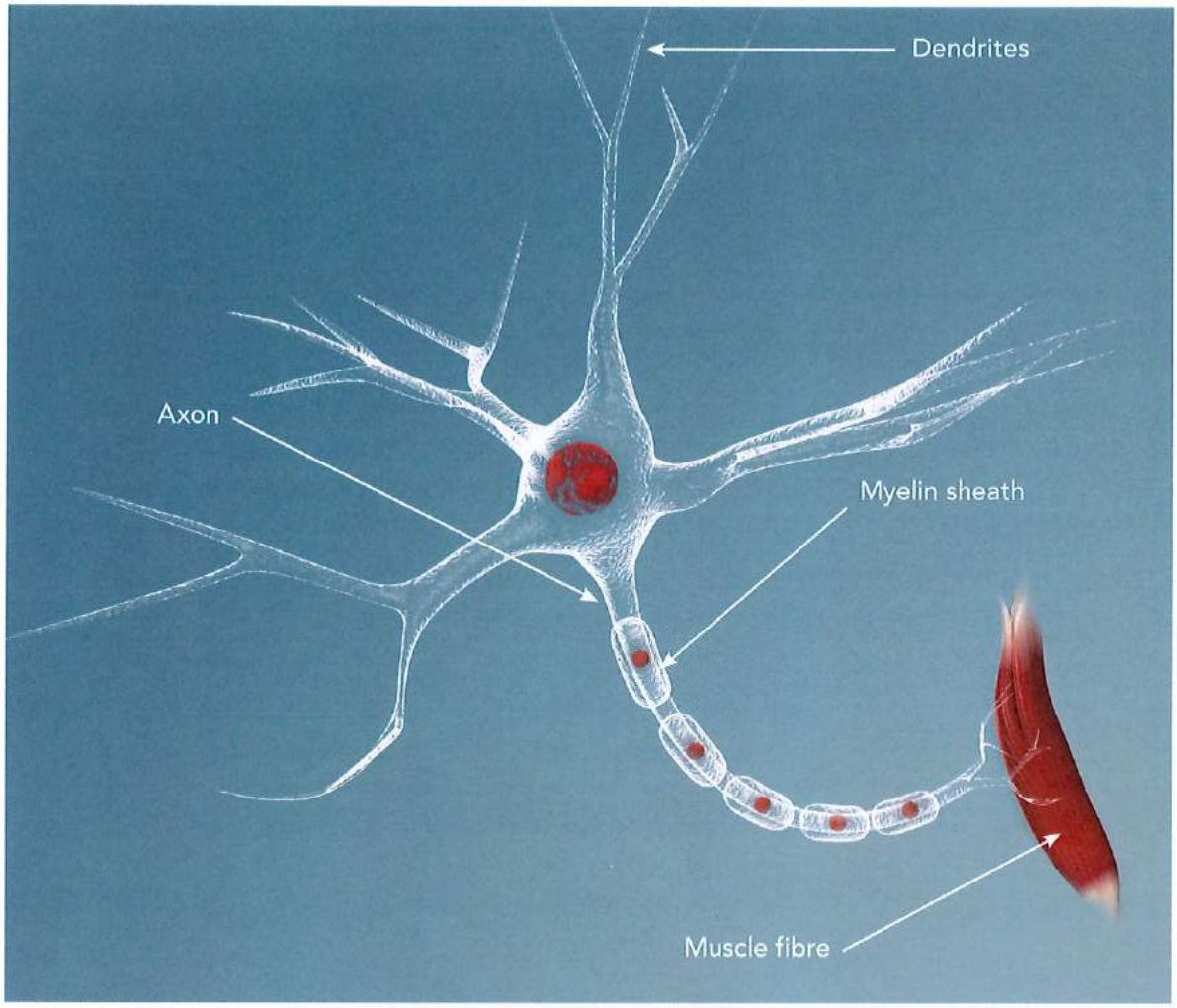
The autonomic branch of this system can itself be subdivided into the parasympathetic and sympathetic nervous systems. This is ultimately where the balance, or the homeostasis, of the body takes place. For example, when the heart rate needs to be increased to pump more blood around the body during exercise, this is the responsibility of the sympathetic nervous system. The sympathetic system is the accelerator – it speeds everything up. The parasympathetic system, on the other hand, acts as the brakes. For example, during the cool-down phase of an exercise programme, when less blood is required, the parasympathetic system brings about a reduced heart rate.



Nerve impulses

All messages, or impulses, that pass through the nervous system are transmitted by nerve cells. These nerve cells are called neurons. Neurons are the functional units of the nervous system and, essentially, the wiring system of the body. Each neuron is made up of a main cell body, dendrites and one axon. Extending from the main cell body are nerve fibres. These nerve fibres can be microscopic or up to one metre (3–4 ft) in length, and the longest fibres are those from the lumbar spine to the big toe. The cell body itself is responsible for directing information. Dendrites are responsible for transmitting impulses towards the cell body. The axon is responsible for transmitting impulses away from the cell body.

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The conduction of information along nerves requires the involvement of neurotransmitter chemicals produced by the nerve cells that allow the nerve signal to 'jump' from one nerve to the next. These chemicals allow the brain to interpret signals from the periphery and to respond mechanically. They are also extremely important in less obvious reactions, such as emotion, desire, blood pressure, pain and consciousness.

The two main types of neurons are:

1. Motor neurons
   These transmit the impulse messages from the brain to the muscles and glands.

2. Sensory neurons
   These transmit the impulse messages from the sensory organs to the brain.

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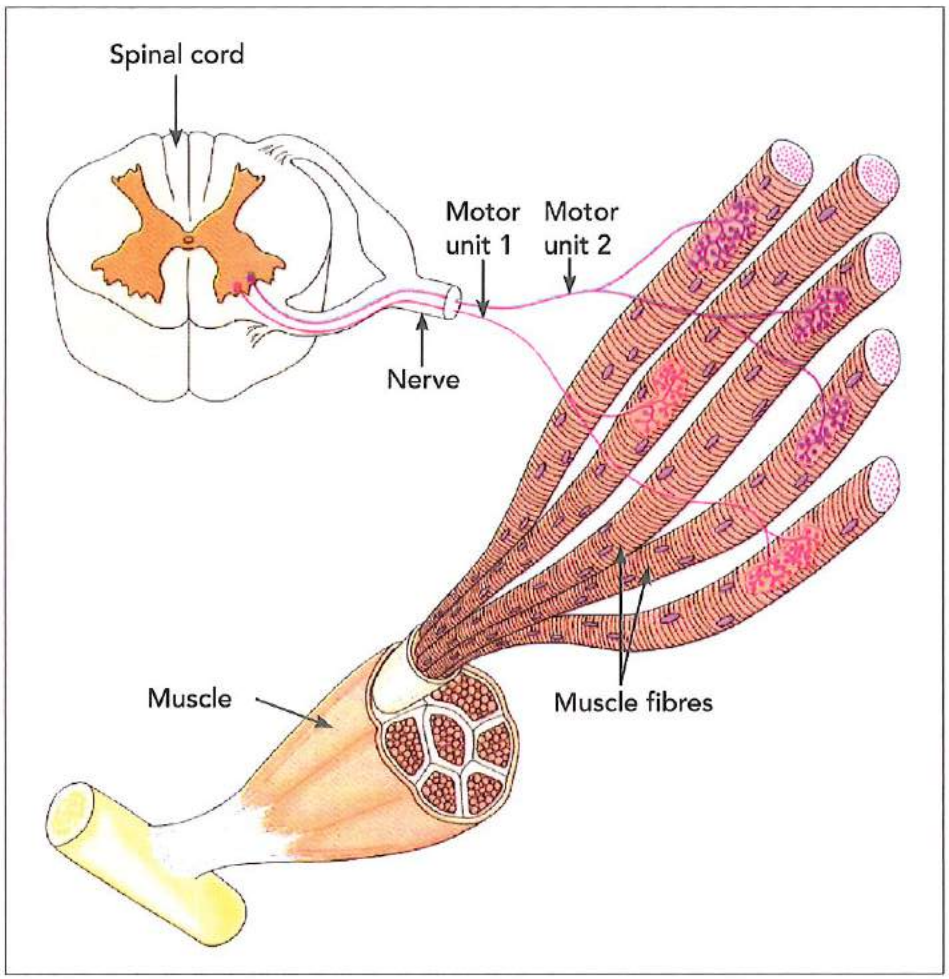
Motor neurons

Motor unit recruitment

Muscles are always in a slight state of tension, ready to react to a stimulus from their nerve supply. Without this 'tone', the body would collapse. When a nervous stimulus occurs, the muscle fibres work according to the 'all or none' principle. This means that muscle fibres do not partially contract; they contract fully or not at all.

Each muscle fibre is linked to the central nervous system by nerves. A motor unit consists of a single motor nerve (motor neuron) that connects to the muscle at the motor end plate. Therefore, all the muscle fibres in the motor unit receive stimulation from that motor nerve.

The strength of the muscle contraction will depend upon the number of muscle fibres brought into use. For example, to lift a light weight, a few muscle fibres within the muscle will contract to their maximum; the rest will remain inactive. To lift a heavier weight, more muscle fibres will be required. This process is called motor unit recruitment.



The muscle fibres in any given motor unit are distributed throughout the entire muscle, but only a few motor units need to be activated to bring about co-ordinated muscle contraction. This arrangement allows individual motor units to alternately switch on and off when work is performed.

The two key factors that affect the strength of a muscle contraction are the frequency of nerve impulses and the number of motor units activated. As the frequency of nerve impulses increases, so too does the strength of the muscle contraction, and as the frequency of nerve impulses decreases, so the strength of muscle contraction decreases.

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One of the major adaptations to exercise training is improvement in the frequency of nerve impulses to muscles (neuromuscular pathways). Parallel to this is an increase in the number of motor units recruited; the more motor units activated by the central nervous system, the stronger the muscular contraction.

Nervous system responses are essential for life. As with any other system in the body, the nervous system can be improved with regular motor skill training, which results in the following adaptations:

- strengthening/growing new connections within the nervous system
- speeding up the frequency of nerve impulses to motor units
- improving synchronous recruitment of motor units, resulting in stronger muscle contraction.

Special populations and the nervous system

The nervous system is extremely complex. Unfortunately, this very complicated system can go wrong before, during and after birth. There are hundreds of disabling neurological diseases and disorders. These are very complex and therefore require specialist knowledge and care.

It is thought that ageing can bring about deterioration in the manufacture of the neurotransmitters, thereby interfering with nerve transmission. Additionally, ageing causes the internal architecture of the nerves to become deranged which affects the flow of chemicals through the nerve fibres. This results in a slower central processing time.

Some decline in nervous system function as we age can be attributed to poor blood supply (another ageing factor, mentioned earlier).

Increased risk of falls also can be attributed to the nervous system. The balance centre in the brain relies on information coming from the muscles. If any of this information is faulty or delayed, then balance may be affected.

Key points for the nervous system

- The nervous system controls the actions of all bodily systems.
- The central nervous system (CNS), comprising the brain and spinal cord, has three main roles in the body: sensory, integrative and motor.
- The peripheral nervous system (PNS) consists of all other parts of the nervous system.
- The PNS is divided into two parts: the somatic (voluntary) and autonomic (involuntary) nervous systems.
- The autonomic system is further divided into the sympathetic system (the accelerator) and parasympathetic system (the brakes).
- Homeostasis ensures balance within the body, enabling it to operate effectively and efficiently.
- Nerve cells (neurons) transmit information to and from the brain by chemicals (neurotransmitters) that allow the brain to initiate the correct response.
- A motor unit consists of a motor nerve (neuron), motor end plate and all the muscle fibres contained within the unit. Muscles work on an all or none principle. The number of motor units activated and the frequency of the nerve impulses affect the strength of a muscle contraction.

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Health, safety and welfare in a fitness environment

Introduction

This unit explores how to maintain health, safety and client welfare in a fitness environment, looking at relevant policies and procedures relating to these areas. It is designed to give health and fitness professionals an understanding of the requirements so they are able to effectively carry out their role within the industry.

Understanding emergency procedures in a fitness environment

Introduction

In this section, we will look at the different types of emergency that may occur in a fitness environment. We will also look at the roles and responsibilities different parties may play during such emergencies and how best to react in an emergency situation.

Objectives

By the end of this section, the learner should be able to:

- identify different types of emergency that may occur in a fitness environment
- describe the roles and responsibilities of both staff and external services during an emergency
- describe internal accident and emergency procedures
- describe how to contact emergency services
- describe how to report the incident or accident in an emergency
- list the instructions to be given to both internal staff and external services
- list the different types of emergency that may occur in a fitness environment.

There are many potential emergency situations that could arise during a fitness instructor's shift. It is important to be aware of the potential hazards in order to limit their likelihood. In addition, it is important to have knowledge of and be prepared for any emergency situation.

Medical emergencies

In today's fitness environments, more participants are attending facilities with pre-existing medical conditions. Some participants with pre-existing medical conditions are actively encouraged by their GP to begin a fitness regimen. Common medical conditions that may be encountered include:

- hypertension – high blood pressure
- CHD – coronary heart disease (known and unknown to the individual)
- cancer – in remission
- recovery from major and minor surgical operations
- musculoskeletal injuries
- obesity
- diabetes mellitus.

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With the increase in the number of participants with pre-existing medical conditions comes the increased risk of a medical emergency happening during an exercise session. Possible medical emergencies and their symptoms are as follows:

- angina – chest pain, chest tightness when performing physical activity
- heart attack – chest tightening, pain spreading to shoulders, neck and arms
- asthma attack – severe wheezing and coughing, rapid breathing, anxiety and panic
- anaphylactic shock – itching, red raised blotchy skin, swelling and shortness of breath
- transient ischaemic attack (TIA) or minor stroke – sudden numbness, weakness to face, arm or leg, especially to one side of the body, sudden confusion or difficulty speaking, trouble walking, dizziness, loss of balance and co-ordination
- hypoglycaemic episode – hunger, shakiness, nervousness, sweating, dizziness and weakness.

If any of the above occurs to a participant, dial 999, call for an ambulance and follow the facility's emergency procedures.

Accidents

Fitness instructors should be familiar and confident with the equipment available on the gym floor, swimming pool, in a studio or outdoors. Instructors should have learnt how to use the equipment in a safe and effective manner and will also have taught countless participants how to use this equipment safely. This does not mean, however, that all instructors will always follow this advice and accidents often happen when least expected. In any facility with equipment, machinery and unsupervised or supervised exercise sessions, the potential for an accident to happen is present. Some of the more common accidents include:

- bruising or breaking of limbs caused by incorrect use of equipment
- fainting and banging the head caused by working at the incorrect intensity
- strains and sprains caused by incorrect use of equipment or over exertion
- heat exhaustion caused by dehydration, temperature or incorrect clothing
- cuts
- muscle spasms.

Even if precautions are taken to avoid incidents, there remains the potential for countless accidents to occur in any fitness environment. Fitness instructors need to be vigilant when supervising their areas and when an accident does occur, instructors must keep calm and follow the facility's emergency procedures.

Other emergency situations that could occur are:

- fire
- suspected bomb
- missing person
- chemical emergency (eg, in pools and plant rooms).

While these are relatively uncommon in the fitness industry, every fitness instructor needs to be aware of these potential hazards and the emergency procedures to follow if such a situation does arise. With the increase in families joining fitness facilities, the potential for missing persons (specifically children) is increasing.

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The roles and responsibilities of staff and external services during an emergency

General manager

The general manager has overall responsibility for the facility on a day-to-day basis. He or she is also responsible for the implementation and enforcement of all accident and emergency procedures.

Should an accident or emergency situation arise, the general manager should be informed of the situation immediately. He or she has the duty to ensure that all members of staff follow the company's emergency procedures correctly. This may include calling the relevant emergency services, looking after the patient, looking after any other members of the public affected by the situation, evacuating the building and making appropriate announcements, using the public address system if necessary.

Duty manager

The duty managers are the facility's managers at any given time when they are on shift. They will deal with the day-to-day management issues, such as member complaints, operational issues and staff issues. They will also have overall responsibility for the facility at times when the general manager is absent.

During an emergency situation, the duty manager will be informed of the situation and will follow the company's accident and emergency procedures correctly. If the general manager is absent, the duty manager will have overall responsibility for the situation and will need to ensure that all members of staff follow the emergency procedures.

First-aid personnel

In any facility, it is a requirement to have first-aid qualified personnel in the building in order to deal with any accident or emergency situations that may arise. There is a range of different first-aid qualifications that permit certain first-aid procedures to be performed, including administering CPR and the use of defibrillators. A list of first-aid qualified staff and their contact details should be kept in the facility.

During an accident and emergency situation, it is the responsibility of first-aid qualified personnel to administer first-aid to the patient. They must follow the appropriate protocols according to their role and first-aid qualification. If they are not qualified to use a defibrillator, they should pass this responsibility on to a suitably qualified first-aider.

Local GP surgery

If the accident is not serious but the patient requires medical attention, a first-aider or member of staff designated by the general manager may accompany the patient to their local GP surgery for medical attention by a doctor or practice nurse. Alternatively, the patient may choose to take themselves to their own GP in their own time.

Emergency services

The three key emergency services and their responsibilities are:

- fire brigade – attends fires, floods, chemical emergencies, trapped persons, etc.
- ambulance service – saves lives and provides care and treatment to anyone injured at the scene or if there is a risk of anyone becoming injured
- police – may move people to a safe place, keep people away from the scene and co-ordinate the activities of the other emergency services.

These emergency services can be contacted by dialing 999, whereupon the caller will be asked which emergency service is required. It is the responsibility of the emergency services to respond to the situation as quickly as possible and to prevent further harm, injury or damage to persons and property.

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Managing the accident or emergency situation

To manage an emergency situation effectively, those responsible should remain calm. Remaining calm is the only way to be able to stay focused on the steps that are needed. The responsible instructor should be able to help any injured or ill individuals until the arrival of the qualified first-aider, or be able to contact the emergency services and explain the situation in a calm and effective manner so they can help administer first-aid over the phone, if necessary.

It is also important that fitness instructors familiarise themselves with their organisation's health and safety manual, which will contain the appropriate accident and emergency procedures. Any updates to the manual will be communicated to all instructors by a member of staff and it is important to review the manual regularly to ensure familiarity with these procedures.

All workplaces should have an accident/incident record book. Any accidents or injuries must be recorded in this book, along with details of any first-aid that was administered, however small or insignificant. This serves as a record of the incident for reference, should the individual suffer additional complications at a later time, and helps protect instructors and the organisation if any legal action is taken by the individual at a later date.

To recap: whomever is the first on the scene at any incident must follow the organisation's accident and emergency procedures correctly. This may involve contacting the duty manager, contacting a qualified first-aider and/or calling the emergency services. It is important to remain calm, ensure any instructions or information that is provided is clear and easily understood and that any instructions given are recorded in the accident report book after the emergency is over.

Maintaining the safety of individuals in an emergency, including children, older people and disabled people

As a fitness instructor, it is important to be aware of boundaries of competence and capability in an emergency situation. To administer first-aid at work, one must hold a recognised 'first-aid at work' qualification. In addition to this, there are qualifications that enable individuals to administer CPR, use a defibrillator and administer first-aid to special population groups, such as children. When attending to an accident or incident, one should only operate within the limits of personal competence and qualifications. Leave the administration of first-aid to qualified personnel only.

If first on the scene at an accident, ensure that the type of injury or illness is identified, as this is essential for giving the correct information to emergency responders. Priorities should be to assess the situation without putting oneself in any danger, making sure the area and the casualty are safe, assessing the casualty and sending for help immediately. The first responder will need to decide whether the casualty requires the help of a qualified first-aider or the emergency services. If the casualty is unconscious, having difficulty breathing or appears to have a serious injury, it is important to call the emergency services without delay.

If the casualty is a child or disabled person, it is important to contact their parents/guardians, as they are legally responsible for the individual and are required to give their consent for any treatment or action taken in an emergency situation. If the parent or guardian is not present at the scene and the participant's condition is considered serious, it is important that they are called immediately to inform them of the situation and to gain their consent for treatment. If it is a minor incident (eg, a small graze), it should be recorded in the incident book, and the parent or guardian should be told about the incident and any treatment given by qualified personnel. Ask the parent or guardian to sign the record book, acknowledging the incident and confirming that they have consented to the treatment given.

In any accident or emergency situation, it is vital to provide comfort and reassurance to the casualty. This can be verbally (eg, using appropriate language in a calm manner) or physically (eg, holding the casualty until assistance arrives). There are situations where some physical contact may be deemed inappropriate, such as when dealing with children and disabled persons. If the casualty does not understand English, or has a learning difficulty, then it is important to try to ensure that the casualty is able to understand what is being said as well as their situation.

It is also important, where possible, to be aware of any medical issues, including medications or mobility restrictions, that may affect the casualty's immediate safety.

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Health and safety in a fitness environment

Introduction

In this section, we will be looking at why health and safety is important in a fitness environment, the legal and regulatory requirements for health and safety relevant to working in the fitness environment and key individuals' roles and responsibilities relating to the fitness organisation's health and safety policies and procedures.

Objectives

By the end of this section, the learner should be able to:

- outline why health and safety is important in a fitness environment
- identify the legal and regulatory requirements for health and safety in a fitness environment
- describe the duty of care and professional role boundaries in relation to special population groups
- describe the typical roles and responsibilities for health and safety in a fitness environment
- describe security procedures that may apply in a fitness environment
- describe the key health and safety documents relevant to the fitness environment.

Health and safety overview

It is the fitness instructor's responsibility to ensure that health and safety is treated as a priority within the fitness environment, regardless of which area, including: indoors, outdoors, fitness suite, studio and pool areas.

Not only should the fitness instructor be aware of the potential hazards in the fitness environment and what to do in the case of an accident or emergency, but they also have a responsibility to participants to ensure a safe working environment.

A fitness instructor is responsible for doing their utmost to ensure that any potential risks of an incident occurring are minimised. This may include checking equipment is well maintained and in good working order, ensuring pathways are kept clear from obstructions, keeping the wet side areas of a pool as clean and dry as possible and monitoring participants exercise techniques to avoid injury and being observant around the pool area.

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The legal and regulatory requirements for health and safety relevant to working in a fitness environment

There are several legal and regulatory requirements specific to your role as a fitness instructor that you need to be aware of, as detailed below.

1. Health and Safety at Work Act, 1974

This act is the basis of British health and safety law and sets out the general duties that employers have towards their employees and members of the public, as well as those employees have to themselves and each other relating to health and safety. The responsibilities can be summarised in the following two sentences:

Employer's responsibility – To ensure, so far as is reasonably practicable, the health, safety and welfare of all its employees.

Employee's responsibility – To take reasonable care of themselves in the workplace and to be mindful of the effects of their acts and omissions.

2. Register of Exercise Professionals' (REPs') code of ethical conduct

All fitness instructors who are REPs' qualified and are REPs' members sign up to the code of ethical conduct. Its aim is to establish, publicise and maintain industry standards and to inform and protect members of the public and customers using the services of exercise professionals. In short, it sets the industry standards. There are five principles relating to the code:

Principle 1 – Rights

Principle 2 – Relationships

Principle 3 – Personal responsibilities

Principle 4 – Professional standards

Principle 5 – Safe working practices

The full version of this code can be found on the REPs' website, www.exerciseregister.org.

Note: Also see the section 'Know how to support clients who take part in physical activity' in this manual.

3. Criminal Records Bureau – CRB checks

The Criminal Records Bureau provides access to criminal records and other relevant information to employers. The results of the checks carried out by CRB helps employers to make more informed decisions when recruiting people to work with children and vulnerable populations. As a fitness instructor who may work with children and vulnerable adults, an employer will carry out a CRB check.

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The duty of care and professional boundaries of a fitness instructor that apply in relation to special population groups

1. REPs'

As mentioned above, REPs' registered fitness instructors are bound by the REPs' code of ethical conduct relating to all members of the public, including special population groups.

2. Qualifications

Fitness instructors are only allowed to work within the limits of their individual qualifications and competence. As a level 2 fitness instructor, the qualification is permissible for work with apparently healthy adults. To work with specific population groups such as children, older adults, ante and post-natal women and disabled participants, an instructor must have a REPs' level 3 qualification. Without this, the instructor should refer anyone from the special population groups to an appropriately qualified fitness instructor or personal trainer. The level 2 fitness instructor qualification will give the instructor an awareness of the special population groups and this should equip the instructor with sufficient knowledge to judge whether the session being delivered is suitable for any participant who falls into one of those groups.

3. Informed consent

Informed consent is a legal procedure to ensure that the participant knows the risks involved in any assessment, exercise or treatment they are about to perform or undergo. Informed consent includes informing the participant of the nature of what is about to happen, possible alternatives and any potential risks and benefits. For the informed consent to be deemed valid, the client must be considered competent and the consent given voluntarily.

4. Informed consent by an appropriate adult, parent or guardian

For fitness professionals working within a fitness environment, there are many situations that require the consent of an individual (eg, fitness assessment, exercise programme or treatment after an accident). In the majority of cases, the participant is able to provide their own informed consent. However, there are some situations in which the participant is deemed not to be competent, including:

- children under the age of 16
- participants with learning difficulties
- participants with dementia
- participants suffering from mental ill health.

In these circumstances, it is the fitness instructor's duty to obtain informed consent from the participant's parent, guardian or a designated appropriate adult (eg, family member or social/health care provider).

5. Confidentiality

There are several situations in which a fitness instructor is in possession of confidential information relating to participants. This can include personal details, medical information, personal information relating to lifestyle or family matters. Instructors are duty bound to not share this data but to protect the confidentiality and privacy of the participant and show the utmost discretion in dealing with confidential matters.

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Key individuals responsible for health and safety in a fitness organisation and their roles

General manager

He or she has overall responsibility for the facility and is responsible for ensuring that policies and procedures are implemented and followed.

Duty manager

He or she may have overall responsibility for the facility in the absence of the general manager, is responsible for ensuring that policies and procedures are followed and for maintaining the day-to-day running of the facility.

'First-aid at work' qualified staff

This individual can administer first-aid within the limitations of their qualifications and competence. CPR qualified staff administer CPR if required; they are first-aid trained.

Defibrillator-qualified staff

This individual is qualified to use a defibrillator; they may also be first-aid qualified.

All on-duty staff

All staff must ensure that all policies and procedures are adhered to and executed accordingly.

Health and safety officer

He or she has specific responsibility for all health and safety matters, including risk assessments and compiling and implementing health and safety policies and procedures.

Director of the company

He or she is ultimately responsible for health and safety within the organisation. If any legal proceedings are taken as a result of health and safety issues, he or she would be ultimately liable.

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Security procedures in a fitness environment

There are many different types of security procedure in most fitness environments that serve to protect members of staff, the public and the facility. Some of these measures include:

Opening and closing the facility

Every fitness facility will have strict procedures to follow when opening and closing. This will include turning machinery on and off, checking lighting, equipment and alarms, ensuring the facility is empty of staff and participants and locking up.

Monitoring entry and exit

Most facilities will have a reception area where the receptionists can monitor members of the public entering and leaving the facility. Some facilities will have a swipe card system to gain access to the facility, some will manually record names of participants and visitors and some will have a gated entry system. This serves several purposes:

- It ensures that if there were an evacuation of the building, there would be a record of who or at least how many people were in the facility so that the emergency services can identify if anyone is left in the building.
- It may help in logging participants attending group classes or pre-booked activities to ensure that classes are not overcrowded.
- It can prevent intruders from entering the premises.

Fire and evacuation procedures

Every facility will have a fire and evacuation policy and procedure. All members of staff are required to know these procedures. These procedures will be practised regularly to ensure that they are adhered to by all on-duty staff.

Roll call procedures

In the event of an emergency evacuation of the facility, there will be a roll call at the agreed meeting point to ensure that no one has been left or is trapped in the building. These roll calls will be practised regularly to ensure all on-duty staff are aware of the procedure and can perform their duties as quickly and as safely as possible.

Chemical spillage procedures

Where there is a risk of chemical spillages occurring in a facility (eg, in a pool or plant room), there will be strict health and safety guidelines, policies and procedures that will need to be adhered to by all on-duty staff. These will vary between workplaces, but will be contained in the organisation's health and safety manual and must be adhered to by all on-duty staff.

Fire alarm testing

All fire alarms in any business premises are tested regularly to ensure that they are functioning correctly. An announcement will be made prior to the test that the fire alarms will sound at a certain time but that it is only a test and individuals within the facility do not need to evacuate the building.

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What are the key health and safety documents relevant in a fitness environment?

First-aid book

This is a quick reference guide to emergency first-aid and is most likely kept in or near the first-aid box. It covers how to deal with most incidents, including asthma attacks, bleeding, broken bones, burns, choking, CPR and diabetes.

Accident recording book

This is required under UK health and safety legislation. It is important to be aware of where this book is kept. It is provided to record accident information and will be part of the organisation's management policy on health and safety. It is a legal requirement that any workplace must keep records of any reportable injury, disease or dangerous occurrence. When reporting an incident, it should be recorded in the accident record book with the following details:

- date and method of reporting
- date, time and place of the incident
- personal details of all persons involved
- brief description of the nature of the event.

All records are required to be kept for a minimum of three years from the date on which the report was made.

Accident report forms

If your workplace does not keep an accident recording book on site, the legal responsibility remains the same – all incidents must be reported as above. In this situation, however, it is a requirement to complete an accident report form that will either be filed on site or to be sent to the person responsible for the organisation's health and safety implementation, who may be, in the case of larger organisations, at the company's head office. All instructors are responsible for ensuring that they know the process and procedures for reporting an incident.

Some accident report forms may be specific to an incident, including:

- report of an injury or dangerous occurrence
- report of a case of disease.

In these situations, it is essential to ensure that the correct accident report form is completed.

Manufacturer's guidelines on safe use and maintenance of equipment

Fitness environments usually have a large array of technical and complex fitness equipment for participants to use during exercise. All such equipment will come with a manual detailing the manufacturer's guidelines on how to assemble the equipment, how to use the equipment correctly and any maintenance required to keep the equipment in safe working order. These documents will be filed and kept safe within the facility, and instructors should be aware of where they are kept and be familiar with the content. Fitness instructors are often required to carry out basic maintenance on fitness machines within the fitness environment as part of their roles and responsibilities. This is usually performed on a regular basis and is scheduled according to the manufacturer's guidelines. In some larger establishments, a senior instructor or manager may have the sole responsibility of equipment maintenance. Instructors should be familiar with their employer's processes and procedures in this regard.

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Health and safety policies and procedures manual in line with the Health and Safety at Work Act, 1974

Employers are legally required to provide a written health and safety document that includes the company's policy on health and safety in accordance with the Health and Safety at Work Act, 1974. This manual will be updated regularly in line with legislation and changes in the workplace but will always include the following information:

- the company's health and safety statement
- the management organisation and structure for health and safety matters
- the health and safety responsibilities of individuals
- health and safety rules relating to working practices, procedures and accompanying guidance expected to be kept by staff, visitors and any contractors that might enter the workplace
- risk-assessment procedures, including a set of generic risk assessments
- accident reporting and disease reporting procedures.

The documents listed above will be tailored to the company's needs and requirements. Policies and procedures will be different in every workplace – for instance, a fitness environment with a swimming pool is likely to have a different set of policies than one without, as employees will be expected to carry out different tasks.

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How to control risks in a fitness environment

Introduction

While the fitness environment is considered a place of leisure or enjoyment for the majority of participants, it is also an environment with many potential hazards. In this section, we look at the different areas of the fitness environment and the potential hazards the fitness instructor needs to be aware of in order to help to prevent them.

Objectives

By the end of this section, the learner should be able to:

- identify hazards and understand how to control risks in a fitness environment in relation to the facilities, equipment, working practices, client behaviour, security and hygiene
- describe how to risk-assess the types of possible hazard in a fitness environment
- describe how to control the risks associated with hazards in a fitness environment
- identify the appropriate person to contact within a fitness organisation when hazards and risks cannot be controlled personally.

The potential hazards within a fitness environment

1. Facilities

Wet side

Water is a hazard, particularly where the pool has varying depths. Instructors need to be aware of the different hazards of the wet side, including:

- pH-testing of the water to stop the water becoming too acidic and causing eye injury
- correct pool temperature
- the changes in water depth (ie, shallow and deep areas and how they are managed)
- the use of electrical equipment in wet areas.

Space within the environment

There should be sufficient space within the facility and in the different environments to ensure that activities can be performed safely. Be aware of possible obstructions such as pillars that people might walk into or that might obstruct their view of visual instructions. Clients' clothing, water bottles and other personal belongings can also cause obstructions if left lying around the environment. Clients should be encouraged to store, or leave, their personal belongings in the appropriate place so as to minimise the risks of any accidents.

Entry and exits

Instructors must be aware of all the entry and exit points within the facility in case of an emergency. Ensure that they are kept clear at all times to allow immediate access or exit in the event of an emergency.

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Hydration stations

Instructors must be aware of where the hydration stations are in the facility and inform clients accordingly. Keep hydration stations clean and full at all times and encourage clients to drink throughout their session in order to avoid dehydration. Ensure areas around the stations are kept clean and dry – particularly the floor, to avoid clients slipping and falling.

2. Working practices within facilities

The organisation should have a manual of operational procedures that all instructors are required to follow. Self-employed instructors are still required to adhere to the organisation's policies and procedures while on the premises.

Operational procedures

Operational procedures are implemented to protect everyone within the fitness environment, including staff, clients and visitors. Failure to understand and follow the operating procedures can create hazards. Instructors should be aware of the organisation's operational procedures and how to comply with them. Failure to follow the operating procedures regarding the opening and closing of the facility could cause a potential fire hazard or security hazard.

Manual handling and lifting

It is important to ensure that both the fitness instructor and clients handle and lift all equipment in the exercise environment in a safe and effective manner. Incorrect handling and lifting of any equipment, such as free weights, portable equipment and electrical equipment, has the potential to cause serious injury.

3. Equipment

Fitness instructors should ensure that clients use the equipment appropriately for their own safety and that of others. Some general things to watch out for include:

- the incorrect machine is set up
- incorrect size equipment for the client (eg, correct size for children to use safely)
- the weight stack falling unexpectedly during an exercise
- poor or uncontrolled exercise technique
- the use of inappropriate resistance and loss of exercise technique
- the use of collars on free weights
- of the presence of hazards that may hamper the operation of equipment (eg, water bottles, towels and bags)
- free weights are not returned to racks.

Cardiovascular machines

Instructors should be familiar with the machines available within the facility and the hazards involved if they are not in good working order. Some general things to watch out for are:

- treadmill – loose or worn belt
- rower – damaged or worn cables and foot straps
- bike – damaged or worn foot straps.

Note: If the CV machine is powered by electricity, it is also important to watch out for loose connections and that the cable is not causing a trip hazard.

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Resistance machines

It is important to be familiar with the machines available within the facility and the hazards involved if they are not in good working order. Some general things to watch out for are:

- damaged or worn cables
- worn seats or pads
- worn or damaged adjustment pins
- stiff, jerky machine action.

Free weights

Instructors should be familiar with the different free weights available within the facility and the hazards involved if they are not in good working order. Some general things to watch out for are:

- worn, loose or broken collars
- worn or broken benches
- unstable barbell or dumbbell racks
- weights left out after use.

Portable equipment

All portable equipment should be checked to ensure that it is fit for purpose and safe to use, including the following types:

gym – elastic exercise bands, dumbbells, Swiss balls, BOSU, foam rollers, kettlebells
studio – elastic exercise bands, dumbbells, Swiss balls, BOSU, steps, skipping ropes
water-based – paddles, noodles, jog belts, hand weights, ankle weights, mitts, kick boards.

Note: Any of the above items has the potential to cause an injury or accident if not properly managed.

Storage of equipment after use

All equipment must been stored safely in the designated areas after use and, where appropriate, in accordance with manufacturer's guidelines. Remember that any equipment not stored correctly has the potential to cause injury.

Specific safety checks

Regular safety checks should take place according to the manufacturer's guidelines and the organisation's requirements. These checks may include the facility and equipment. How often checks are carried out may vary between organisations. Usually checks are made against a checklist, which will be signed by the person carrying out the check and passed on to the duty manager, who will take any necessary action.

Reporting mechanisms

There should be a reporting mechanism for the removal of damaged, faulty or out-of-order equipment. An 'out of order' sign should be clearly displayed or the machine/equipment should be removed from the environment.

Electrical equipment by poolside and wet areas

All electrical equipment installed in wet areas should comply with health and safety regulations. The correct equipment leads should be used, and these must be appropriately insulated. Cables, plugs and electrical connections leading into the wet area should be managed according to the manufacturer's and health and safety guidelines. Failure to correctly operate electrical equipment in wet areas could lead to a severe and potentially fatal incident, such as an electric shock.

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4. Client behaviour

Failure to ensure that clients behave appropriately within an exercise session could lead to many different hazards. As a fitness instructor, it is important to ensure that any etiquette policies are followed by all clients. Consider the following:

- Failure to implement an etiquette policy, such as participants not wiping the floor under their bikes after a spin class, could lead to another participant slipping and hurting themselves.
- The use of mobile phones could distract another participant from what they are doing, causing them to injure themselves.

Note: Clients who are putting themselves and others at risk and do not respond to a request made by a member of staff should be asked to leave the facility.

Young adults and children

While we want to encourage young adults (teenagers) and children to use our facilities, it is important to ensure that they are using the facilities in a safe and effective manner in order to prevent them hurting themselves or others.

In a fitness environment, young adults and children may wish to push themselves harder than the fitness instructor has recommended. This can cause long-term harm to their developing bones, joints and muscles, and they should be closely supervised at all times, paying particular attention to intensity and duration of exercises.

Failure to correct technique in young adults and children could cause long-term injury problems and permanent damage to their musculoskeletal systems.

Approaching clients

There may be certain situations in which you see a client, either on the gym floor or within a supervised exercise session, behaving in an unsafe manner. It is important to be able to approach them in a calm but effective manner and provide advice accordingly.

Clients performing an exercise with incorrect technique could cause themselves an injury or anyone else who tries to copy them. Therefore, it is important to advise them on how to perform the exercise safely and effectively. Clients who do not listen to instructions and are generally disruptive can cause themselves and others injury. In such cases, it is important to approach them and ask them to adhere to the etiquette policy or ask them to leave the area to prevent disruption and potential injury.

Referral to an appropriate colleague

To work with certain special population groups, fitness instructors require specialist training and qualifications in that area. Clients of specialist populations may have certain contraindications to exercise and other special considerations that need to be taken into account when prescribing or supervising exercise sessions. It is important to recognise this and refer them to an appropriate colleague with the relevant qualification. This includes the following:

- children under the age of 16
- older adults
- ante and post-natal women
- vulnerable adults with disabilities
- certain medical conditions, eg, cardiac rehabilitation.

Note: In all cases, incorrect exercise prescription by an unqualified fitness instructor for these groups may lead to severe medical complications, which in some cases could be fatal.

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5. Security

Individuals who should not be in the facility or the session can be a hazard. Consider the following:

- They may cause damage to the facility, harm persons within the facility and/or cause an emergency situation putting themselves and others at risk.
- The session might not be suitable for the client, potentially leading to injury (eg, the session is an advanced session and the participant is a beginner).

Procedures in the event of a fire or other evacuation situation are hazardous

In situations such as an evacuation, clients may panic and start running and many will not be thinking about other people's safety, rather just about exiting the building as quickly as possible. In these circumstances, clients may fall and hurt themselves or others. Instructors must assist people's exit of the facility in a calm and efficient manner.

Special considerations for children and vulnerable adults

If the instructor suspects a vulnerable adult or child has gone missing from the session or facility, or there are any concerns regarding their safety and security, it is essential to immediately report any concerns to an appropriate person so that the necessary actions can be implemented immediately.

When reporting any concerns regarding an individual's security, especially children and young adults, it is important to remain calm and to follow the health and safety policy and procedures contained in the health and safety manual.

In some emergencies, it will be necessary to either open or close the facility to protect individuals (eg, in the case of a missing person), and possibly to limit damage to the facility or property (eg, in the case of a fire). In these cases, it is important to already be familiar with procedures for the opening and closing of the facility. Failure to close a facility in the case of a missing child could lead to the child leaving the facility unnoticed.

6. Hygiene

It is important to ensure that maintenance and cleaning of all equipment is carried out regularly. This is usually done on a rota basis and reduces the risk of germs and disease spreading, as well as preserving equipment and ensuring it is in safe working order.

Clients should be encouraged to wipe down equipment after use for hygiene reasons (ie, to reduce the spread of germs and disease) and for safety reasons (eg, to prevent another client slipping and hurting themselves on wet or slippery equipment).

All floors should be kept clean and dry, especially after group classes to prevent another participant slipping and hurting themselves on a wet floor. Clients should be encouraged to clean up the areas they used and the fitness instructor should check the area afterwards to ensure that it is dry and no longer a hazard.

It is important that there are adequate facilities for clients to clean equipment after use, and fitness instructors should regularly check any towel dispensers to ensure they are well maintained and stocked. If there are no towels available for members to use, then it is likely that the hazards above will be more prevalent.

To prevent the spread of germs, bacteria and disease, it is important that fitness instructors emphasise the importance of personal hygiene to clients and ensure that instructors themselves have the highest level of personal hygiene.

Appropriate footwear must be worn at all times by participants and instructors to prevent injury. This is particularly important at wet sides, as the area is wet and the risk of slips and falls is far greater.

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Risk assessment

To control risks associated with hazards in any kind of fitness environment, it is important to ensure that risk assessment procedures are followed. Every business must carry out a workplace risk assessment to check that the necessary precautions are in place. The law does not expect a business to eliminate all risk, but businesses are required to protect people as much as possible. A risk assessment helps the business to focus on the risks that could potentially cause real harm.

The following five-step risk assessment process should be followed.

1. Look for any hazards (eg, slips, falls, trips).
2. Decide who might be harmed and how.
3. Evaluate the risks and decide whether existing precautions are adequate or whether more needs to be done.
4. Record the findings and implement any necessary changes.
5. Review the risk assessment and update as necessary.

The risk assessment can be carried out by the general manger or owner of the business, but in larger organisations, there is usually a responsible health and safety manager/executive or advisor employed by the company.

The basic principles of risk assessment

The principles and methods of identification

When carrying out a risk assessment for any organisation, it is important to identify how people might be harmed. This can be done in several ways, including:

- walking around the fitness environment to see what can reasonably be expected to cause harm to employees
- asking the employees who work in the environment on a daily basis about any concerns
- visiting the Health and Safety Executive website – www.hse.gov.uk – for practical guidance on where hazards occur and how to control them
- checking the manufacturer's guidelines on the maintenance and safe use of equipment and chemicals; they sometimes specify certain hazards
- reviewing previous accident record books, as they may identify less obvious hazards.

It is also important to ascertain who might be harmed, and the easiest way to do this is to group people into categories (eg, people working in the gym, people working in the exercise studios, other participants and lifeguards). In each case, identify how they might be harmed (eg, pool plant operators may be at risk of being exposed to dangerous chemicals).

Assessment

When assessing the risk, it is important to look at what is happening in the facility, what controls are in place and how the work is organised. This should then be compared with good practice to see if more can be done. The questions to ask are:

- Can the hazard be taken away completely?
- If not, how can the risks be controlled to make the hazard less likely to occur?

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Review

Few workplaces, especially fitness environments, remain the same for very long; new equipment may be introduced to the facility or new procedures may be introduced, which can lead to new hazards. It is important to try to review the risk assessment every year or when an element of the facility changes (eg, a new spin studio is built).

When considering how to risk assess the types of hazards in any working environment including the fitness environment, reference should be made to the Health and Safety at Work Act, 1974, published by the Health and Safety Executive. This is the UK legislation that covers all matters relating to health and safety at work and gives guidelines on risk assessment strategies, policies and procedures. Lastly, it is important to reduce the risks of hazards in the fitness environment by ensuring that regular checks are made on all equipment and on the facility itself.

Risk assessment for planned sessions

In the same way that risk assessments are carried out on the workplace, it is the instructor's duty to undertake a risk assessment before any planned exercise session, whether in the gym, studio or pool. The principles will apply in the same way as above and the fitness instructor should follow a similar process.

- What are the hazards (eg, slips, falls, trips)?
- Who might be harmed and how?
- Evaluate the risks and decide whether existing precautions are adequate or whether more needs to be done – if possible, before the session begins.
- Review each session.

When assessing the risks of the planned activity, particular attention should be paid to the following areas and the five steps applied to each area:

1. Environment
2. Equipment
3. Other people exercising in the same area
4. Planned activities
5. Emergency procedures

Below is a table summarising some of the risks and hazards and what can be done to reduce or, in most cases, eliminate those risks:

	Hazard	Reduce the risks
Environment	Slipping due to water on the floor.	Wipe the floor before the session begins. Keep areas around hydration stations dry.
Equipment	Injury to a participant due to a frayed cable.	Make regular machine checks. Put an 'out of order' sign on the machine.
Other people	Bumping into other people in the area due to lack of space to perform the planned activities.	Change the session or activities so that the exercises performed require less space.
Planned activities	Planned activities chosen are no longer appropriate due to a change in the participant's medical condition. This could lead to an injury.	Choose alternative activities suitable for the participant.
Emergency procedures	Bags are blocking the door and exit from the studio.	Ask participants to move their bags and store them in an appropriate place.

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Who to contact when hazards and risks cannot be controlled personally

In any situation where an instructor becomes aware of a risk or hazard that he or she cannot control but have identified, it is important they know whom to contact within the organisation. The process for reporting any risks or hazards will be set out in the health and safety manual and should be adhered to at all times.

If the general manager (GM) is not on duty that day, then instead instructors should contact the duty manager (DM), who is responsible for the facility in the GM's absence. If there is more than one DM on shift, report your concerns to the most senior of the DMs.

If the risks or hazards identified concern the gym environment, then it may be useful to report it to the gym manager, who is responsible for the gym but also reports to the GM. If the risks or hazards relate to the exercise studios, then it may be useful to report any concerns to the studio co-ordinator, who also reports to the GM.

If working for a larger organisation with a health and safety officer, any matters relating to health and safety can be reported to them.

Finally, if working in an environment other than a fitness facility (eg, a church hall), any issues relating to health and safety or risks and hazards within that environment should be reported to the person responsible for the building. It is always important to obtain details of an emergency contact when using independent facilities for this reason and to ascertain who is responsible for health and safety matters at the site.

If the emergency services are required, follow the health and safety policies and procedures in place, dial 999 and request the services required. Refer back to the first section for further information.

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Safeguarding vulnerable people

Introduction

As facilities are increasingly being made more accessible to all, as well as with the increasing focus by fitness operators on families and children, it is vital that fitness instructors are equipped to deal with a variety of population groups. In this section, we will look at the implications and additional responsibilities that fitness instructors need to be aware of when working with children, young adults and vulnerable adults, together with the legislation that is designed to protect them.

Objectives

By the end of this section, the learner should be able to:

- have a basic understanding of the legislation that protects children and vulnerable adults
- understand the responsibilities and limitations of a fitness instructor with regard to safeguarding children and vulnerable adults
- identify different types of abuse encountered with clients, including children and vulnerable adults
- understand the importance of an organisation's policies and procedures relating to safeguarding children and vulnerable adults
- identify the statutory agencies responsible for safeguarding children and vulnerable adults
- discuss the importance of maintaining confidentiality of all reports and information relating to suspected abuse of children and vulnerable adults.

Legislation relating to safeguarding the welfare of children and vulnerable adults

Part of a fitness instructor's role is likely to involve working with children or vulnerable adults. In these circumstances, the instructor will have additional responsibilities in order to safeguard these groups. To do this, the instructor should be aware of the legislation that exists to protect children, young adults and vulnerable adults. While it is important to have a basic understanding of the legislation that protects these groups, it is not necessary to know their content in detail.

1. Legislation relating to children and young adults:

A child is legally defined as anyone under the age of 18.

The Children Act, 1989

This act provides legislation to ensure that the welfare and developmental needs of children are met, including their need to be protected from harm.

The act serves to:

- re-enforce the autonomy of families through definition of parental responsibility
- provide for support from local authorities, in particular for families with children in need
- legislate to protect children who may be suffering or are likely to suffer significant harm.

The Children Act, 2004

This act is an amendment to the above act. Each act has progressively attempted to improve the legal powers and official functions related to children, and to make official provision for children better and safer.

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The Police Act, 1997

This act contains the provision to set up the CRB for England and Wales. Under this act, it is a criminal offence for an employer to:

- not check an employee working with children or vulnerable adults
- give a job to someone who is inappropriate to work with children or vulnerable adults when they know this to be the case.

The Protection of Children Act, 1999

Under this act, childcare organisations (defined as those that are 'concerned' with the provision of accommodation, social services or health care services to children or the supervision of children) must make use of the disclosure service (using CRB) in their recruitment and reporting process and urge other organisations working with children to do the same.

Every Child Matters Initiative and The Children Act, 2004

This legislation was published as a formal response to the report into the death of Victoria Climbié. Victoria was an eight-year-old girl killed by her guardians in 2000, after numerous agencies (including the police, NHS, social services, NSPCC and local churches) failed to follow up on evidence of abuse. As a result of an investigation into this failure, both the initiative and revised act set out the government's approach to the well-being of children and young people from birth to 19. Their combined aim is to maximise opportunities and minimise risk for all children and young people by focusing services more effectively around the needs of children, young people and families. The four key themes of this legislation include:

- increasing the focus on supporting families and carers
- ensuring the necessary intervention takes place before children reach crisis point and protecting children from 'falling through the net'
- addressing the underlying problems identified in the report into the death of Victoria Climbié, including weak accountability and poor integration
- ensuring that the people working with children are valued, rewarded and well trained.

Safeguarding Vulnerable Groups Act, 2006

This act came about as a response to the Bichard Inquiry report following the 2002 Soham murders of 10-year-olds Holly Wells and Jessica Chapman. Under this act, new arrangements for people whose work brings them into contact with children and vulnerable adults were phased in from October 2009.

The aim of this act is to provide a more effective and streamlined vetting service for potential employees and volunteers. Under this legislation, there will be a single list of people barred from working with children. In addition, a separate but aligned list of people barred from working with vulnerable adults will be established. The two lists are called:

- the children's barred list
- the adults' barred list.

The application process will be run via the CRB, and decisions on who should be placed on the barred list lies with the Independent Safeguarding Authority. CRB and ISA have now merged to form the Disclosure and Barring Service.

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The Disability Discrimination Act (DDA), 1995 and The Disability Discrimination Act, 2005

These acts of Parliament make it unlawful to discriminate against people in respect of their disabilities in relation to employment, the provision of goods and services, education and transport. The duties on service providers (which will include fitness operators) were introduced in three stages as the acts were developed, including:

- It is unlawful for service providers to treat disabled people less favourably for a reason related to their disability (1996).
- Service providers must make 'reasonable adjustments' for disabled people, such as making changes to the way they provide their services (1999).
- Service providers may have to make other 'reasonable adjustments' in relation to the physical features of their premises to overcome physical barriers to access (eg, installing an appropriate lift).

2. The laws implemented under the Safeguarding Vulnerable Groups Act, 2006

Under this act, anyone who works with or is applying to work with children or vulnerable adults must apply to do so with the CRB. Their names will be checked against the two lists mentioned above. All decisions on who should be placed on the barred lists will be made by the Independent Safeguarding Authority (ISA), an independent statutory body. CRB and ISA have now merged to form the Disclosure and Barring Service.

Jobs that fall within the catchment of this act include:

- teaching, training or instruction, care or supervision of children
- teaching, training or instruction for vulnerable adults
- providing advice or guidance wholly or mainly for children, relating to their physical, emotional or educational well-being
- providing advice, guidance or assistance wholly or mainly for vulnerable adults
- any form of treatment or therapy provided to children or vulnerable adults
- driving a vehicle that is being used only for the purpose of conveying children or vulnerable adults and their carers
- any job where there is opportunity for contact with children or vulnerable adults in some specified settings (eg, catering, administrative or maintenance staff in a school setting, children's home, adult care home) and where the activity is 'frequent' (once a week or more, except in health or personal care services where frequent means once a month or more) or takes place on four or more days in a 30 day period ('intensive').

No barred individual may engage in any regulated activity, whether paid or voluntary. It is a criminal offence for employers to employ someone in a regulated activity if they are not registered with the ISA.

Laws, policies and acts are subject to government change and updates, so it is essential that research is carried out into the most up-to-date versions in order to obtain the most current information available. The information in this chapter is based on legislation in the United Kingdom.

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The responsibilities and limitations of a fitness instructor regarding the safeguarding and welfare of children and vulnerable adults

In line with the legislation outlined above, fitness instructors who are likely to work with children and/or vulnerable adults must have a CRB check, preferably prior to the commencement of their employment. The employer may request a CRB check on the instructor's behalf.

Even if the instructor already holds a CRB check with another employer/organisation, it is still necessary to have a CRB check with any new employer. CRB checks are no longer portable (except in some situations relating to education and schools). In addition, CRB checks do not have a period of validity because an individual's circumstances can change at any time. Most organisations will specify in their internal policies and procedures manual when CRB checks need to be updated; this will usually be between one and three years.

As mentioned above, most companies will have their own internal policies and procedures relating to the safeguarding and welfare of children and vulnerable adults. Please see below for more information regarding what this manual may contain. It is important for the role of fitness instructor working with children or vulnerable adults to be familiar with the organisation's policies and procedures and keep up to date with any changes in the relevant legislation. In addition, this manual should be made known to children and vulnerable adults and be made available in an accessible format to parents, carers, volunteers and all staff.

The safety and well-being of children and vulnerable adults in the instructor's care is of paramount importance, and it is therefore important to be aware of what possible abuse looks like and to know who to report this information to. Guidelines relating to the reporting procedures of abuse will be set out in your organisation's policies and procedures manual. If you are working as a self-employed instructor and suspect abuse, it is important that you know who to contact and how (see 'Reporting procedures'). The important thing to remember is that any information regarding possible abuse must be acted upon immediately to protect vulnerable persons.

When deciding whether to report any concerns about possible abuse, it is important to consider the following factors:

- What is the definition of abuse? List the symptoms of abuse and compare them to what has been witnessed, heard etc.
- Consider who should be notified.
- How will records be made? Consideration should be made to the Data Protection Act, 1998.
- How will the child or vulnerable adult be treated? Ensure you are able to reassure them if the need arises.
- How will the confidentiality of the information and documentation be kept?
- Most importantly, remember that it is the responsibility of the local authorities to determine whether abuse has occurred and not the instructor or organisation.

If the instructor's organisation has a safeguarding policy and procedures in place, it is the instructor's responsibility to follow these and report their concerns to the designated safeguarding officer. This person will be responsible for recording any allegations or reported incidents and contacting the relevant agencies, local authority services, police and social services.

If working independently, the instructor will need to be aware of whom to contact, including the persons who provided informed consent, namely the parent/guardian or appropriate adult (except in cases where you believe the perpetrator of the abuse is this person), local authority agencies, social services and possibly the police. When contacting local authority services, it is important to advise them of the nature of the abuse and they will be able to direct the caller to the relevant department that will handle and record any information relating to suspected abuse.

Due to the nature and sensitivity of these issues, confidentiality of all information and records is vital. Access to the records of the allegation or incident is limited only to those individuals with a specific interest in the issue and who are legally entitled to see the documentation. Any documented reports or evidence should be stored securely and kept for a minimum of three years. Matters such as abuse should not be discussed with colleagues or friends who are not involved in the matter.

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Types of abuse

Abuse is the violation of an individual's human rights and can take many forms. It can be a single act or repeated acts and can be physical, sexual or emotional. As a fitness instructor, it is important to be aware of the different types of abuse and how to recognise the signs of abuse.

Types of abuse relating to children, older adults or vulnerable adults, including those with disabilities, include:

- physical abuse – unexplained bruising, injuries, cuts or breaks, fractures and repeated injuries
- emotional abuse – threatening behaviour directed at the participant, discriminating remarks, taunting
- neglect – developmental problems not attributed to a pre-existing medical condition, personal hygiene issues, lack of general care
- bullying
- sexual abuse.

If it is suspected that a participant is the victim of abuse, it is important to observe the participant's physical condition in a way that is sensitive to the person and the situation; try not to question the participant relentlessly or with leading questions, instead show support and encouragement and build trust and rapport. They may not want to disclose the abuse and may be doing their utmost to disguise or hide any symptoms. The perpetrator of the abuse may be someone close to the participant and they may not want to disclose this. Often a victim of abuse will blame themselves and not the perpetrator, loving them regardless. It is essential to observe the participant's condition discretely.

Fundamentally, do not accuse anyone of abuse. Follow the organisation's safeguarding policies and procedures at all times; if working independently, instructors should report any concerns to the Local Authority and let them handle the matter professionally. If it is seen that an instructor or organisation is investigating the suspected abuse, it could actively damage the chances of the case reaching a resolution.

It is not an instructor's responsibility to decide whether or not abuse or bullying is taking place or has taken place. However, it is the instructor's responsibility to act on any concerns.

In situations where abuse is suspected, there may be other types of information to consider when noting signs and indications of possible abuse, including:

- have the participant's circumstances at home changed? (eg, a change in parental responsibility)
- have there been any other fundamental changes in the participant's life? (eg, change of schools, care home, recent bereavement)
- the age of the participant (eg, puberty)
- the relationship the participant has with their parents/guardians or carers.

If there is any concern that abuse may be taking place, it is important to consider all the factors and information available before making a conclusion and reporting the allegation or incident. While there may be unequivocal signs of abuse, such as witnessing a person punching the participant, there are also signs that may be an indication of abuse but are not in themselves evidence of actual abuse taking place. An example of this is if the participant is withdrawn or has cuts or bruises that are unexplained. While these factors may be a sign of abuse, it should be recognised that the presence of one or more of these indicators is not necessarily proof of abuse actually taking place.

The emotional signs and symptoms could be related to family issues, such as divorce or bereavement, and the physical signs could be from something as simple as the child falling off a bicycle. This highlights the importance of communication between the parties, including, where appropriate, the participant's parents/guardians or carers.

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Signs of abuse

Physical signs and indicators may include:

- unexplained (or repeated) bruises, burns, fractures, lacerations or abrasions
- unexplained burns
- unexplained fractures, lacerations, abrasions
- swollen areas
- evidence of delayed or inappropriate treatment for injuries
- personal hygiene issues
- lack of adult supervision on a daily basis
- difficulty walking or sitting
- weight loss for no apparent reason
- a variation in eating habits (eg,overeating, loss of appetite).

Behavioural signs and indicators may include:

- stilted conversation, vacant stares, overly watchful
- wariness of adults
- arrives early, stays late for sessions and is reluctant to go home
- flinches if touched unexpectedly
- overly compliant and eager to please
- drug or alcohol misuse
- depression
- sudden outbursts of temper/aggressive behavior
- inappropriate sexual awareness.

Safeguarding policies and procedures

As mentioned previously, most large organisations that employ staff who work with children and vulnerable adults will have in place a safeguarding and welfare policy and procedures manual. The exact content of such a manual will vary between organisations, although legislation dictates that certain information must be included. The extent of how much detail and guidance the policy will provide will depend on the size of organisation and the type of contact it has with children or vulnerable adults.

The following basic information should be included in any policy and procedures manual:

- Why the safeguarding policy is important.
- Clarification that the policy refers to all children or vulnerable adults regardless of gender, age, ethnicity, disability, sexuality or religion.
- CRB checks, policy and procedures.
- What abuse is.
- How abuse might take place in the workplace.
- How to recognise abuse.
- What to do if there are signs or there is a suspicion of abuse.
- What to do if a vulnerable person reports abuse happening at home or elsewhere, and how to get in touch with local authority social services, in case a concern needs to be reported.
- Information on how to respond to the vulnerable person.
- What to do if there are allegations of abuse against an employee or volunteer, including any internal anti-bullying procedures and policies.
- Who to tell and how to respond to the person making the allegation.
- What safeguards are or will be put in place to protect children or vulnerable adults, including the level and type of supervision, providing clear guidelines and procedures and involving parents/guardians and carers.
- How children or vulnerable adults will be informed about their rights and what to do if they have any concerns.
- How employees will be supported in their understanding and awareness of safeguarding children or vulnerable adults' issues (eg, what sort of training will be provided).

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- How the policy will be put into practice within all levels of the organisation and within all policies and procedures.
- How the policy will be monitored and reviewed.
- How confidentiality should be kept should an allegation be made (eg, how records should be kept and who will have access to them).
- How other sensitive or potentially sensitive information should be handled (eg, web-based materials and activities).

A person within the organisation should be appointed to deal with allegations or suspicions of abuse and it is essential that they get the correct training for safeguarding children or vulnerable adults. All employees should be clear about who this person is and they should be the first person staff, volunteers, children or vulnerable adults approach with concerns. This person will appropriately record an allegation or reported incident and they will be responsible for contacting the statutory child protection agency, such as the Local Safeguarding Children Board or the police, if necessary. This person can also ensure that the policies and procedures are implemented.

Procedures to help protect oneself from accusations of abuse

Unfortunately, there have been several reported incidents involving false accusations of abuse. To protect oneself from false allegations, there are several measures available:

- Ensure that you have a current and up-to-date CRB check in place, even if an employer does not insist on this. This could be done annually.
- Ensure familiarity with the organisation's safeguarding policy and procedures relating specifically to physical contact with participants and being alone with participants. Avoid any unnecessary situations that could give rise to suspicion, such as by accompanying children to the bathroom or helping them change clothes. If required to perform such activities, it is always best if another adult is present and consent has been received from the parent/guardian or carer.
- Ensure to make a note of any evidence of possible abuse carefully and include this in any report you make.This may be used as evidence in any possible prosecution, so it must be accurate.
- When working with clients, it is important to obtain their informed consent for the activities or assessments that are to follow.
- When working with children and vulnerable adults, it is important to obtain the informed consent of their parents, guardians or an appropriate adult before commencing any assessment or exercise activity. See section 2 on informed consent for more information.

Statutory agencies

There are various statutory agencies in the UK that are responsible for safeguarding children and vulnerable adults. As a fitness instructor, it is important to be aware of these agencies in case their assistance is required at any time.

Ofsted

This is a government agency whose role is to inspect and regulate the care of children and young people. Ofsted is often associated with schools, but it is also responsible for:

- checking places where children and young people are looked after
- the people who look after children and young people
- schools and colleges
- adult learning and training
- how teachers are trained.

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Local authority (social services)

Various local authorities will have different departments that deal with different policies and areas of local concern. They are bound by the laws laid down by the national government, but each will have its own budgets and administration procedures. The local authorities in each area have a duty to safeguard the welfare of children and vulnerable adults through departments such as social services. Most cases of abuse will be reported to the local authority in the first instance.

Police

The police provide the mechanisms for agreeing how organisations will co-operate to safeguard and promote the welfare of children. They will enforce the law relating to the protection of children and vulnerable persons. In some cases, reports of abuse may be reported to the police. They will work closely with local authorities to protect the local community.

Local Safeguarding Children Boards (LSCBs)

These are statutory bodies set up by local authorities. Every local area has an LSCB. Their aim is to make sure that key agencies work together effectively to ensure that children are properly safeguarded. The core members of the LSCB may include local authorities, health bodies, the police and others.

Independent Safeguarding Authority (ISA)

The ISA is an independent statutory body whose aim is to prevent unsuitable people from working with children and vulnerable adults. Please see above for further information.

If it is suspected that abuse has been or is being taken against a participant within the facility, it may be necessary to contact one of the organisations listed above. It is not the responsibility of the instructor to decide if abuse has occurred, only to report any allegations or founded suspicions to the relevant authority. They will investigate whether any abuse has occurred or is occurring and will take the relevant action.

Note: As of December 2015 the ISA and CRB were merged together to form the Disclosure and Barring Service (DBS. For more information go to www.homeoffice.gov.uk/crime/vetting-barring-scheme/

Confidentiality of information relating to abuse

In accordance with the Data Protection Act, 1988, instructors are under a legal obligation to ensure where possible that any data including computerised, electronic and manual records are stored securely and not disclosed to any party without the client's consent. It is important that the confidentiality of the participant's information is not put at risk; failure to do so could result in a compensation claim made by the participant for breach of confidentiality. As well as the legal responsibilities outlined, an instructor also has a moral responsibility not to discuss with a third party any matters relating to the participant without the participant's consent.

Where reports have been written in relation to an allegation or incident of abuse, these reports may be given to any appropriate statutory agencies and/or their representatives in accordance with legislation protecting children and vulnerable adults.

Statutory agencies are subject to government change, so it is essential that research is carried out into the most up-to-date agencies in order to obtain the most current information available.

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Principles of exercise, fitness and health

Introduction

This unit explores the relationship between health and fitness. It looks at the principles of training and how the application of the various principles can help clients achieve health and fitness gains through physical activity and exercise. This unit concludes with a look at the considerations which need to be applied to the principles of exercise, fitness and health when dealing with special populations.

Principles of exercise, fitness and health

Introduction

In this section, we will explore the relationship between total fitness, physical fitness and health.

Objectives

By the end of this section, the learner should be able to:

- understand the effects of exercise on the body
- understand the components of fitness
- understand how to apply the principles and variables of fitness to an exercise programme
- understand the exercise contraindications and key safety guidelines for special populations
- understand how to safely monitor exercise intensity
- understand the health benefits of physical activity
- understand the importance of healthy eating.

Health

Health is a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity (World Health Organisation, 1946).

Physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure. Physical inactivity is an independent risk factor for chronic disease and is estimated to cause 1.9 million deaths globally.

Regular physical activity is one of the most important things that can be done to benefit health. According to the Chief Medical Officer (CMO), guidelines for physical activity (health benefits) 'Start Active Stay Active' report states that different types and amounts of physical activity are required for different age groups and the health benefits can be as follows:

- decreasing the risk of coronary heart disease
- decreasing the risk of some cancers
- normalising blood pressure
- decreasing high cholesterol
- promoting bone density to protect against osteoporosis and falls in older age
- decreasing the risk of type 2 diabetes
- promoting healthy growth in children
- managing weight
- improving confidence and well-being
- strengthening bones, joints and muscles to improve joint stability and posture
- decreasing the risk of injury.

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The report clearly links the lack of regular physical activity to the likelihood of developing diseases, such as coronary heart disease (CHD), some cancers, type 2 diabetes, hypertension, obesity and osteoporosis, and explains how taking the prescribed levels of activity can dramatically reduce the chances of developing one of these diseases.

Fitness

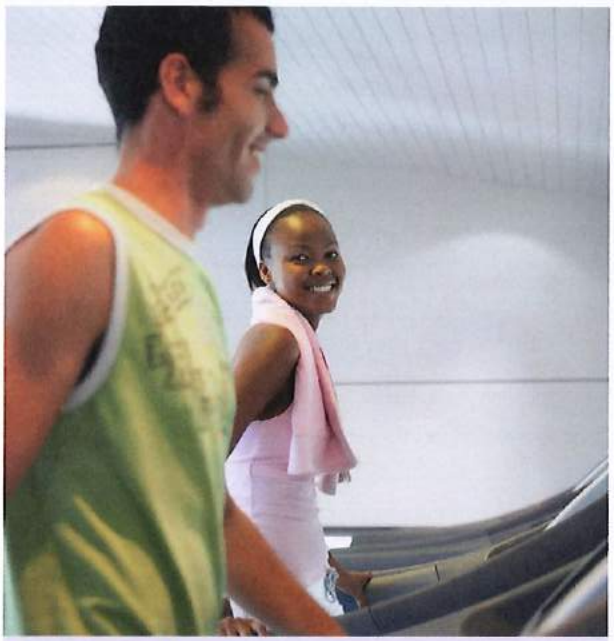
'Fitness' means – the condition of being physically fit and healthy (Oxford Dictionaires.com). Fitness is a multidimensional concept, and the level of fitness in one area can influence other areas, including:

- emotional and mental – this is concerned with psychological well-being. The pressures of daily life can have a negative effect on mental and emotional fitness. This affects the ability to think clearly and constructively, leading to stress, which is a contributory factor to CHD.
- social – an individual's ability to interact, communicate, establish and maintain relationships with others.
- medical – an individual's state of health and the absence of disease, illness, injury or disability so that the body is in optimal working order.
- nutritional – eating a well-balanced diet to ensure the body has sufficient energy and ability to carry out daily life.
- spiritual – an individual's attitude, honouring one's own and others' basic human values and beliefs.
- physical fitness – a combination of attributes that allow you to function effectively, to enjoy leisure and to cope with emergencies. Fitness is the capacity to combine all these aspects to facilitate positive health and maintain optimal quality of life. This is often referred to as 'total fitness'.

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Physical fitness

Physical fitness is a combination of the following five components, which helps to explain why no single type of exercise will achieve total physical fitness.



Cardiovascular fitness
the ability of the heart and lungs to take in, transport and utilise oxygen.

The components of physical exercise

All of these components are important for the development of a well-balanced exercise programme.



Motor skills
the ability of the nervous system to control the movement of the body to perform a range of skills, such as balance, co-ordination, speed, agility and reaction time.



Muscular strength
the ability of muscle to create high force to lift a heavy weight.



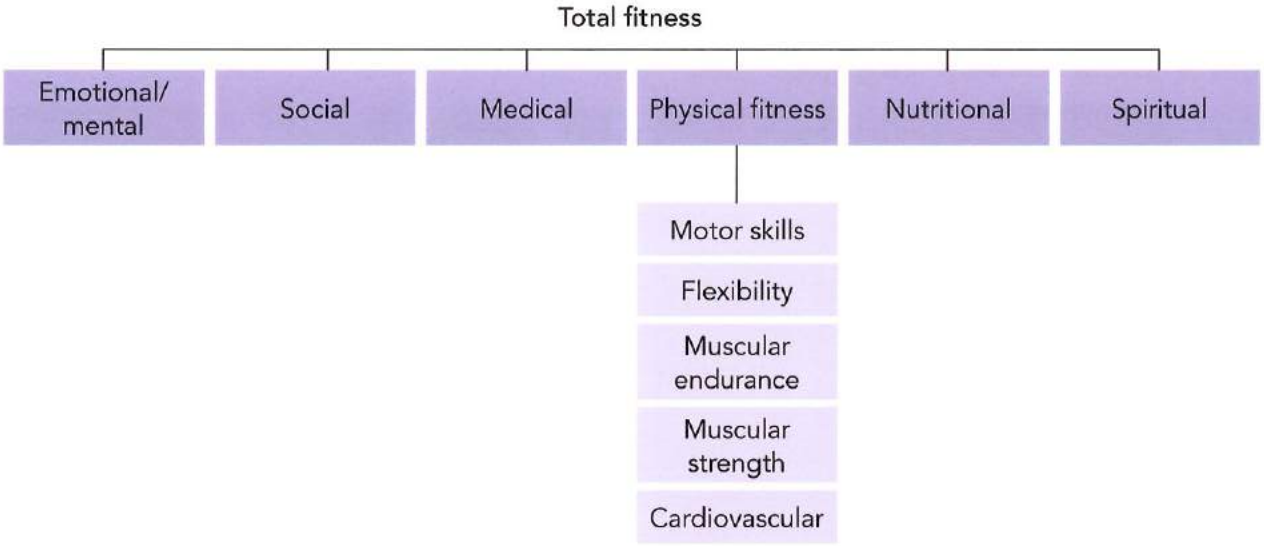
Flexibility
the range of movement achievable about a joint or joint complex.



Muscular endurance
the ability of a muscle or muscle group to keep contracting and work for a long period of time.

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Overview of the relationship between total fitness and physical fitness



Factors affecting health, physical fitness and training potential

Health, physical fitness and training potential are determined by several variables, including:

Heredity

The genetic make-up of an individual can, in part, pre-determine health and the responsiveness of an individual to training.

Medical

Some hereditary medical conditions will affect physical performance (eg, cerebral palsy, Down's syndrome and type 1 diabetes).

Gender

There are many gender differences that are apparent when looking at physical fitness. Men and women have different levels of certain hormones that affect their physical fitness and training potential. In general terms, women tend to have greater flexibility around the hip joint and good buoyancy for water activities like swimming. Men are generally larger and tend to have a greater physical capacity than women. Men also have greater upper body strength and a bigger heart and lung capacity. In terms of health, women generally tend to live longer than men and are more likely to suffer from certain types of cancer; men are more likely to suffer from coronary heart disease (CHD).

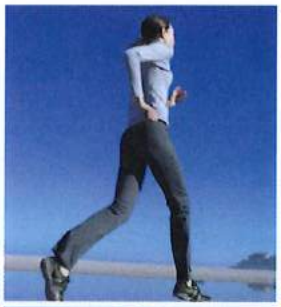
Age

Fitness inevitably declines due to hormonal changes, metabolic changes and simply the accumulation of many years of wear and tear. While it is impossible to change one's chronological age, it is possible to offset many age-related changes by remaining fit and active, looking after the body and by making good lifestyle choices.

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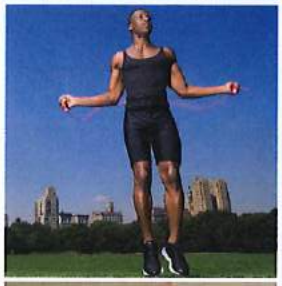
Body type

Closely related to the heredity factor is the morphic shape of an individual. This shape can influence physical capabilities (as previously highlighted in the bones and joints chapter). The three main body types each have their own characteristics.



Ectomorph

typically tall and lean. Such individuals are generally better at endurance events, such as marathon running and long-distance cycling.



Mesomorph

typically athletic, with a muscular physique. Such people tend to do well in sports that involve jumps, throws and sprints.



Endomorph

typically with a soft, rounded shape and shorter limbs. Such individuals tend to do well in long-distance swimming, wrestling and judo.

Rather than categorising an individual into a specific body type, individuals usually have a leaning towards one type or another.

Lifestyle factors

These are factors over which individuals have some control and can make positive choices to enhance their health and physical fitness.

Lifestyle habits

Certain lifestyle habits, such as smoking, heavy alcohol consumption and substance abuse, can have negative effects on health and physical fitness.

Everyday activity

An individual's general level of everyday activity can affect physical fitness. This includes not only exercise and playing sports, but also daily activities such as levels of occupational activity (eg, office/sedentary vs. postman/active), housework, gardening, DIY projects, walking to the shops and other activities that require a low to moderate degree of physical effort.

Health status

Physical performance can be severely affected by poor health, injury or disability. A simple cold virus can be as limiting as asthma or a sprained ankle.

Diet

It is important to establish healthy eating patterns to provide the body with sufficient nutrients to sustain physical activity and maintain a healthy state of function.

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Exercise prescription for health

To improve health, the Chief Medical Officer (CMO) and Department of Health (DH) published the 'Start Active Stay Active' report, which outlines the guidelines for physical activity for health, for the various age ranges. They are as follows;

- under-fives – 180 minutes each day once a child is able to walk
- children and young people (5 to 18 year-olds) – 60 minutes and up to several hours every day of moderate to vigorous intensity physical activity on three days per week. Should include vigorous activity that strengthen muscles and bones
- adults (19 to 64 year olds) and older people (65+) – 150 minutes each week of moderate to vigorous intensity physical activity (adults should do some physical activity every day). Muscle strengthening activity should also be included twice a week

For a detailed breakdown, go to: http://www.bhfactive.org.uk/homepage-latest-news-item/75/index.html

Barriers to fitness and exercise

Despite being aware of the benefits of regular exercise, individuals can find it difficult to adhere to exercise programmes.

Some common barriers to exercise include:

- physical – age, injury, ill health and disability
- physiological – anxiety and fear of feeling out of comfort zone
- financial – cost of buying equipment or joining a health club
- time – family and work commitments and overall lack of time
- motivational – lack of support from family and friends, not enjoying exercise or boredom.

In spite of how common these barriers are, these issues don't need to stand in the way of exercise. With some careful thought, practical strategies can be implemented for overcoming these common barriers to achieving fitness. See the next section, 'Know how to support clients who take part in exercise and physical activity', for more detail on helping clients to overcome their barriers.

Key points for physical fitness and health

- Total fitness is a multidimensional concept that includes various fitness aspects, including emotional, mental, social, medical, nutritional, spiritual and physical.
- Regular physical activity is beneficial to health.
- Physical fitness has five components: cardiovascular fitness, muscular strength, muscular endurance, flexibility and motor fitness.
- Physical fitness is affected by factors such as heredity, body type, gender, level of daily activity, health status lifestyle habits, age and diet.
- Common barriers can influence an individual's participation in regular exercise.

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Principles of training

For any component of physical fitness to improve, the body must be trained in an effective manner. It must be trained to the point of overload, followed by sufficient recovery time to allow adaptation to take place. Training is a slow and subtle process that cannot be rushed. Conducted safely and correctly, training leads to improved performance, as well as physiological and psychological changes. A carefully structured exercise programme uses the principles discussed below.

Overload principle

The overload principle states that in order to make improvements, a body system must work at a level slightly higher than that to which it is accustomed. For example, an individual whose cardiovascular fitness is low due to years of sedentary living can overload the heart, lungs and circulatory system simply by walking at a faster pace than normal. However, gradually, the heart gets stronger and the individual has to walk faster still to overload the heart.

The appropriate overload level is achieved by combinations of the FITT principle.

Frequency – the number of sessions in a given period (how often).
Intensity – the level of work performed during an activity session (how hard).
Time – the duration of a given session (how long).
Type – the choice of activity. For example, running, weight training, stretching, etc.

Progressive principle

This relates to the 'intensity' part of the FITT principle. To achieve more training gains as the body adapts to the initial overload, training should become more intense to achieve progressive overload – that is, overload should be increased gradually over time. This can be achieved by:

- repetitions – increasing the number of repetitions
- resistance – increasing resistance by using gravity, length of lever, external weight, body weight and surface area in water
- rate – changing the speed of the exercise (eg, slowing a muscular strength exercise down will increase the intensity, whereas speeding up a cardiovascular exercise will increase the intensity)
- rest – decreasing the rest periods (between sets, exercises and training sessions)
- range – increasing the range of movement applied to the exercise
- complexity – using exercises with more complex movement patterns.

Specificity principle

The specificity principle refers to the adaptations that are specific to the type of training performed and the demands placed on the body. Simply stated, different forms of exercise produce different results. Each sport or activity has its own particular muscular and movement characteristics. If an individual wants to improve their performance in a particular sport or activity, the training needs to be specific to those characteristics. For example, a marathon runner would be unlikely to improve their marathon performance by participating in a sprinting programme.

This is easily remembered by the SAID principle:

Specific
Adaptation
Imposed
Demand

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Reversibility principle

This principle states that training adaptations will gradually decline if training stops or a maintenance programme is not followed. Some decline in fitness occurs naturally with the ageing process, especially between the ages of 50–70 years. However, by remaining active much of this degeneration can be avoided.

Adaptability

This is the ability of the body to cope with and adapt to specific training needs.

Individuality

One size does not fit all. A training programme should be relevant and appropriate for the individual and their specific training requirements.

Recovery time

Rest is required for the body to recover from the training session and to allow adaptation to take place. This includes the heart becoming stronger, the lungs becoming more efficient and the muscles becoming more toned, thereby improving fitness. It is important to know that without sufficient recovery time, improvements in fitness will not take place. The exact amount of time will vary depending on the type of training session; however, typically 24 to 48 hours rest is required.

Plateau

Plateau occurs when continued adaptations no longer occur. In order for further adaptations and responses to take place, some aspects of the training must change (ie, FITT principles would need to be altered).

These principles encompass factors that affect the training outcome. They equally apply to a variety of exercises, as well as the chosen discipline (eg, exercise to music, weight training, stretching, cardiovascular training and neuromuscular training).

Changing any aspect of the various principles can lead to adaptation. For example, an additional session per week, increasing intensity or using a different training method may subject the system to unused stimuli and overload, initiating an adaptation.

It is important to remember that individuals may require modifications, adaptations and progression to different exercises and training methods to meet their needs. These include:

- individual needs
- fitness level
- skill level
- experience
- injury or disability
- medical conditions
- environment.

Regression

It is important to recognise when to regress a training programme. Individuals who come back to training after illness, injury or a break will need to have their programme regressed to avoid overworking and possible further injury.

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What happens to the body during training?

When we begin to exercise, the body has to respond to the change in activity. These changes are usually referred to as short-term responses to training and are listed below.

- Activity of the nervous system increases in order to control the various changes that take place during activity.
- Heart rate, blood flow, oxygen uptake, cardiac output and stroke volume all increase.
- Blood vessels dilate.
- Concentration of CO2 in the blood increases, thereby increasing breathing rate.
- Muscle temperature and overall core body temperature increase.
- Levels of lactic acid in the blood rise, causing a burning or aching sensation in the muscles.
- Blood pressure increases. Systolic pressure rises, and diastolic pressure remains the same.
- Joints become more mobile due to increased flow and viscosity of the synovial fluid.

Once training stops, the body returns to its normal resting state. However, it is important to ensure that this is a gradual process in order to avoid blood pooling.

Blood pooling

When exercising, your heart is pumping large amounts of blood to the working muscles to provide them with the level of oxygen and nutrients they need. When they are used up, the force of the contracting (exercising) muscles pushes the blood back to the heart to be re-oxygenated.

However, when the exercise stops, so does the force that pushes the blood back to the heart. This blood, and waste products such as lactic acid, stays in the muscles. This process is referred to as 'blood pooling'. Stopping exercise suddenly reduces the oxygen supply to the brain, leading to dizziness or fainting.

An effective cool down is one in which the intensity is reduced gradually. This helps to keep the blood circulating and helps to prevent blood pooling, assisting in removing waste products from the muscles. This cool down also helps your body with its repair process and helps to reduce post-exercise soreness, or DOMS (delayed onset muscle soreness).

Key points for principles of training

- The principles of training are: overload, progression, specificity, reversibility, adaptability, individuality, recovery time and plateau.
- Overload can be applied by using the FITT principle: Frequency, Intensity, Time and Type.
- Modifications, adaptation and progression are required to meet individual needs, fitness level, experience, skill level, injury, disability, medical conditions and the environment.
- An effective cool down after exercise will ensure that the short-term effects of exercise safely enable the body to return to normal.

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Cardiovascular fitness

Cardiovascular fitness is often referred to as stamina, endurance, cardiorespiratory fitness (heart and lungs) or aerobic fitness. The lungs take in oxygen, the heart and circulation transport oxygen and the muscles utilise the oxygen. Therefore, cardiovascular fitness is a measure of the efficiency of all of these systems.

A measure of this ability is 'maximum oxygen uptake' (called VO_2 max). Maximum oxygen uptake involves the measurement of oxygen, carbon dioxide and the volume of expired air during maximal exercise, normally assessed under laboratory conditions.

Cardiovascular exercise can be defined as any activity that is rhythmic in nature, continuous and using large muscle groups under low to moderate tension over an extended period of time. This type of exercise is frequently referred to as 'aerobic exercise'. Some common exercises of this type include, walking, cycling, swimming and jogging.

Exercise intensity and heart rate

Exercise intensity refers to the degree of difficulty experienced during exercise. A quick and simple method for measuring exercise intensity, particularly for aerobic work, is to use the heart rate.

Resting heart rate

Resting heart rates vary tremendously among individuals and between genders. Women generally average about 5–10 (bpm) higher than men, mainly due to their proportionately smaller hearts. Fit individuals tend to have lower resting heart rates, sometimes below 40 bpm. Inactive and unfit individuals can often have high resting heart rates, sometimes over 100 bpm. The average adult resting heart rate is in the range of 60–80 bpm.

Maximum heart rate

Exercise intensity for aerobic work is generally expressed as a percentage of the maximum heart rate (Max HR, or MHR). Your maximum heart rate is literally just that: the maximum number of times in one minute that your heart can contract when exercising. The simplest way to estimate your maximum heart rate is by the formula below:

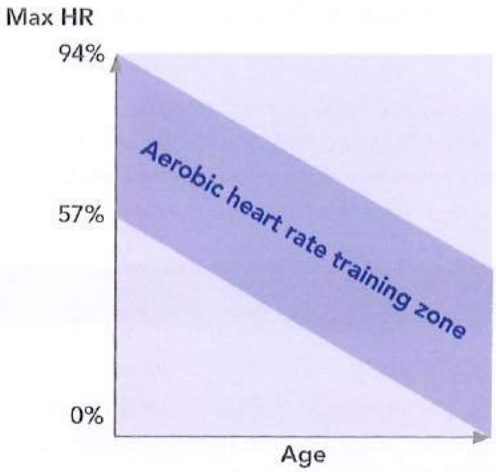
age-adjusted maximum heart rate formula = 220 - your age

Work out your Max HR using this age-adjusted formula: 220 - your age =

The maximum heart rate is somewhat variable, and is in part genetically determined. A major factor affecting the maximum heart rate is the ageing process, which progressively decreases it.

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Relationship between heart rate training zone and age



The four heart rate training zones of aerobic training

A useful way to look at the aerobic training zone is to view it as consisting of four different training zones, with each zone able to assist in achieving a specific cardiovascular health or fitness goal. Heart rate training zones are calculated by exercising at a specific percentage of your max HR.

The moderate aerobic zone

This zone begins at 50% of maximum heart rate (MHR) and is mainly for the unfit or sedentary individual. It represents a level of intensity that most people find comfortable and can maintain for extended periods of time, without breaking out into a sweat or risking injury. This zone also represents a realistic first step for the inactive and unfit person who wants to improve their cardiovascular fitness and health status.

The fitness zone

This zone of 60–70% of maximum heart rate (MHR) is often referred to as the 'fat–burning zone'. That is because this level of intensity is moderate enough for most people to be able to exercise comfortably for long periods of time while utilising fat as the primary fuel source.

For individuals who want to manage their weight, this zone can be used effectively, provided longer training durations are emphasised. This zone also represents the next step up the exercise intensity and fitness scale for the unfit person.

The performance zone

This zone of 70–80% of maximum heart rate (MHR) is mainly recommended for the improvement of cardiovascular fitness and health and is often referred to as the 'aerobic training zone', or the 'training sensitive zone'.

Training in this zone represents a vigorous and challenging level of exercise intensity for most individuals. This is because, after a few weeks of training in this zone, you should notice the training effect. That means the same pace will feel easier than a few weeks ago.

For active and trained individuals, this zone can provide an endurance base for more intense aerobic exercise.

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The performance anaerobic zone

This zone of 80–90% of maximum heart rate (MHR) represents the highest level of aerobic training and is only recommended for the very well-trained individual. Working in this zone can help to increase speed and pace and prepare for competition.

The main training adaptation for the well-trained individual working at this intensity is the 'shift', or elevation of the anaerobic threshold. The anaerobic threshold is the intensity point where one shifts from aerobic to anaerobic energy production. This elevation of the anaerobic threshold is achieved by increasing the body's ability to metabolise lactic acid.

Monitoring exercising heart rate

Using the palpation method, to measure heart rate while exercising, is notoriously difficult. Recent research has indicated that palpation can be unreliable and inaccurate when exercising. For this reason, a heart rate monitor is suggested for this purpose. A heart rate monitor measures the number of times the heart beats in one minute using electrodes that measure the heart's electrical changes.

Alternative approaches to monitoring intensity

As well as monitoring heart rate, it is also possible to monitor intensity of exercise in a variety of ways, with the use of visual and verbal instruction.

The most popular ways include: talk test, observation of facial expressions, pallor or colouring and observation of technique using a scientifically validated test called the rating of perceived exertion (RPE) scale.

The RPE scale was devised by Borg (1967, 1982) to show that individuals can perceive how hard they are working on a scale. The scale runs from 6-20, with verbal anchors to suggest the intensity of the activity, reflecting heart rates ranging from 60–200 bpm.

It is a valid and simple method for determining an estimate of exercise intensity. It is generally recommended that during aerobic work, the intensity should remain somewhere between 11–16 on the scale. It has been estimated that ratings between 12–13 are equal to 60% of MHR and 16 is equal to about 90% of MHR (Pollock, Wilmore and Fox). It may take time and practice to become proficient in using the scale.

An adapted scale has been devised that is simpler for individuals to use. This scale is known as the Borg CR10 scale. The Borg CR-10 scale is a category scale with ratio properties consisting of numbers related to verbal expressions, which allows rate comparison between intensities as well as a determination of intensity levels, it has been used for more than two decades (Borg and Kaijser, 2006; Neely et al., 1992). Again, verbal anchors are used, this scale is not parallel to other physiological measures of intensity (heart rate/oxygen uptake), but it has been reported that if one person suggests that they are working harder than another person, it is legitimate that they are actually working harder.

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The 6–20 Borg scale

6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

The Borg CR10 scale

0	Nothing at all
0.5	Extremely light – just noticeable
1	Very light
2	Light
3	Moderate
4	Somewhat hard
5	Hard
6	
7	Very hard
8	
9	Extremely hard (almost maximal)
10	Maximal

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Cardiorespiratory fitness

The ACSM recommends the guidelines below for improving the heart and lungs capacity to deliver oxygen to the working muscles and in the muscles to increase the ability to generate energy with oxygen. This range is intentionally broad and reflects the fact that unfit or deconditioned individuals may achieve a training effect at the lower end of the range, while those that are already physically active require higher intensities to further improve their cardiorespiratory fitness.

ACSM guidelines to achieve and maintain cardiovascular health and fitness benefits	
Frequency	3–5 days per week
Intensity	Moderate and vigorous intensity
Time	Moderate 30 mins x 5 days per week or vigorous 20-25 mins x 3 days per week
Type	Rhythmic aerobic activity that involves large muscle groups

Source: ACSM Guidelines for Exercise Testing and Prescription (8th Edition)

These guidelines are intended to assist in the development of an individually tailored exercise programme. They are to be used as a guide for an apparently healthy adult. There will be situations in which they do not apply because of individual characteristics, such as health status, physical ability, age or athletic performance goals.

The long-term benefits of cardiovascular training

Long-term, moderate levels of cardiovascular fitness can provide protection against many major medical problems, such as heart disease, stroke, high blood pressure and high blood cholesterol, some cancers and type 2 diabetes. In addition, this can also provide additional benefits, including reducing or controlling body fat, easing of daily tasks, greater independence and quality of life, and improved self-confidence and body image.

Regular training over a period of time causes the body to make the following physiological adaptations over the long term:

The lungs

Training causes the lungs to take in more oxygen, making the lungs more efficient. Rather than the lungs growing bigger, the body simply utilises more of the available lung tissue that is already present. This means that at any one time, more air can be sucked into the lungs, thus more oxygen is available to be exchanged into the blood system for carbon dioxide.

The breathing process becomes more efficient, as the respiratory muscles get trained and can continue to work aerobically for longer periods of time or at higher levels of exercise intensity.

The heart

In response to regular cardiovascular training, the left ventricle increases in volume and its muscular wall becomes stronger. The stroke volume of the heart increases, this means that each time the heart beats, a greater volume of blood is pumped out of the left ventricle into the aorta to be sent around the body. This may be accompanied by a lower resting heart rate because the same amount of blood can be pumped out in one minute with fewer beats.

In the same context, for any given level of exercise intensity, more blood can be pumped out of the heart each minute (ie, the cardiac output increases).

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Circulatory efficiency

With training, arteries and veins become better at delivering oxygen and removing waste products. There is an increase in the number of blood capillaries within the body, in part due to the manufacture of new blood vessels and in part due to previously dormant vessels being used. This extra 'capillarisation' occurs in and around muscle tissue; consequently, the delivery of freshly oxygenated blood to the working area is improved. There is a similar increase in capillarisation in and around the lungs and also the heart, which allows both of these organs to function more efficiently for longer.

The blood

To 'transport' more oxygen around the body, there is an increase in both the blood volume and the number of red blood cells in which oxygen is carried.

As cardiovascular exercise promotes fat metabolism, there is an important health benefit related to the way in which fats are transported around the bloodstream. Fats are carried in the blood, combined with proteins as lipo-protein (lipids is another name for fats). The lipo-proteins that have a high proportion of fat compared to protein are known as low density lipo-proteins (LDL), as fat is much less dense than protein. Conversely, lipo-proteins that have a higher proportion of protein to fats are known as high density lipo-proteins (HDL).

The LDLs have a tendency to stick to the blood vessel walls during transportation, and this may lead to an accumulation of fat deposits, which cause a blockage in the blood vessel (atherosclerosis or atheroma). Regular cardiovascular exercise improves the blood fat profile by causing more of the fat to be carried as HDL rather than LDL.

Blood pressure

As a result of this extra capillarisation, there are more avenues through which blood can flow. This means that the actual pressure of blood flow along any one vessel may be lower than before the aerobic adaptations occurred and overall blood pressure may be reduced.

The skeleton

Cardiovascular training that has a degree of impact can provide benefits to the skeletal system. The stress of the pulling effects of the muscles on the bones stimulates the activity of the osetoblasts to lay down new bone. This strengthens the bones, providing protection against osetoporosis (bone thinning). Connective tissue such as ligaments and tendons also benefit by becoming stronger, thereby improving the stability of the joints.

Non weight–bearing aerobic activities, such as cycling or swimming, will not have the same level of effect on bone density.

The muscles

Within the muscles, training causes an increase in both the number and size of mitochondria. There is also an increase in the amount of aerobic enzyme activity, and together this results in the muscles being capable of utilising more oxygen and fat at any given time. The muscles can continue to produce energy aerobically for longer, or at somewhat higher intensities of exercise. As a result, at a given exercise intensity, less lactic acid will be produced and so fatigue will be offset for longer.

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Special populations and cardiovascular training

Children

Younger people need to work harder than adults during aerobic activity in order to supply the muscles with the amount of oxygen they are burning. They are not well equipped to tolerate anaerobic exercise and therefore respond best to interval and fartlek training (a type of interval training using speed play) which are more suitable to their energy systems development.

Children tend to heat up and cool down faster than adults due to an inferior and underdeveloped cooling mechanism. They don't carry as much water in their body and can dehydrate during activities more easily. Heart rate training with children can be tricky; it is safer and more effective to use the RPE scale, talk test and visual observation.

Pregnancy

During pregnancy, low to moderate exercise intensity is recommended in order to preserve blood flow to the foetus. Individual target heart rates depend on the level of fitness and the stage of pregnancy. The body's normal heating process increases, which can lead to overheating. Pregnant women feel more breathless due to weight gain and hormonal influences.

When monitoring exercise intensity, it is best to use the talk test and client's appearance, rather than other methods of monitoring.

Ageing

Older adults tend to tire more easily and are less able to maintain their maximum pace than those younger. There is a decrease of 30% in the efficiency of the cardiovascular system between the ages of 30–70 years. Older adults have a lower tolerance to lactic acid, need longer to recover and can overheat rapidly. Some individuals may also have age-related increased blood pressure. When moving from one position to another, in particular from lying to standing, older adults may experience dizziness. Therefore, position changes should be made slowly to allow time for the blood to redistribute.

Loss of flexibility in the rib cage leads to increased frequency of breathing (shallow and fast). There is also a reduced ability for exchange of gases, leading to breathlessness.

Due to the changes in the bones and joints associated with ageing, continuous high-impact cardiovascular activities should be avoided, as these can damage the joints.

Disability

Individuals with disabilities may have limitations specific to their disability. Their fitness level may be low due to inactivity caused by their disability. These factors should be carefully considered prior to exercising.

Key points for cardiovascular fitness

- Cardiovascular fitness refers to the body's ability to take in, transport and utilise oxygen.
- Cardiovascular exercise is classified as being rhythmic, continuous and using large muscle groups under moderate tension over an extended period of time.
- The maximum heart rate can be estimated using the formula 220 minus age.
- The four aerobic heart rate training zones are: the moderate aerobic zone (50–60%), the fitness zone (60–70%), the performance zone (70–80%) and the performance (anaerobic) zone (80–90%).
- Heart rate during exercise is best monitored by using a variety of methods (including: heart rate monitor, talk test, observation and use of an RPE scale).
- The benefits of cardiovascular exercise can provide protection against chronic heart disease (CHD) and provide health-related benefits for most people.

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Muscular strength and muscular endurance

Muscular fitness is of fundamental importance to everyday life and necessary for the maintenance of an independent lifestyle. Research from the Allied Dunbar National Fitness Survey revealed that 30% of men and 50% of women aged 65–74 years did not have sufficient strength in their dominant leg to exert a force required to lift 50% of their body weight. Consequently, a simple task, such rising from a chair, would be difficult without using the arms to assist in standing up. Muscular fitness can determine an individual's mobility, work performance and ability to enjoy leisure activities.

Muscular strength

Muscular strength refers to the maximal tension or force that is produced by a muscle or muscle group. Absolute strength is usually measured by determining how much weight can be lifted in a single effort. This can be expressed as the one repetition maximum (1 RM).

To improve muscular strength, training intensity should be high and the number of repetitions of each lift or movement should be kept relatively low. This is expressed as:

Very high resistance x low repetitions
75% (or above) of 1 RM x low repetitions (1–10)

Muscular endurance

Muscular endurance refers to the ability of a muscle, or muscle group, to exert sub-maximal forces against a resistance over an extended period of time.

To improve muscular endurance, training intensity should be low to moderate and the number of repetitions kept relatively high. It is expressed as:

Low to moderate intensity x high repetitions
40–60% of 1 RM x high repetitions (15–25)

Muscular strength and endurance can also be effectively trained in a studio or sports hall, or outside of the gym by using exercise bands or body weight exercises such as press-ups, squats and abdominal curls. Body weight exercises like these can be easily adapted for strength or endurance by increasing the lever length or changing the body position or the angle of the movement.

The usual rule for muscular strength and endurance training is to perform exercise with a slow and controlled technique, keeping the muscles under tension. An exercise performed at a faster pace will develop power. This may be important when training for certain sports.

Power is defined as: force x speed.

A jumping squat, performed at speed, is an example of an exercise that will effectively develop power.

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The muscular strength and endurance continuum

The relative intensity of any given exercise can be placed on a continuum according to an individual's muscular fitness. This continuum ranges from pure strength at one end to muscular endurance at the other. For example, as you move away from the strength end, the gains in muscular strength diminish and the gains in muscular endurance increase. To put this in simple terms, an individual who can only perform five full press-ups would be working towards improving muscular strength, whereas an individual who can perform 30 full press-ups would be working towards muscular endurance.

Everyday tasks require varying degrees of muscular effort. Some may lean more towards strength (eg, lifting a wardrobe or carrying a heavy bag of shopping), whereas others may be more endurance-based (eg, digging the garden, or washing clothes by hand).

Muscular strength and endurance continuum		
1–8 reps	8–12 reps	12–25 reps
Strength	Strength and endurance	Endurance
Heavy resistance	Heavy/moderate resistance	Moderate/light resistance
PC energy system	PC/LA energy system	LA/O2 energy system
Fast-twitch muscle fibres	Mix of fibre types	Slow-twitch muscle fibres

Remember that the changes in a muscle are specific to the stimulus placed upon it (the SAID principle). If the stimulus is of low intensity and towards the endurance end of the continuum, then the changes will improve endurance capabilities. If the stimulus is very high in intensity, then the changes will improve strength capabilities. When one trains on this continuum, remember that the resistance must be sufficient to overload the muscles, otherwise no improvements will occur.

When training with resistance equipment, it is easy to determine whether it is best to work towards muscular strength or endurance; one simply employs the appropriate resistance and number of repetitions. However, when using one's own body weight, it is important to take a more 'scientific' approach by altering the body position, lever length or exercise angle to achieve the desired strength or endurance goal. For example, the shorter lever is closer to the pivot point, thereby decreasing the exercise intensity. Conversely, the longer lever is further away from the pivot point, thereby increasing the exercise intensity.

Gravity and body position also affect exercise intensity. For example, performing a standing squat in which the whole body is being used against gravity is more intense than a lying leg lift in which the leg only is being used as the resistance without the influence of gravity.

Muscular response to strength training

Over a period of time, long-term strength training brings about physiological changes within the muscle that occur due to the specific stress placed on it. The muscle adapts to enable it to meet these new physical demands.

Strength training largely utilises fast-twitch muscle fibres and is primarily fuelled by the phosphocreatine energy system. Therefore, this system will adapt and increase its efficiency.

This type of training causes microscopic tears to the contractile proteins, actin and myosin filaments in the muscle fibres. Providing there is adequate rest and nutrition following training, it is thought that the repair process results in extra contractile proteins being laid down, increasing muscle size and strength. The increase in muscle size is referred to as 'muscular hypertrophy'. As the muscles become stronger, they will start to burn more calories. However, muscular hypertrophy is not permanent. With muscle disuse (eg, as in cessation of training or disuse due to an injury or disability), muscular atrophy occurs (reduction or wasting of the muscle fibres).

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Connective tissues become stronger. Adaptations to ligaments make the joints more stable, and the pulling effects of the tendons on the bones can result in increased bone density at the site of muscle attachment.

Adaptations of the nervous system, or neuromuscular adaptations, can also include improved synchronisation of motor unit firing and improved ability to recruit motor units to enable a person to match the strength elicited by electrical stimulation. This adaptation explains the rapid gains in strength that often occur in the first few weeks of strength training without any increase in muscle size.

Delayed onset muscle soreness (DOMS)

Strength training puts stress on the connective tissues and muscular structure of the body. It can produce micro-tears in the tissues, resulting in pain, soreness, stiffness and inflammation.

Delayed onset muscle soreness (DOMS) describes muscle pain, soreness or stiffness that is felt 12–72 hours after exercise. This is particularly the case at the beginning of a new exercise programme, after a change in sports activities or after an increase in the duration or intensity of exercise or activity. DOMS should not be confused with the muscle discomfort experienced immediately following severe physical stress due to an increased in carbon dioxide in the muscles.

Eccentric training is a method of training that allows a person to push his or her muscles past their normal point of failure. It allows one to lift, eccentrically (the lowering/negative phase of an exercise), 30-40% more resistance than the concentric (lifting/positive phase of an exercise). However, this is much more demanding on your muscles and produces a high level of muscle damage in the form of micro-tears. It is a method of training that carries the highest risk of DOMS and is not suitable for the deconditioned individual.

Muscular response to endurance training

Long-term endurance training brings about its own specific physiological changes within the muscle that occur due to the stress placed on it. The resultant adaptations differ from those that occur following strength training.

Endurance training largely utilises slow-twitch muscle fibres and is primarily fuelled by the lactic acid energy system. This system will adapt and increase its efficiency. It is the gradual accumulation of lactic acid in the muscle that leads to fatigue, as the sliding filament process of muscle contraction is inhibited. To offset this fatigue and improve muscle endurance, it is necessary to improve the supply of oxygen to the muscle, and the muscle's ability to use this oxygen, reducing the build-up of lactic acid. The supply of oxygen is improved by an increase in blood capillaries in and around the muscle, as well as an increase in both the number and size of mitochondria in the muscle.

This type of training maintains muscle mass, which is often referred to as muscle tone. As the muscles become more toned, they will start to burn more calories.

Changes to the nervous system or neuromuscular changes will also occur.

In the middle of the continuum, at 8–12 reps, both strength and endurance will be training in equal balance. This makes it an ideal range for individuals who want to train for general fitness and health benefits. The American College of Sports Medicine (ACSM) recommends the following guidelines for improving muscular fitness.

ACSM guidelines for improving muscular fitness	
Frequency	2–3 times per week with 48 hours separating the training sessions
Intensity	*2–4 sets at 8–12 repetitions, with a rest interval of 2–4 minutes between sets For older adults and the deconditioned, 1 or more sets of 10–15 repetitions
Time	Relative to the number of exercises and sets/reps
Type	Whole-body, multi joint exercises for the major muscle groups Free weights, resistance machines, body weight, etc.

*The number of sets, reps and rests can be manipulated to accommodate specific muscular strength or muscular endurance training goals

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Summary of the benefits of muscular fitness training

Over the last 10 years, numerous studies have shown that muscular fitness training produces many benefits for all ages and both genders. These include:

- increased bone density – studies have shown that women over the age of 35 can lose about 1% of bone mass per year, a figure that tends to be significantly increased after the menopause. Regular muscular fitness training has been shown to increase bone mineral content. For example, one study found that women who performed resistance training twice a week for a year significantly increased their bone density. Regular muscular fitness training reduces the risk of osteoporosis and bone fractures in later life.
- increased metabolic rate and calorie expenditure – long-term resistance training has been shown to increase the resting metabolic rate (ie, the energy required to maintain the functioning of the body at rest). This helps to reduce body fat and control body weight.
- decreased blood pressure – regular muscular fitness training has been shown to reduce both systolic and diastolic blood pressure.
- decreased blood cholesterol – numerous studies have shown that regular muscular fitness training can improve the blood cholesterol profile.
- improved self-image – changes in muscle tone, shape and size can contribute greatly to enhanced self-image.
- daily activities – activities such as lifting children, carrying heavy shopping bags and standing up from a chair become easier.
- decreased risk of injury – increased mobility and stability of the joints and stronger muscles and connective tissue result in a stronger body. A stronger body and core is better able to avoid or resist injuries and knocks from falls or other physical activities.
- improved core stability – the core includes the back, pelvis and shoulder girdle. Improving the ability of the core, or trunk, to support your everyday functional activities enables the muscles and joints to perform at their safest and most effective position. Typical exercises for this include the plank, crunches, oblique crunches and back extension. Core stability is the ability to move the limbs (arms and legs) while maintaining correct alignment of the spine.
- improved posture – employing functional, push–pull type muscular strength and endurance training can help to correct muscular imbalances, which can lead to postural problems.

Posture

To improve posture, there must be an appropriate choice of exercises; this could involve strengthening weak muscles and stretching tight ones. For example, if a client has an increased curvature of the upper back, they may benefit from strengthening the rhomboids and mid trapezius and stretching the pectorals. This combination of strengthening and stretching could counteract the stooped position often associated with sitting and working at a desk all day.

A client with an increased arching of the lower back will usually benefit from exercises to strengthen the abdominals and gluteus maximus muscles and stretch the hip flexors. This combination may counteract the excessive curve in the lower back and bring the spine into a more neutral alignment.

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Special populations and muscular strength and endurance training

Children

Weight-bearing exercise for children is an important feature of their development. It is important to remember that weight-bearing exercises that employ the appropriate repetitions and resistance stimulate bone growth. Very high intensity strength training for children should be avoided, as it may damage bone and the growth plates. Note that muscle growth does not keep up with bone growth, although both are an important consideration when training children.

Pregnancy

The hormone relaxin affects joint stability, making the joints more lax – especially those in the pelvis. Because all the joints are affected, there is a greater risk of injury. Changing body shape during pregnancy, brought about the growth of the foetus and lax ligaments, leads to postural changes and changes in gravity.

A supine lying position should be avoided after the first trimester, due to the restriction of blood return to the heart and the pressure on internal organs.

The timescales for release and withdrawal of relaxin should be considered for exercise, as relaxin could remain, diminishing gradually, in the system for up to around five months after childbirth.

Ageing

With age, the metabolic rate tends to decrease. This decrease is largely thought to be due to the loss of muscle tissue (particularly fast-twitch muscle fibres), which is more a product of inactivity than ageing. Regular resistance training is an excellent way to preserve muscle mass, prevent a reduction in metabolic rate and avoid putting on weight (fat) with age.

Regular muscular fitness training reduces the risk of osteoporosis and bone fractures in later life and can reduce the frequency and severity of falls and fractures.

Disability

Individuals with disabilities may have limitations specific to their disability. Their muscles may be deconditioned or atrophied due to inactivity caused by their disability. These factors should be carefully considered prior to exercising.

Key points for muscular fitness

- Muscular strength can be achieved by using high-resistance, low-repetition training regimes.
- Muscular endurance can be achieved by using low-resistance, high-repetition training regimes.
- Power is defined as force x speed.
- The main muscular adaptations to strength training are increased fast-twitch muscle fibre motor unit recruitment and hypertrophy of fast-twitch muscle fibres.
- The main muscular adaptations to endurance training are increased capillarisation, increased size and number of mitochondria in the slow-twitch muscle fibres and increased recruitment of slow-twitch muscle fibres.
- DOMS describes micro-tears in the tissues, with resulting pain, soreness, stiffness and inflammation, and is brought about by very high intensity training.
- Body weight exercises can be simply adapted for strength or endurance by increasing the length of the lever or changing body position or the angle of movement.
- The ACSM guidelines for improving muscular fitness are: 2–3 times per week, 2–4 sets of 8–12 reps or 1 or more set of 10–15 reps. For older adults and the deconditioned, whole-body, multi joint exercises for the major muscle groups.
- The benefits of muscular strength and endurance training contribute to weight loss and management, decreased blood pressure and blood cholesterol, improved posture and core stability, improved self-image, reduced risk of falls and injury, ease of daily activities and increased bone density.

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Flexibility

Flexibility is a measure of the maximum possible range of movement (ROM) around a joint or joints. Flexibility is specific to a particular joint or set of joints.

Most individuals only become aware of flexibility as they get older or if they participate in activities in which its presence or absence affects their performance (eg, yoga or Pilates). However, lack of flexibility at any age will make the body stiff, less mobile and restrict everyday movements.

Flexibility is probably the most underrated components of physical fitness, yet there is a wide range of health-related benefits to be gained from a regular stretching programme. Flexible joints and muscles contribute to the maintenance of correct posture and joint alignment. This aspect of physical fitness should be included at the end of every exercise session, when the muscles are at their warmest.

Types of stretching

Stretching exercises require the two ends of the muscle (the start/origin and end/insertion) to move further apart. This causes the muscle to lengthen and will potentially increase the range of motion at the joint. Remember that the muscles should always be thoroughly warm in order to facilitate effective stretching. There are several types of stretching to consider. These are outlined below.

Static stretching

This method of stretching involves a controlled lengthening of the muscle tissue under tension for a period of time (eg, sitting on the floor and gently leaning forwards over an extended leg to stretch the hamstrings). This type of stretching carries a lower risk of muscle damage and muscle soreness than other types and should be given preference when dealing with health-related exercise.

Static stretching can be subdivided into two further categories, based on the force that is generated in the stretch.

Active stretching – when the opposing muscle contracts and shortens to bring about a lengthening of the antagonistic muscle pairing (eg, when standing up and flexing the knee). This is an active stretch of the quadriceps caused by the contraction of the hamstrings to bring about a lengthening of the quadriceps.

Passive stretching – when an external force other than the opposing muscle brings about a stretch. This external force could be another body part, a wall or the floor in conjunction with gravity, or a partner (eg, taking the previous active quadriceps stretch, but instead, taking hold of the ankle. The stretch becomes passive as an external force – another body part – is now allowing the opposite muscle to relax. Notice that also it is now possible to significantly increase the range of movement.)

Ballistic stretching

Ballistic stretching involves a bouncing, bobbing, rhythmic or jerking movement. The aim of this type of stretching is to use the momentum generated in the movement to take the body part concerned through a greater range of movement. Results are usually positive; however, the increased range of movement is caused by the lengthening of tendons and ligaments. This will affect the joint stability and is potentially contraindicated. This type of stretching may be considered for persons whose sports activities involve ballistic movements. However, due to the high risk of injury involved, it is unsuitable for health-related improvements in flexibility.

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Dynamic range of movement stretching

Dynamic range of movement stretching involves moving in and out of stretches in a controlled manner. The muscle is lengthened slowly to the end of the range of motion and then back to the start position. This process is repeated several times progressively and steadily. Care must be taken not to move too quickly or too far into the stretch, as otherwise the stretch may become ballistic in nature and could potentially cause injury. This type of stretching, if executed effectively, provides a safe alternative method to static stretching. It is particularly suitable for the warm-up phase of an exercise session.

When to stretch

During an exercise session, stretching exercises are normally performed at two points: the warm-up and cool down.

Short stretches should be included in the warm-up after the mobility and pulse-raising sections. The general aim of short stretches is to reduce the chance of injury by preparing the muscles for the range of movement expected within the workout. These stretches can either be static stretches or dynamic stretches.

Maintenance and developmental stretches are performed as part of the cool down. Maintenance stretches are for those muscles that simply need returning to their pre-exercise length after the workout, as no further increases in flexibility are required. However, developmental stretches are for targeted muscle groups that require improved range of movement or increased flexibility. The muscle is slowly lengthened until a point of tightness is felt and then held in that position. When the tension subsides, the process can be repeated again. This type of stretching is the only type that actually aims to improve or increase flexibility.

Factors affecting flexibility

The structure of the joint

This is the biggest limiting factor in determining range of movement. It is not possible to force a joint to move beyond its anatomically functional range without risking injury.

The ligaments and tendons supporting the joint

The function of ligaments is to bind bone to bone and support a joint. They allow movement to occur, but are strong and inextensible, so as not to yield too easily to force. This is because they are made mainly of collagenous fibres.

Collagenous fibres are arranged in closely packed wavy bundles, similar to the wires in an electric cable. This arrangement provides them with the strength to resist high forces and is the reason why they are the main components of ligaments and tendons.

Muscles are attached to bones by the tendons, which transfer movement to the bones. Tendons provide about 10% of the total resistance to movement.

Opposing tissue bulk (muscle or fat tissue)

For an individual with massive biceps, this will physically restrict the range of movement at the elbow joint when trying to stretch the triceps. Likewise, for an individual with a large belly who wants to stretch the hamstrings, their range will be limited by the fatty tissue.

The muscle and its connective tissues

Sheaths of connective tissue surround a muscle. This meshwork of connective tissue makes up about 30% of the muscle mass and accounts for around 40% of the total resistance to movement. This resistance represents a large factor, which we can influence in flexibility development.

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One of the most significant ways in which we can influence connective tissue is to ensure that the muscle is warm and to hold the stretch statically. As tissue temperature rises, connective tissue stiffness decreases and extensibility increases.

There are a number of other non-structural factors that can affect one's degree of flexibility, as detailed below.

Gender

Any difference between the genders is probably anatomical. For example, women have broader and shallower hips, thus they have a greater potential range of movement than men in this area. However, there are lots of exceptions to this rule, such as male gymnasts and martial artists who have trained specifically to be flexible.

Age

Flexibility can be developed at any age, given the appropriate training. However, due to a loss of water and an increase in calcium salt deposits associated with ageing, there is an increase in muscle stiffness that affects the muscle and its connective tissue. This is associated with a decreased potential among older exercises. It is generally thought that the greatest improvement in flexibility occurs between the ages of 7–15 years.

Pregnancy

During the later stages of pregnancy, the hormone relaxin affects ligaments and this makes all joints more flexible and less stable. After giving birth, the effects of relaxin remain in the body for several months.

Temperature

Warm muscles stretch more easily than cold ones. This is why it is important to ensure that muscles are warm prior to stretching.

Time of day

We all have our own unique body rhythm, called circadian rhythm. Our circadian rhythm influences blood pressure, body temperature, heart rate and hormone levels. It is not uncommon for people to feel more flexible in the evening than in the morning or vice versa.

ACSM guidelines for stretching	
Frequency	Minimum 2–3 times per week
Intensity	3–4 reps per muscle group to the end of the range of motion, without inducing discomfort
Time	15–60 seconds for each stretch
Type	Static, dynamic or PNF for the major muscle/tendon groups (whole-body approach)

Source: ACSM Guidelines for Fitness Testing and Exercise Prescription 8th Edition

Benefits of flexibility training

- Quality of life – if the normal free range of movement capabilities can be maintained or enhanced, then the ability to cope with everyday activities can be improved (eg, reaching for the top shelf or simply being able to tie your own shoelaces!).

- Improved posture – for example, tight hamstring muscles can pull the pelvis out of alignment and cause an arching of the lower spine (lordosis). Tight pectoral muscles can pull the shoulders forwards, causing a rounded upper back (kyphosis). Chronic back problems are a major cause of disability in the UK, and it is widely recognised that inflexible hamstrings, hip flexors and erector spinae muscles contribute to this condition. A regular stretching programme can help alleviate some of the problems associated with back pain.

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- Improved sports performance – flexibility exercises are useful for sports performance because they increase the range of movement at a joint, thus allowing muscles to exert more force over an extended period of time. For example, in golf and tennis, increased flexibility in the shoulder, elbow and wrist joints can enhance performance by allowing a player to hit the ball harder by applying more force through a greater range of movement.

- Stress management – the process of stretching can produce profound changes in physical and mental relaxation. Wide ranges of stress management methodologies incorporate some form of stretching to induce a calm and relaxed state.

Special populations and flexibility training

Children

Stretching for this age group needs to be handled with care. The problems arise due to soft joints and growth spurts. In very young children, joints are still soft and can easily be injured if forced into certain positions. In older children, the muscles are already very tight, as the bones grow faster than the muscles can stretch.

Pregnancy

During pregnancy, especially the later stages of pregnancy, there is an increased ability to achieve a greater range of movement. This is predominantly due to the hormone relaxin, which increases the pliability of the connective tissue in readiness for birth. A fitness instructor must be very cautious to avoid permanent damage and advise the client to perform only short stretches, avoiding all developmental stretching at this time.

Ageing

Increased muscle stiffness affects the muscle and its connective tissue decreasing stretching potential among older exercisers. This age group tends to lose body heat quickly, which further affects stretching potential.

Disability

Individuals with disabilities may have limitations specific to their disability. Their range of movement may be impaired due to inactivity caused by their disability. These factors should be carefully considered prior to exercising.

Key points for flexibility training

- Flexibility is the range of movement around a joint or joints and is specific to each joint.
- The types of flexibility are: static (either active or passive), ballistic and dynamic.
- Stretching in an exercise session is usually performed with short stretches during the warm-up and with maintenance and developmental stretches in the cool down.
- Developmental stretches are the only stretches that improve flexibility (in a health-related context) and are used to target muscles where a greater range of movement would be beneficial.
- The recommended guidelines to improve flexibility are static stretching, 2–3 x per week, 3–4 reps per muscle group and 15–60 seconds for each stretch.
- The benefits of a flexibility programme are improvements in quality of life, sporting performance, posture and prevention of chronic back pain conditions.

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Motor fitness

The skill-related component of physical fitness is referred to as motor skills, motor fitness or neuromuscular fitness. It is described as the ability of the brain and nervous system to control the movements of the body that are necessary to complete, or master, a prescribed action or task. It refers to a number of interrelated factors, which include:

- **agility** – the ability to rapidly change the position of the entire body in space with speed and accuracy
- **balance** – the ability to keep the body centred over a base of support
- **speed** – the rate or rapidity of any motion
- **coordination** – the ability to perform smooth and accurate movements requiring good awareness and integration of senses, muscles and body position involved in the movement
- **power** – the amount of work done per unit of time: work divided by time, force and speed
- **reaction time** – the interval between a stimulus and the initiation of a response.

Movement of any kind is influenced by responses from and to the nervous system. Together, these provide an individual with kinaesthetic awareness, a sensory skill that the body uses to know where it is in time and space.

Why we need motor fitness

Some exercises require a high level of motor skills to be performed correctly. Some examples are:

- yoga – for balance
- Swiss ball exercises – for balance
- studio classes – for co-ordination
- racquet sports – for agility, co-ordination and reaction time
- Olympic weight-lifting – for power and co-ordination.

Motor fitness requires the effective transmission and management of messages and responses between the central nervous system (the brain and spinal cord) and the peripheral nervous system (sensory and motor). The peripheral nervous system collects information via the sensory system; the central nervous system receives and processes this information and sends an appropriate response via the motor system, which initiates the appropriate movement.

Many everyday activities, sporting activities and specific types of exercise demand the acquisition of one or more of these components to produce a smooth, efficient action to master a particular task and improve performance. Within health-related fitness, skilful performance of specific exercises will contribute to both the safety and effectiveness of the specific exercise, thereby reducing the risk of injury.

Motor skill acquisition and the learning process

Individuals need both time and practice to develop new specific skills (eg, to perform a sequence of choreography in an exercise to music class, a new resistance lift or any other complex activity).

Managing body weight, manoeuvring one's centre of gravity, co-ordinating the body movements and moving at different speeds and in different directions and at different intensities, will in the long term help to improve your motor skills.

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There are three main stages of learning when training motor skills: cognitive, motor and automatic.

Cognitive

This is the initial phase of skill development in which the performer finds out what they are expected to do. At this stage, they will be less co-ordinated and unfamiliar with the exercise or movement pattern. They may also tire easily, as concentration levels will need to be high. It is essential at this stage not to overload the individual with too much information; the exploratory nature of this stage will mean that errors are made.

Motor (associative)

Many learners stay at this stage of learning for a long period of time. They are more able to recognise mistakes, make comparatively fewer errors and are able to make some of the necessary adjustments to improve technique. Although learners are able to link together movement patterns, their movement is often slower, more deliberate and their concentration levels are high.

Automatic (autonomous)

At this stage of learning, individuals will have developed their reaction time, will be able to move faster and can perform multiple actions. They can also maintain a higher degree of accuracy in their movement. The level of anxiety regarding performance is also reduced. Movements are less cognitive and are performed more automatically. To maintain this level of skill, it will still be necessary to return to earlier stages of learning on occasion.

Factors affecting motor skills

Previous skill

If someone has previous experience of a skill, then it is much easier to re-acquire that skill at a later date. Skills such as riding a bike, used in childhood but not for several years, can be easily restored as the basic skill patterns still exist.

Kinaesthetic awareness

This means being aware of the position of the body without looking. Receptors in the muscles constantly feed information to the brain, which can then work out how the body is moving. This awareness is essential for good motor skills.

Special populations and motor skill training

Children

Motor skills are used in varying degrees in all physical activities. Young children will not have gained sufficient motor skills to participate in some activities with good technique. Children's lower limbs grow fast, so much so that their brain cannot keep up. This can make them uncoordinated and appear clumsy. It is imperative that all activities promote motor skills by rehearsal and repetition in a controlled manner.

Pregnancy

As the foetus grows, the pregnant client will notice a change in spacial awareness and their centre of gravity. These adaptations will have an effect on balance, co-ordination and speed. This will make it harder for the client to move swiftly from one exercise to another, so more time may be needed prior to a change in direction and/or activity.

Remember the impact that relaxin has on connective tissue – in particular, on joint stability, which, compounded with moving too fast in an unco-ordinated manner, may lead to injury.

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Ageing

Although the evidence is less conclusive than with some of the other components of fitness, it is generally accepted that with ageing there is a reduction in motor skill ability. This age group may need longer to process information and may have reduced concentration. This requires constant repetition and reinforcement when teaching a new exercise or movement pattern. Short-term memory is affected, which can lead to individuals forgetting a technique or movement pattern, so it is important to be patient and prepared to constantly repeat and reinforce. Reduced vision and hearing can compound the problem, so it may help to be more visual than verbal. Balance, co-ordination and reaction time are also affected, which can make older people slower to react, a little clumsy and prone to dizziness.

Disability

Individuals with disabilities may have limitations specific to their disability. Their motor fitness may be poor due to inactivity caused by their disability. These factors should be carefully considered prior to exercising.

Key points for motor skill training

- The learning process has three main stages: cognitive, motor and automatic.
- Motor fitness refers to the skill-related elements of fitness: agility, balance, speed, co-ordination, power and reaction time.
- Motor fitness is essential for everyday life, sporting activities and specific exercises to produce smooth, efficient actions and reduce the risk of injury.
- To develop motor fitness, skills need to be broken down in a logical learning process.

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General considerations for special populations

Working with older people

The advancement of age is something that happens to us all. As life expectancy is extending and people are living well into their eighties there is an increased need to be physically fit to enable individuals to be independent and enjoy life.

Age should not be a barrier to exercise. Regular physical activity can:

- stimulate physical and mental health
- increase mobility and independence
- improve stamina, strength, posture, co-ordination and reduce the risk of falls
- reduce the risks of osteoporosis and fractures
- help to overcome loneliness and isolation
- assist in reducing anxiety and depression and give a general sense of well-being.

The effects of ageing vary greatly between individuals. Although the effects of ageing are inevitable, activity is an excellent way of slowing down the ageing process. Simple adaptations to mainstream exercise sessions can be made to accommodate those in this age group who are apparently healthy (eg, the use of chairs or additional tools to help balance and support allow this age group to integrate with everyone else).
The key safety guidelines as defined by the National Occupational Standards for older people are as follows.

Exercises to include for this age group include:

- back extension (in particular thoracic extension) to improve posture
- interval-type activities that allow for rest between harder bouts of activity
- multijoint, functional activities to assist in everyday tasks
- balance activities and core stability activities
- longer warm-ups.

Exercises to avoid for this age group include:

- high-impact
- prone/flexion activities
- complex choreography/exercises.

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Working with young people (14–16 years of age)

A sedentary lifestyle in young people can have negative health consequences both now and later in life. An obese child has an 80% chance of growing up to be an obese adult. This could be due to unhealthy lifestyle choices and learned behaviours from parents or guardians, coupled with becoming increasingly self-conscious about their body while growing up.

A young person who is active will have:

- stronger muscles and bones
- a leaner body, controlled body fat and be less likely to become overweight
- a decreased risk of developing type 2 diabetes
- possibly lower blood pressure and blood cholesterol levels
- more confidence and a better outlook on life.

If through the usual screening process, it is apparent that the individual has a specific condition, an instructor must refer them to a specialist instructor.

Note: A young person's parent or guardian should complete the screening form. If there are any questions regarding the safety of continuing with the exercise session, it is essential to contact the parent and discuss the best course of action.

General exercise guidelines for young people include:

Exercises to include:

- interval-type training (ie, reducing the impact and intensity in between heavier bouts of exercise)
- body weight exercises incorporating gravity and lever length as resistance
- functional activities such as pulling and pushing
- activities to develop motor skills (eg, balance and co-ordination).

Exercises to avoid:

- prolonged high-intensity training (anaerobic training)
- high-resistance training, which can cause damage or fractures to the growth plate.

Boys' and girls' lower limbs grow fast, so much so that their brain cannot keep up. This can make them seem unco-ordinated and clumsy. Therefore, it is imperative that all activities promote motor skills by rehearsal and repetition in a controlled manner.

Child protection

Before working with this age group, all instructors will be required to adhere to government policy regarding the safety and welfare of children under the Child Protection Act, 2004. This requires individuals to undertake a CRB (criminal records bureau) check to become registered. The act requires the registered person to comply with local child protection procedures approved by the Area Child Protection Committee and ensures that all adults working with and looking after children in the provision are able to put the procedures into practice.

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Working with ante-natal and post-natal clients

Exercise plays an important role in promoting health and well-being before, during and after pregnancy.

Women who exercise during pregnancy have reduced weight gain, more rapid weight loss after delivery, improved mood and improved sleep patterns. Some studies have demonstrated that women who exercise regularly during pregnancy have less incidence of induction, faster labours, are less likely to require epidural analgesia, have fewer operative births and have a quicker recovery from delivery. These are persuasive arguments for staying active.

Pregnancy is a highly complex physiological process, and precautions are needed to ensure that exercise does not contribute to any complications.

After birth, most of the physiological changes persist for 4 – 6 weeks; therefore, gradual introduction of pre-pregnancy exercise should be based on capability.

The following guidelines will help to ensure the safety and well-being of mother and baby.

Exercise to include:

- interval-type exercises (ie, reducing intensity in between heavier bouts of exercise)
- maintenance stretches (eg, static stretches)
- core stability exercises
- balance exercises.

Exercises to avoid:

- supine positions and exercises after the first trimester (restriction of blood return via inferior vena cava)
- developmental, proprioceptor neuromuscular facilitation (PNF) or ballistic stretching due to the effects of the hormone relaxin on connective tissue
- high-impact exercises
- exercises that carry a risk of falling or abdominal trauma.

Working with disabled individuals

It is estimated that there are over 10 million disabled people in the UK, almost a quarter of whom will experience disability, most of them as a result of age-related changes. While people are now living longer, some are doing so with disabling medical conditions.

Only 7% of disabled people are sufficiently physically active for disease prevention. Appropriate levels of physical activity are known to reduce the incidence of certain chronic diseases by as much as 50%, including cancers and cardiovascular diseases – two of the leading causes of early death.

Disabled people may have an even greater opportunity for benefiting from keeping physically active, as it can help to reduce, manage or even reverse some of the effects of their impairment. When dealing with clients with a disability, precautions are needed to ensure that the exercises do not contribute to complications or make their condition worse.

An instructor should always seek information from the client concerning their individual disability. Adaptations should be made to facilitate participation specific to the individual's condition, ability and experience. For example, an individual with a hearing or sight impairment can easily be integrated within a regular training environment with some careful planning, by ensuring they are always in a position where they can best follow the instructor.

Note: There are many physiological changes that take place with these specialist populations. It is important to appreciate the scope of one's own personal ability in teaching these individuals in a gym or studio setting. If in any doubt as to whether these individuals can be included into a mainstream session, or for individuals with specific conditions, it is essential to refer them to a specialist instructor, who will be able to deal with them safely and effectively.

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Specialist training

The number of individuals requiring specialist instruction for one reason or another is on the increase. Specialist exercise instructors can make a big contribution to the overall health of this population, contributing to an overall improvement to their quality of life.

Gym instructors, group exercise instructors and personal trainers without additional qualifications are restricted to working with the 'apparently healthy' category of individuals.

Undertaking specialist training in one or more of the above populations demonstrates that an instructor has the knowledge and skills necessary to provide more in-depth advice and exercise programming for a particular population. It also provides an instructor with the ability to work with a range of fitness, health and medical professionals in a particular field (eg, personal trainers, physiotherapists, ante-natal/post-natal clinics and other healthcare organisations).

Key points for special populations

- Due to the physiological differences in children, older adults, ante-natal/post-natal and disabled clients, specialist training is required.
- For those who are apparently healthy, simple adaptations to mainstream exercise sessions can be made to accommodate specialist populations.
- Working with specialist populations can be rewarding and fun for the instructor and potentially life-changing for the participant.

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Nutrition for exercise and health

Our understanding of the relationship between nutrition and health has dramatically improved due to a wealth of recent research and scientific studies.

The following information will help an instructor to make recommendations in line with healthy eating guidelines in order to achieve a 'balanced diet'. Without further training, an instructor's role in making dietary recommendations is limited to advising based on this information.

Food and drink are central to life, and we cannot survive without them. However, the quantity and quality of the food and drink we consume can have an enormous influence on body weight, complexion, concentration, energy levels and mood. Inadequate or poor nutrition can lead to vitamin and mineral deficiencies. It can also dramatically influence the risk of developing many diseases such as coronary heart disease (CHD), obesity, cancer and diabetes and can help in the treatment and recovery from other illnesses.

Nutrients

The body needs fuel in order to provide energy for all organs and cells to perform their job of maintaining health (including the building and repair of body tissues) and to drive activity patterns.

These fuels are provided in the form of the following macronutrients:

Macronutrient	Example foods	Necessary for
Carbohydrates	Rice, pasta, potatoes, bread, cereals and grains	Energy production
Fats	Dairy, oils, nuts, seeds and fish	Insulation and energy production
Proteins	Meat, dairy, nuts, pulses and fish	Repair and growth of body tissues

Carbohydrates in the food we eat come in two different forms:

- **simple carbohydrates** – these are naturally occurring sugars found in fruits and milk.
- **complex carbohydrates** – these are the starches found in plants, particularly grains, seeds and root vegetables, such as potatoes.

Dietary fats are complex organic substances that are not soluble in water. There are two basic types of fat: saturated and unsaturated.

Type of fat	Example foods
Saturated fats (solid at room temperature)	Butter, suet and lard. Meat, meat products, cheese and cream also contain a high percentage of saturated fats.
Unsaturated fats Poly unsaturated, mono unsaturated (very soft or liquid at room temperature)	Nuts, fish and many types of seed and plant product.

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In addition, we need the following micronutrients:

- **vitamins** – to enable us to effectively use the energy from the macronutrients.
- **minerals** – these are necessary for a range of very specific tasks.

Sources and functions of minerals		
Mineral	Found in	Necessary for
Calcium	Milk, cheese, green vegetables, soya	Hardening of bones and teeth, muscle contraction
Phosphorus	Cheese, oatmeal, liver, kidney	Needed to work with calcium in the formation of bone
Iron	Liver, beef, egg yolk, cereals, green vegetables	Production of haemoglobin in red blood cells
Sodium	Fish, meat, eggs, milk, cooking and table salt	Regulating the body's water content
Potassium	Most foods	Water and electrolyte balance and normal functioning cells
Iodine	Most foods and drinking water	Essential component of thyroid hormones
Zinc	Nuts and fish	Growth and tissue repair

Deficiencies in vitamins and minerals can lead to anaemia, reduced bone mineral density/osteoporosis, digestive disorders such as constipation and diarrhoea, reduced muscle mass, weight loss/gain and deficiencies in essential fatty acids.

Fibre

In addition, the human body also needs fibre, which is a form of carbohydrate that is found in plant cell walls. Fibre is essential for optimum function of the digestive system and is sometimes referred to 'roughage'.

The fibre content of a variety of foods	
Food	% fibre
Wheat bran	44.0
Coconut (fresh)	13.6
Cornflakes	11.0
Peanuts	8.0
Muesli	7.4
Sweetcorn (canned)	5.7
Brown rice	5.5
Brown bread	5.1
Spring greens (boiled)	3.8
Bananas	3.4

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Water

Water provides the right conditions for all other functions. Approximately 80% of the weight of a newborn child is made up of water. Even in adulthood, water accounts for approximately two-thirds of our weight. We could all survive for a number of weeks without food, but four to five days without water would kill any human.

Water is the main component of cells and blood, and the body needs a constant amount of it. This means that whatever we lose in a day MUST be replaced. Water is lost from our bodies in a number of ways: through urine and faeces, evaporation from the skin as sweat and from expired breath. Even without moving around, we lose 2–2.5 litres of water per day via these routes. Approximately 50% of this can be replaced from the foods that we eat, but it is still necessary to drink plenty of fluids. Current guidelines state we should drink on average 2 litres of water per day, and this should increase with exercise.

An inactive person needs to drink about six glasses of fluid a day. A sportsperson in training would need to drink much more, as up to 4–5 litres of water can be lost in sweat in a day, and even more in hot environments. If one loses too much water from the body without it being replaced, then the building of body tissues, temperature regulation and metabolic rate are all affected. The resulting dehydration can lead to fatigue, headaches, lack of concentration and constipation. A loss of only 10% of normal bodily requirements can result in severe dehydration that may be fatal.

Metabolism and energy balance

The range of internal activities that take place in our bodies is known as metabolism, and the amount of energy that is required at rest to drive metabolism is known as our basal metabolic rate (BMR). BMR is measured in calories.

BMR will be different for each individual, as it predominantly depends on how much of us there is (ie, our body weight and how active we are). Another contributory factor is the ratio of fat-free mass to fat mass, or body composition. Fat-free mass is made up of our body fluids, bones and muscle tissue and is more metabolically active (therefore will require more energy) than fat mass.

BMR is usually around 1,500 kcals (kilocalories) for an average female and 2,000 kcals for an average male.

Note: The above is an estimation and will vary from one person to another. These figures do not take into consideration individual activity levels.

The energy balance equation

The energy balance equation states that body weight will remain the same when calorific intake equals calorific expenditure. The energy content of food is constantly being transformed into other forms of energy. If the intake of energy exceeds the energy output, the excess energy is stored as fat. The key to losing fat is to create an imbalance between energy expenditure and energy intake. Thus, it is not a prerequisite to work in this zone to lose fat if one is well-conditioned, only if you have low fitness and are overweight.

Energy in > energy out = weight gain.
Energy in < energy out = weight loss.
Energy in = energy out = weight maintenance.

To lose fat, a deficit must be achieved. A deficit of 3,500 kcals is required to lose 1 lb of stored fat. This deficit for weight management is generally best achieved through a combination of increased physical activity and a slight reduction in daily consumption of calories.

Regardless of the actual amount of calories necessary to sustain our basic daily body functioning and activity levels, we should all consume a balanced diet. This means that we should consume a certain percentage of these calories from each food group.

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Recommendations for a healthy diet

It is always advisable to check the current national guidelines, as these do have a tendency to change over time. Currently, the NHS Live Well website offers the most up-to-date guidance and emphasises the importance of getting your five a day. The 'eatwell plate' also features on this website and is a good visual representation of how different foods contribute towards a healthy balanced diet (this is not recommended for children under the age of two).

The eatwell plate is based on the five food groups, which include:

- bread, rice, potatoes, pasta and other starchy foods
- fruits and vegetables
- milk and dairy foods
- meat, fish, eggs, beans and other non-dairy sources of protein
- foods and drinks high in fat and/or sugar.



The eatwell plate makes healthy eating easier to understand by showing the types of food we need to have a healthy and well-balanced diet.

The eatwell plate encourages each one of us to choose different foods from the first four groups every day, to help ensure that we all obtain the wide range of nutrients our body needs to remain healthy and to function properly.

Choosing a variety of foods from within each group will add to the range of nutrients consumed. Foods in the fifth group – foods and drinks high in fat and/or sugar – are not essential to a healthy diet.

Below is a summary of the most important tips on healthy eating.

- **Carbohydrates** – eat predominantly complex carbohydrates. They supply energy, fibre vitamins and minerals. They supply energy at a more sustained rate throughout the day than simple carbohydrates.
- **Fruits and vegetables** – eat 5–7 portions per day. Fruits and vegetables contain vitamins, minerals and fibre. They are also low in fat. Evidence shows that plenty of fruits and vegetables in the diet help to protect against heart disease and some cancers.
- **Protein** – eat moderate intakes of protein and less protein from animal sources. Protein from beans, pulses and cereals are naturally lower in fat and less expensive.
- **Sugar** – restrict intakes of food that are high in sugar.
- **Fats** – eat less saturated fat. Saturated fats from meats and dairy products are thought to increase the risk of heart disease. Replace these with mono-unsaturated and poly-unsaturated fats, such as olive oil and oily fish.
- **Fluids** – drink at least two litres of water per day.
- **Salt** – reduce salt intake. Excessive sodium in salt can cause high blood pressure in some people.

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The health risks of poor nutrition

Poor nutrition can increase the risk of many health problems. Deficiencies in certain food groups can result in a lack of vitamins, minerals and essential fatty acids, each of which can cause a wide range of health problems. In general terms, poor nutrition can lead to increased risk of type 2 diabetes, high cholesterol, high blood pressure, heart disease, osteoporosis and some cancers.

A bad diet causes both physical and mental fatigue, slower problem-solving ability and decreased alertness and muscle response time. Nutrition affects the production of certain hormones, which have many negative effects on health.

Eating too many calories will result in weight gain (obesity). Obesity contributes to a number of health problems, including high blood pressure, type 2 diabetes, coronary heart disease and osteoarthritis. Eating too few calories due to a very low calorie diet or clinical eating disorder can lead to lots of nutrient deficiencies and is very unhealthy.

Key points for nutrition

- Good quality foods of the correct quantity are essential to a healthy body weight, good concentration, mood and complexion and high energy levels.
- The main food groups are carbohydrates (eg, rice, pasta and potatoes for energy production), fats (eg, dairy, oils and nuts for insulation and energy production) and protein (eg, meat, dairy for repair and growth of tissues).
- Vitamins, minerals, fibre and water are also necessary for a variety of bodily processes.
- The energy balance equation states that if one consumes more calories than are burned, weight will be gained; if one burns more calories than consumed, weight will be lost.
- A deficit of 3,500 kcal is required to lose 1 lb of stored fat. This is best achieved by a combination of increasing physical activity and reducing calorie intake.
- The NHS Live Well website can provide current, up-to-date healthy eating guidance.
- A poor diet can lead to many physical and psychological health problems.
- Fitness instructors without further training are limited to providing information to clients. Instructors should recommend that clients look at current national healthy eating guidelines for the most up-to-date information.

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Know how to support clients who take part in exercise and physical activity

Introduction

This unit covers the knowledge and skills required to communicate effectively with clients, with the aim of helping them to adhere to an exercise programme. It explores communication tools that increase exercise behaviour, adherence and retention. The unit also looks at motivation and a client-focused approach to training.

This unit is for health and fitness professionals who are hoping to begin to understand what drives their clients both physically and mentally towards, or away from, activity.

Establishing and maintaining effective working relationships with clients

Objectives

By the end of this section, the learner should be able to:

- identify the importance of professional conduct
- identify the importance of building professional relationships
- identify professional boundaries.

It is vital that instructors display a professional attitude if they want clients to trust that they can do a professional job. It is important that instructors present themselves positively, as well as the organisation for which they work, paying particular attention to:

- professional conduct (appropriate dress and behaviour)
- respect for the clients
- reflection of equal opportunity (use of language and communication)
- inclusion and exclusion of a client in an exercise programme as a result of screening
- punctuality: arriving on time and keeping to timetable slots.

The client

When individuals decide to take part in an exercise programme, it is important that they feel safe in the environment and they can trust the professionals looking after their needs. Clients should be able to rely on the same standard of instructor professionalism whether they join a large gym or attend their village hall.

The REPs' code of ethical conduct clearly defines mutual trust as an important element to help motivate clients to adhere to a programme. It is the role of the instructor to support the client in taking the first steps towards becoming more active. An instructor can provide professional advice, but the main skill is in listening to the client and finding out what they want from the experience.

There must be mutual trust between the instructor and client, clearly defined roles and evidence of an open, honest and unconditional positive regard towards the client.

Carl Rogers (1902–87) is best known as the founder of 'client-centered', or non-directive, therapy. He believed that clients usually know better how to proceed than their therapist. Thorne argues that 'the whole conceptual framework of Carl Rogers rests on his profound experience that human beings become increasingly more trustworthy once they feel at a deep level that their subjective experience is both respected and progressively understood' (Thorne, B. (1992), Carl Rogers, London: Sage). This idea can be applied to the role of the fitness instructor and also as the instructor progresses to working as a personal trainer or with special populations.

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The following conditions are a development of Carl Rogers' work:

- Unconditional positive regard – the instructor listens to all of the client's positive and negative thoughts and feelings. The client feels comfortable that there will be no rejection based on their beliefs.
- Empathetic understanding – the instructor understands the client's own perspective. The instructor has empathy with what the world must feel and look like from the client's point of view.
- Congruence – the instructor is genuine and does not have an attitude (at a conscious or unconscious level). The client should believe that the instructor is honest in their relationship.

The instructor

The REPs' code of ethical conduct provides all instructors with a framework within which they should work in order to achieve high professional standards of best practice in the industry. It outlines the need for mutual trust and clearly defines roles for the instructor and client. Any behaviour or interaction that damages the client or professional constitutes a violation of the code.

The register performs the same function for exercise instructors as professional registers do for other health professional groups. Registration is achieved and maintained through the gaining of qualifications and training, which are nationally recognised and which are linked to the National Occupational Standards (NOS) for exercise and fitness. Registration is available to anyone who works as, or is involved in, gym instruction, exercise to music classes, circuits, keep fit, personal training, yoga, aqua aerobics, advanced instruction techniques or working with special populations.

For the instructor, REPs' provides a clear career path, helps to ensure that qualifications and skills are kept up to date, aids with personal development and provides recognition of achievements. Inclusion on the register signifies that an exercise professional has met certain standards of good practice. The register encourages a properly qualified base of exercise professionals who:

- have gained recognised and approved qualifications
- can demonstrate competence in their working environment
- are committed to continuing professional development (CPD)
- have appropriate public liability insurance for the level at which they are working
- demonstrate commitment to the industry code of ethical conduct.

When an instructor joins REPs', he or she is agreeing to abide by its code of ethical conduct. These are essentially standards of best practice for fitness professionals reflecting the core values of rights, relationships, personal responsibilities, professional standards and safe working practice. Failure to comply, or a breach of any of these codes of conduct, do not only result in fines, loss of membership and employer disciplinary action, but can also lead to more serious consequences such as loss of employment and, in some cases, legal prosecution.

There are five main areas for consideration:

- Principle 1 – rights
- Principle 2 – relationships
- Principle 3 – personal responsibilities
- Principle 4 – professional standards
- Principle 5 – safe working practices.

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The Register of Exercise Professionals code of ethical conduct

Introduction

As with all industries, we are professionals and should adopt a professional manner in everything we do. As such, REPs' have produced a code of ethics for fitness professionals to abide by, and reading this will help instructors to develop a greater understanding of their role within the fitness industry.

The Register of Exercise Professionals (REPs')

REPs' is a rigorous system of self-regulation for all instructors, coaches, trainers and teachers involved in supervising people who exercise and partake of physical activity programmes. The register has created a framework within which individual instructors can achieve the highest standards of professionalism linked to best practice in the health, fitness and exercise industry.

Registration is achieved and maintained through the gaining of qualifications and training, which are nationally recognised and linked to the NOS for the fitness industry. Membership signifies that an exercise professional meets required standards of good practice, and professionals who join the register will need to:

- have gained a recognised and approved qualification
- demonstrate competence in their working environment
- be committed to their own ongoing professional development
- have public liability insurance that meets the minimum requirements for registration
- adhere to an industry accepted code of ethical conduct.

In isolation, any one of the five points above is of little value – but together, they are essential in measuring the suitability of individuals to be members of the exercise community and members of the register.

Any alleged professional misconduct or avoidance of compliance with the terms of membership of the register will be referred to the Professional Practice Committee (PPC), which will consider any need for sanctions against the instructor, coach, trainer or teacher. The appropriate authority will deal with any criminal allegations. The terms of reference for the PPC can be viewed at: www.exerciseregister.org/whorunsit.asp.

This code of ethical conduct defines what is best in good practice for professionals in the fitness industry by reflecting on the core values of rights, relationships, responsibilities, standards and safe working practices. The term 'professional' is used in a qualitative context in this code and does not necessarily imply a paid position or person. Exercise professionals who assent to this code accept their responsibility to people who participate in exercise, to other fitness professionals and colleagues, to their respective fitness associations, professional bodies and institutes, to their employer and to society.

Instructors will need to download the code of ethical conduct and read it in full.
Go to: www.exerciseregister.org.

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Equality and diversity

Fitness instructors have an obligation to promote equality and diversity in the workplace.

Equality is about ensuring that individuals (or groups of individuals) are treated fairly, equally and no less favourably regardless of issues such as race, gender, religion, belief, disability, sexual orientation or age.

Diversity is about recognising, respecting and valuing people's differences, and promoting an inclusive culture in which everyone can realise their full potential.

As a fitness instructor, equality and diversity can be promoted by:

- treating all clients fairly
- creating an inclusive culture for all clients
- ensuring equal access to opportunities to exercise and activity
- enabling all clients to exercise to their full potential
- ensuring that the exercise environment does not discriminate against any individuals or groups
- ensuring procedures do not discriminate against any individuals or groups.

Key points for establishing and maintaining relationships with clients

- When an individual decides to take part in an exercise programme, it is important they feel safe in the environment and can trust the professionals looking after their needs.
- The REPs' code of ethical conduct highlights the principles to adopt in order to form a professional relationship with a client.
- There must be trust between the instructor and clients, as well as clearly defined roles and evidence of an open, honest and unconditional positive regard towards the client.
- Both the client and the instructor can be at risk of boundary violation. Instructors should be aware of being open in all dealings with their clients, be visible to others where possible and not be misleading in communication.
- As a fitness instructor, it is essential to promote equality and diversity in the workplace.

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Effective communication

Effective communication skills are essential within all areas of our lives. When having a conversation, we often tend to hear the bits that we want to relate to our own experiences and do not hear or observe other key signs that would let us understand what the individual is really trying to say.

Objectives

By the end of this section, the learner should be able to:

- identify effective visual and verbal communication skills
- recognise potential barriers to effective communication
- identify the importance of body language, listening, observation and rapport when communicating with clients
- define the fundamental skills: rapport and empathy, unconditional acceptance listening, active and reflective listening.

Effectiveness

The effectiveness of communication will increase dramatically if the instructor understands the fundamental skills required. Although health professionals believe that they demonstrate these skills effectively, there is often still room for further development and improvement. Such skills are also transferable to other aspects of life and can positively affect both the client and the instructor.

Effective communication builds on the receiver's knowledge, affects attitudes and can change behaviour and have an influence on motivation and therefore adherence.

Potential barriers to effective communication are:

- poor listening skills
- inappropriate nonverbal communication (body language and facial expressions)
- set patterns of thinking (prejudice and perceived ideas)
- making assumptions
- labelling and stereotyping
- lack of trust
- lack of clarity
- personal style
- social and cultural differences (age, gender, social class, ethnicity, language, etc.)
- learning difficulties.

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Types of communication

There are three main forms of communication to consider, each with their own advantages and disadvantages. These are:

- written – in the form of posters, leaflets, newsletters, letters, e-mails, text messages and social network sites
- verbal – face-to-face or via telephone. The language used, voice intonation and how accent or dialect affect what is being said
- non-verbal – the use of body language, gestures, eye contact, facial expressions and posture.

	Advantages	Disadvantages
Written	Provides a written record of what is being communicated.	The information can be missed, or misunderstood. Can be perceived as being impersonal.
Verbal	More personal than written. The meaning of the information can be more specific as long as it is clearly stated.	Can be misunderstood if the language, accent or dialect is strong. There is no record of what has been said.
Non-verbal	Positive body language can make customers feel at ease, be encouraging, welcoming and show empathy and understanding.	Can say more about what the instructor thinks than the words being said; therefore, care is required to ensure that it is not negative.

Body language

Body language is not considered an exact science; however, it provides additional information that can be useful when helping people to change their health behaviours. Various postures have been given specific meanings, although this, too, can be misleading. For example, sitting with one's arms crossed is often read as demonstrating that the individual is defensive; however, it could be a very comfortable position for some, while in others it could indicate that the client is feeling cold.

Research shows that body language is the most important aspect of communication and how one uses their body, facial expressions, gestures and eye contact override the words that are spoken. The term 'body language' refers to non-verbal, and often unintended, communication on the part of one individual to another. Non-verbal communication takes place by means of facial expressions, head movements, eye contact, hand gestures, body positions and acts, tones of voice, etc. In general, body language expresses an individual's emotions, feelings and attitudes.

Other people's body language reveals their feelings and meanings to you

Take note of your customer's body language, posture and facial expressions, as this can provide a lot of information about the situation and how the customer is feeling.

Use body language and posture to establish a level of unconscious rapport by assuming a similar body position and rate of speech as those of the customer. Putting oneself into this position can provide the instructor with a greater understanding of the customer's thoughts and feelings. Try to avoid folding the arms in front of the body, as this can convey defensive or confrontational body language. Remember that body language reveals feelings and meanings to others.

Eye contact is a powerful tool because it lets customers know that you are interested and attentive. Make eye contact and concentrate on projecting a warm and friendly manner. Try to avoid averting one's gaze, as this can give the impression of shiftiness or disinterest in what the customer has to say. Similarly, try not to stare uninterruptedly, as this may make some customers feel uncomfortable.

Effective communication can improve the customer's knowledge, attitude, behaviour and motivation to physical activity and exercise, thereby enhancing a positive customer experience.

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Listening skills

Listening to another person is a key skill. We all believe that we listen to everything all of the time; however, sometimes we listen but do not hear. As information is absorbed from others, we attempt to make pictures and draw on our own experiences. This can interfere with listening skills, as it draws attention away from the information being given. This can be because pictures in the forefront of our own mind take centre stage.

When proper listening has been developed, the listener will hear more than the spoken words and capture more information. It is then possible to understand what is truly being said. For example, a client could be saying how much he or she enjoyed an activity while shaking his or her head, demonstrating that the speech and body language do not match. By developing listening skills, the instructor will be able to identify incongruent messages similar to this from their clients.

Effective listening is about understanding what is being communicated. One may sit quietly and appear to listen, but if now displaying the appropriate body language and facial gestures, then the person being listened to will easily be able to see that that they are not actually being listened to. Instead, use open questions, such as 'Tell me more', which will give more information, or closed questions, which will elicit a short, simple answer, such as 'Yes' or 'No'.

Good listening skills are fundamental to effective communication, such as:

- instructors should ensure that they are not distracted. Switch off any phones and move to a place where it is quiet and away from any distractions. Focus on the customer.
- sit quietly and do not interrupt while your customer is speaking. Instead, use appropriate facial gestures and body language – nodding, smiling, arms unfolded. These simple gestures allow instructors to listen and convey to the speaker that they are listening without interruption.
- be attentive, face the person speaking and give appropriate eye contact. Turning the body towards them and mirroring their body posture conveys the message that the listener is attentive.
- take care not to invade the speaker's personal space. Keep enough distance to create the privacy necessary for discussion and to maintain a safe and comfortable distance. The accepted range in British culture is between 12–16 inches to retain personal respect. Bear in mind that social and cultural differences may affect these guidelines.

Active listening

After listening, employ active listening skills:

- amplification
- clarification
- verification.

The three stages of active listening	
Amplification	This is the stage when an instructor asks for more information and gathers all the facts before responding, using a range of open questions such as 'Tell me more', 'How did you feel about that?', 'When did you decide to begin a fitness programme?'. During this stage, it is important not to interrupt or impose one's own thoughts or ideas. Remember to speak clearly and not to raise the voice.
Clarification	When not completely sure of what the other person is saying, use clarification statements, such as 'Help me understand' and 'Could you be more specific?' By doing this, the customer's feedback will help the instructor to fully understand the message that the customer wants to communicate.
Verification	Simply by repeating the client's statements (ie, paraphrasing and regular intervals), it is possible to verify understanding. Verification statements include 'If I understand you correctly...' and 'Let me make sure I've understood this'. By verifying what has been heard and obtaining acceptance from the other person before moving on, the instructor can get the essential information necessary to meet the client's needs.

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Reflective listening

Reflective listening is a skill that is developed over time. It requires an individual to understand the meaning of what is being said. During any conversation, it is easy to listen to the general content and respond to that (active listening), as opposed to fully understanding what is being said, prior to responding (reflective listening). Misinterpretation is more likely if a response is given prior to fully understanding. This often causes the client to spend more time explaining the meaning of the original point than actually sharing their thoughts. When we are constructing our response while listening to the client, we are no longer listening. If the interviewer 'drifts off' and thinks of their own problems, they are also no longer listening.

Reflective listening differs from active listening – reflective listening is clarifying the meaning of a conversation, while active listening is repeating back the content of a conversation to prove that what was heard was correct.

Reflective listening is often described as making an educated guess about the meaning of the comment. Any conversation between two or more people has messages that are delivered in their own code. At this stage, the role of an instructor is to decipher the meaning of the coded message and to send an appropriate response that clarifies the meaning.

Any responses should be delivered within a statement rather than a question, as a statement produces less resistance. Questions, on the other hand, require the individual to reflect on their original statement, checking that the correct message and meaning was delivered. Questions may also make the client act defensively, providing an opportunity for them to defend and rationalise their position. However, by delivering a statement, the listener is confirming that they understand the client's original meaning and that this interpretation is correct.

Ensure that tone of voice, inflection and sentence construction are empathetic and attentive rather than judgemental or critical. For example, when a reflective statement is made, the inflection of the voice will go down at the end of the sentence, whereas when a question is asked, the inflection of the voice will go up. Avoid sentences starting with who, what, when, why, where and how, as these tend to be obvious questions as opposed to statements. However, incorporating these words into sentences when questioning and probing is appropriate.

Reflective listening is a way of checking the meaning rather than assuming that the listener knows what is meant. However, when using reflective listening, avoid underestimating the importance of 'you'. Placing emphasis on 'you' focuses on the individual and their behaviour, but may not allow the 'individual' to disassociate from the area they want to change.

Examples:

- 'You said that you are considering becoming more active.'
- 'Joining in with one of the classes is something you can see yourself doing.'
- 'Starting now would allow you to achieve some changes before the summer.'

This provides an instructor with the opportunity to establish the most appropriate support. Consider how different the response would be if this was said instead:

- 'What do you want me to do to help?'

The last example covers two issues that are best to avoid when listening reflectively. Firstly, this statement is a question, and secondly, the listener has taken responsibility for the individual's issue(s).

Reflection is not a passive process; full engagement in the process is needed in order to be successful. The instructor will need to make decisions regarding issues to reflect upon as well as areas to ignore. During a conversation, there will be too much content to reflect on everything. It is therefore necessary to pay attention to what appears to be important. Reflective listening is a subtle skill that can easily turn into a question-and-answer session.

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Practice is needed when the skill of reflective listening is being developed. At first, there is a tendency to repeat the sentence used by the other person. This may not be the most appropriate method, as the instructor may start sounding like a parrot. It is preferable to reflect on occasion at first and then increase the frequency once the skill has been developed. As this skill develops, the instructor will learn to use words that are closer to the meaning of the individual's statement(s).

Verbal skills

When speaking, it is important to always use good grammar and pronounce words properly. Avoid being sloppy or lazy with language, using words such as 'yeah', 'yep' or 'um'. Speak softly, clearly and be courteous at all times to convey a sense of respect and consideration. Always address the customer formally with their title (eg, Mr. Smith); only use their first name if you have been invited to do so.

Two useful techniques are explained by the acronyms **PICTURE** and **MERK**

PICTURE

- **Pitch** – it is believed that 38% of our communication consists of how we say what we say. A high-pitched voice can often sound weak and irritating. A lower voice may sound more authoritative and can be used to gain and maintain attention.
- **Inflection** – by varying the inflection in our voices, what we say sounds more interesting and will keep participants' attention. Monotone doesn't work for maintaining and engaging an audience.
- **Courtesy** – treat others as you would like to be treated yourself. 'Please' and 'thank you' paired with positive, non-verbal gestures are great for business.
- **Tone** – by using tone, emphasis can be placed on words, exaggerating meaning and impact. If one speaks in a monotone or 'flat' voice, this can give the impression of boredom. If one speaks too quickly, it can give the impression of lack of time.
- **Understanding** – use jargon-free language and easy-to-understand words. Every industry has its own jargon, for those in the know, and this can be extremely useful shorthand. However, consider the use of terminology that is inappropriate to your client and the adverse effects of excessive jargon. If the listener does not understand, rapport could be disrupted, as participants may feel too intimidated to ask for explanations.
- **Rate** – this relates to the speed at which we speak. A variety of speed gives power to the delivery, slowing down to make a specific point, speeding up to add emphasis and excitement.
- **Enunciation** – speaking clearly helps to avoid misunderstandings. The letters 'T' and 'D' are often confused, as are 'P', 'B', 'S' and 'F'. Precise enunciation ensures explicit delivery.

The acronym **MERK** is more concise and therefore may be easier to remember.

- **Modulate** – alter or adapt the tone of voice according to the circumstances.
- **Emphasise** – lay stress on certain points.
- **Repeat** – repeat phrases, if necessary, to emphasise their importance.
- **Keep eye contact** – sufficient eye contact conveys interest.

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Empathic responding

Empathy is the ability to understand the experience of the client from the client's perspective. This is one of the most important skills in the instructor's repertoire. The instructor must learn the ability to understand reasons for becoming more physically active. It is also a time to work on communication skills to also identify any barriers that may stop exercise participation and adherence.

Below are some suggestions to help an instructor to develop these skills:

- identify non-verbal behaviours
- identify whether the non-verbal behaviours match verbal behaviours
- identify if behaviour(s) create and/or support an underlying theme
- be aware of one's non-verbal reactions to the person and how reactions are interpreted
- identify the content of the information provided
- compare the experiences (content) that the person recounts to the person's previous experiences and/or patterns already identified
- ask oneself how you would feel if this experience happened to you and you were exhibiting the same non-verbal behaviours as the individual.

Building rapport

Building rapport is important in order for effective communication to take place. In order to establish rapport with a client, it is essential to understand the individual prior to progressing. Rapport is built through conversation and body language. When building rapport, it is not vital to mimic the exact position or posture of the other person; however, this may be worth considering. For example, if the person is sitting in a relaxed position, it may be appropriate to copy this.

Remember that voice, tone and pace play a part in developing rapport, as well as the types of vocabulary that are used. For example, using words and descriptions just because they are fashionable will not establish rapport, and can actually make individuals feel uncomfortable. Another area to consider is clothing, it may be appropriate to take consideration prior to dressing for a client session.

- Do the clothes project an image of superiority or power? This is not desirable.
- What would be the most appropriate thing to wear with the people you are working with?

Finally, it is important to remember the rules below:

Rule 1 – establish rapport
Rule 2 – attempt nothing else until you have established rapport.

A popular approach to establishing rapport is known as a 'typical day' approach: trying to understand what is involved in a client's typical day. The instructor could ask the client to describe what they do during a typical day, starting with the first thing they do when they get up. The theory behind this approach is that the client will discuss where and when physical activity may start to be incorporated into their daily routine.

Once rapport has been established, the next step is to set an agenda. The setting up of an agenda identifies the time constraints and areas for discussion. The client may have single or multiple issues to discuss; however, the role of the instructor is to identify what is to be covered and the importance of that issue. Some clients will want to spend time talking to get a better understanding of what is going to happen, and they may expect that the instructor is going to tell them what to do. If this reaction has been apparent from the client, it normally indicates that the instructor has not managed to establish rapport. If this is the case, go back to Rule 1.

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Physical touch

In many cultures, touch is commonplace during conversation. However, in British culture, it still only remains appropriate in established relationships.

With the increase in the popularity of yoga and Pilates instructors have been encouraged to teach and correct posture and position via touching and placing participants into position. While this has become more acceptable in the industry and is a reliable form of correction (if used with positive verbal communication), it is important to always request permission prior to touching an individual and, again, respect the decision of the individual.

Barriers to effective communication

Perhaps the best way to think about the way in which communication can go wrong is to think about what good communication would be like. Recognising barriers to effective communication is a first step in improving communication style.

Below is a list of what can go wrong:

- poor listening skills and barriers to listening
- inappropriate nonverbal communication (ie, body language and facial expressions)
- set patterns of thinking (ie, preconceived ideas and prejudice)
- making assumptions about clients
- labelling and stereotyping clients
- lack of trust between instructor and clients
- lack of clarity of what is being communicated
- social and cultural differences (eg, age, gender, social class, ethnicity, etc.).

The effects of effective communication

Communication is only successful if the receiver understands what the sender is trying to convey. When the message to be conveyed is not clearly understood, the speaker should understand that it is because they have not delivered the information effectively to the receiver. It is also worth remembering that it is important to remain flexible in communication style. Different clients may have very different needs when it comes to communication. It is therefore necessary to be adaptable and to use the correct communication skills in order to convey the information effectively.

Key points for effective communication

- Effective visual and verbal communication skills are vital for maintaining a positive relationship with a client.
- Body language can build or break down barriers to communication.
- Listening, clarifying and demonstrating empathy are important factors to effective communication.
- People have personal boundaries in relation to proximity to others. It is important to respect individual personal space.

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Customer service

This section looks at who customers are and the best way to look after them, the service given to them and why it is important to form effective working relationships with them. It looks at how to develop a non-judgemental approach, equal opportunities and clear professional boundaries in line with the REPs' code of ethical conduct.

Objectives

By the end of this section, the learner should be able to:

- describe internal and external customers
- discuss the significance of customers to business
- describe 'excellent customer service'
- explain how to deal effectively with customer complaints
- identify ways to improve the customer service
- describe how instructors can positively contribute to creating a perception of quality service.

Customers

The fitness industry is a service industry, and it is imperative that instructors look after their customers accordingly. The industry today is very competitive; therefore how the customer perceives their experience is vital. An enhanced customer experience is important for several reasons. It improves the instructor's reputation, as well as that of their organisation, helps with customer retention, provides potential referral (friends and family) and assists the client in achieving their goals. It also gives the instructor and their organisation a professional image.

Customer service generally involves two people – the service provider, or instructor and the customer. A customer is described as any individual or organisation that is the user of the provider's products, services and/or information. To offer a high level of customer service, it is necessary to have a genuine interest in people and enjoy interacting with them. How the provider handles people is as important as knowing how to teach a safe and effective exercise session. Good customer service is a challenge that involves balancing the customer's wants and needs with the interests of the business.

The number one rule is: Every instructor represents their own company!

Whether self-employed or employed, there is no distinction between the instructor and the company from a customer's perspective. If an instructor treats the customer well, the company has treated them well.

Customers come in many guises and consist of:

- internal customers
- external customers.

Internal customers

Internal customers are described as anyone within the organisation involved in the delivery or supply of a product, service or information. An internal customer can be another instructor or another department (eg, the sales department or anyone involved in providing products or services to the external customer).

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External customers

These customers include the general public wanting to use and pay for the facilities. These include:

- those wanting a product, service, information or advice
- potential customers
- people wishing to complain
- visitors
- specialist groups such as older adults, children and teenagers, people with disabilities and ethnic minorities
- other professionals whose services may be used (eg, physiotherapists)
- people from ethnic minorities.

Customer expectations

Improving the customer experience is about exceeding the customers' expectations. If a service is merely adequate, it is probably invisible. Adequate service therefore often registers as poor. Only excellent service gets noticed.

There are general skills and qualities required to exceed expectations, plus some more specific to the role of a fitness professional. They may include the following:

General	Professional behaviour
	Clean, neat and tidy appearance
	Appropriate dress/uniform
	Positive body language
	Good listening skills
	Being (not appearing to be) interested in the customer
	Constructive verbal response
	Empathy
	Referral knowledge
	Desire to help
Specific	Good standard of teaching/instructing
	Friendly approach, tone of voice, recognition of personal space, etc
	Up-to-date industry knowledge
	Punctuality
	Discretion
	Appropriately qualified and insured
	In possession of relevant music licenses
	Knowledge of other related products and services
	A role model for an active, healthy lifestyle

Note: These lists are not exhaustive.

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Providing excellent customer service

Simply smiling at the customer and saying 'Hello' is not enough to project a customer-friendly attitude. Customer service is about continuous improvements in service. Good is simply not good enough – make it better for the customer. Give the customer reasons to enthuse about the experience. The difference between ordinary customer service and extraordinary customer service is that little bit extra. A frequently used phrase is 'under-promise, over-deliver'. It is important to give the customer reasons to enthuse about the club or fitness centre, the business and the services on offer, or the individual instructor.

In a nutshell, that 'little bit extra' is exactly what customer service is all about. It is not about settling for the minimum; it is about adding something extra to the service and giving the customer a reason to come back.

There are many ways that this can be achieved; here are some fitness environment examples:

- helping to spot the weights for clients
- making a correction to an exercise technique
- praising and complimenting an exercise technique
- helping to set up equipment for clients
- offering an exercise adaptation or progression
- making a program suggestion
- offering an alternative exercise when the equipment is busy
- offering alternatives when the class choreography or content is too complex
- offering alternatives in intensity for easier and harder versions to cater for everyone's needs
- helping someone who appears uncertain
- providing heart rate monitors and towels
- offering warm-up, stretching and cool down advice
- ensuring health and safety and cleanliness standards are met in the exercise environment.

Paying attention to detail pays off because people appreciate it

Remember that when working with customers, it is vital to work within the professional boundaries as set out in the code of ethical conduct. Everyone is entitled to the same opportunities and non-judgemental approach. Respect any cultural differences that may impact on how to deal with a client and the content of their exercise session.

The customer comes first!

It is an old adage, but instructors should remember these five simple points:

1. Customers are not dependent on us; we are dependent on them.
2. Customers are not an interruption of work; they are the purpose of it.
3. Customers are doing us a favour when they call; we are not doing them a favour by answering them.
4. Customers are human beings with feelings and needs like our own, not cold statistics.
5. Customers are people who bring us their wants; it is our job to satisfy those wants.

Customers are the lifeblood of our business and we are dependent upon them. It is commonly stated that **'The customer is always right'** in customer service. The importance of this statement is frequently misunderstood and is perhaps best summed up with the acronym **RIGHT**.

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RIGHT	
Respect	There should be mutual respect between the instructor and the customer. It is important to remember that every customer has the potential to increase or decrease the company's business.
Indispensable	All customers are an indispensable part of the business and need to be able to feel a part of it. Asking for feedback on a particular product or service not only helps make improvements, but makes the customer feel part of the process. A sense of belonging can be conveyed in many different ways (eg, thank-you cards, company newsletters, discounted prices and fun events).
Greeted	All customers expect their presence to be acknowledged. Greet each customer promptly so that he or she feels as welcome as a guest in your home (eg, at Disneyland and Disneyworld, every person who visits is called a guest).
Helped	It is important that instructors have a thorough knowledge of their company's products and services so it can easily be passed onto the customer. Instructors may have to research appropriate forms of exercise to meet individual needs. Knowledge is a tool to help better service customers.
Thanked	Whether customers take up a product or service or not, they should always be thanked for their interest. Customer service research indicates that when we receive good service, we tell 9–12 people on average. When we receive poor service, we tell up to 20 people. If customer service is really poor, 91% of retail customers won't come back. Always bear in mind that customers may not need products or services on offer today but they might need them tomorrow.

Dealing with customer complaints

No matter how good an instructor's customer service may be, there may be times when they will have to deal with complaints. When a customer complains, it is because they feel they have a right to. The customer may be angry, shouting and gesticulating. In this type of situation, keep calm and give them the opportunity to express their feelings.

When a customer vents their anger in an instructor's direction, consider the following five key points:

1. Listen to the complaint. If they are angry, it will generally last no more than 30 seconds.
2. Do not interrupt. Allow the customer to convey their message.
3. Do not be defensive, as inevitably it prolongs the process and intensifies the customer's anger.
4. Apologise to the customer and acknowledge that they are upset and have a right to complain.
5. Solve the complaint as quickly and efficiently as possible.

Consider a complaint as an opportunity to 'solve' a problem and make the customer happy. It is a time when an instructor will have to employ all of their communication skills. When a customer complains, listen and then acknowledge the complaint immediately by saying 'Thank you. I can see why you feel that way' or 'Thank you. I understand how upsetting this must be'.

Instructors should put themselves in the customer's shoes. If the tables were turned, would the instructor also be upset? Show empathy and ask for the person's permission to seek further information, allowing time to get the facts straight and better understand their complaint to allow time to get on with solving it.

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The use of open-ended questions enables the instructor to engage the client in discussion. This technique does not require a specific answer and leaves the door open for the client to choose the direction of the conversation and allows the instructor to gather the essential information. Open-ended questions usually begin with words such as:

What? Who? When?
Where? How? Why?

The use of closed questions does not engage the client in discussion and usually provides the opportunity for a yes or no response.

To ensure that the complaint is dealt with effectively and the client feels respected, the following procedure should be followed.

- Acknowledge the complaint immediately.
- If possible, deal with the complaint personally.
- If the instructor is not able to deal with it personally, explain this to the customer and assure them that the complaint will be referred to the appropriate person.
- Record the precise details of the complaint and ask the customer to read it and confirm that it is an accurate recording.
- Ensure that the complaint is resolved satisfactorily.

Remember that everybody has a bad day. If customers get angry, forgive them. Make them feel comfortable about coming back by applying the five points discussed above.

Key points for customer service

- Customer service is a people business, which involves considering customer wants and needs.
- Customers are described as any individual or organisation (internal or external) that uses the instructor's products, services or information.
- There are two types of customer: internal and external. The relationship between both is critical to business success.
- Customer service requires attention to detail and a commitment to provide extra service.
- When interacting with customers, consideration should be given to both non-verbal and verbal communication methods.
- The five steps to dealing with customer complaints are to listen, to not interrupt and to not be defensive. Instead, apologise and solve the complaint.
- Customer perceptions are strongly affected by the impression created by the instructor.

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Barriers and motives for exercise

To reap the benefits of exercise at a local leisure centre or gym, the most important step is turning up. However, the reality is many people do not. Over 50% of the people who join a leisure centre or fitness club cease exercising within three months, and only about 5% of the population in England work out at a vigorous level three times a week for 20 minutes.

In this section, we explore the barriers that prevent people from exercising and discuss the motives that turn people on to exercise.

Objectives

By the end of this section, the learner should be able to:

- describe inactivity levels in England
- identify the main barriers to taking part in exercise and discuss strategies for dealing with these barriers
- discuss the barriers that exist in the gym environment
- describe the main motives for participation in exercise and discuss strategies for motivating clients to exercise
- describe interventions that can be made in the exercise environment to improve adherence.

Inactivity levels in England

In order to promote basic health (as opposed to improving fitness), all adults should take part in activity in accordance with the following guidelines:

At least 150 minutes of activity a week – two and a half hours of moderate intensity activity, in bouts of 10 minutes or more or 30 minutes 5 days per week (Chief Medical Officer's guidelines, 2015).

Numerous studies have shown that physical activity consistently decreases with age after late adolescence or early adulthood. For example, studies (Allied Dunbar National Fitness Survey (ADNFS), 1992; HEANSAH, 1991; National Household Survey, 1998) in England found that the following populations were unable to report participation in any bout of moderate physical activity of 30 minutes per week in the past four weeks:

- 15% of men and 25% of women aged 16–24
- 32% of people aged between 45–64
- 55% of those aged 65 or older.

Attitudes and perceptions of the sedentary person

A study (Health Education Authority, 1993) that explored the attitudes and perceptions of sedentary people in England found that sedentary people held very negative views concerning physical activity. In fact, participation was perceived to be:

- difficult
- unpleasant
- pointless

A large part of this perception is thought to be due to poor quality experiences of physical activity while at school.

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The ADNFS (1992) also examined people's beliefs and attitudes towards physical activity and fitness, and this study found that 80% of both men and women of all ages believed themselves to be fit, and the majority incorrectly believed that they did enough exercise to keep fit. For example, men and women categorised as physical activity level 0 (no occasions of moderate or vigorous activity in the past four weeks) responded to the self-assessment questions in the following way:

Self-assessment related to physical activity level

Activity self-assessment for:	
Men	Women
Very or fairly active: 47%	Very or fairly active: 57%
Fitness self-assessment Very or fairly fit: 61%	Fitness self-assessment Very or fairly fit: 69%

What stops people exercising?

The following table highlights the main reasons given for stopping regular participation in moderate to vigorous sport or active recreation among men and women.

Reasons for stopping regular exercise	Men	Women
Work reasons	23%	17%
Lost interest in activity	19%	16%
Needed time to do other things	13%	10%
Marriage/change in partnership	6%	10%
Having children/looking after children	2%	10%
Facilities closed or changed	7%	6%
Moved house	4%	7%
Team/partner no longer available	4%	4%
Injury or health problem	4%	4%
Sports injury	3%	2%
Getting too old/health failing	3%	1%
Could no longer afford it	1%	2%
Difficulty getting there	1%	1%
Other reasons	10%	10%

Source: Allied Dunbar National Fitness Survey (1992): Main Findings, page 105

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As can be seen from the table above, the three main factors stopping people were:

- work reasons
- loss of interest
- time needed to do other things.

Significant differences between men and women can also be observed in the proportion who gave reasons associated with childcare, marriage and moving house, which suggests that, in general, women perform the larger share of domestic duties.

The barriers to exercise

When clients discuss their exercise goals, they are also likely to raise difficulties in meeting those goals. These difficulties can be described as barriers to change. The significant point about the barriers that clients anticipate is that they can reduce their confidence and may even prevent them from initiating the change to meet their exercise goals.

The key to motivating people is to help them to explore the advantages and disadvantages of adopting the new exercise behaviour, and to identify the exercise or physical activity options that are available to them and that fit in with their lifestyle. It is important to recognise that each individual has the capability to find simple and realistic how-to solutions to overcome or neutralise their barriers. The instructor's role when dealing with client barriers is simply to provide a framework in which the client can freely discuss, explore and evaluate exercise options in a non-judgemental way.

Factors that stopped people aged 16–69 from taking more exercise		% Men	% Women
Physical barriers	I have an injury or disability that stops me	18	15
	I'm too fat	7	14
	My health is not good enough	11	7
	I am too old	7	7
Emotional barriers	I'm not the sporty type	24	38
	I'm too shy or embarrassed	4	12
	I might get injured or damage my health	7	5
Motivational barriers	I need to rest and relax in my spare time	25	26
	I haven't got the energy	13	21
	I'd never keep it up	12	19
	I don't enjoy physical activity	9	13
Time barriers	I haven't got the time	41	43
	I don't have time because of my work	34	21
	I've got young children to look after	10	18
Availability barriers	There is no one to do it with	14	22
	I can't afford it	9	14
	There are no suitable facilities nearby	8	12
	I haven't got the right clothes or equipment	5	7

Source: Allied Dunbar National Fitness Survey (1992).

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The main gender differences

Factors that stopped men aged 16–69 from taking more exercise		16–34 yrs %	35–54 yrs %	55–69 yrs %
Physical barriers	I have an injury or disability that stops me	10	18	32
	I'm too fat	4	8	7
	My health is not good enough	4	9	24
	I am too old	1	7	17
Emotional barriers	I'm not the sporty type	14	27	34
	I'm too shy or embarrassed	3	5	5
	I might get injured or damage my health	3	8	8
Motivational barriers	I need to rest and relax in my spare time	22	28	26
	I haven't got the energy	10	13	18
	I'd never keep it up	10	12	14
	I don't enjoy physical activity	4	12	14
Time barriers	I haven't got the time	46	46	25
	I don't have time because of my work	39	40	16
	I've got young children to look after	15	10	1
Availability barriers	There is no one to do it with	19	12	12
	I can't afford it	10	8	8
	There are no suitable facilities nearby	9	8	7
	I haven't got the right clothes or equipment	5	5	4

Source: Allied Dunbar National Fitness Survey (1992).

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Factors that stopped women aged 16–69 from taking more exercise		16–34 yrs %	35–54 yrs %	55–69 yrs %
Physical barriers	I have an injury or disability that stops me	9	14	24
	I'm too fat	12	13	18
	My health is not good enough	5	11	23
	I am too old	1	6	17
Emotional barriers	I'm not the sporty type	29	43	46
	I'm too shy or embarrassed	12	11	13
	I might get injured or damage my health	2	5	9
Motivational barriers	I need to rest and relax in my spare time	23	26	28
	I haven't got the energy	19	22	22
	I'd never keep it up	17	20	20
	I don't enjoy physical activity	8	16	17
Time barriers	I haven't got the time	54	45	27
	I don't have time because of my work	24	25	10
	I've got young children to look after	31	15	3
Availability barriers	There is no one to do it with	26	18	23
	I can't afford it	19	10	11
	There are no suitable facilities nearby	13	12	12
	I haven't got the right clothes or equipment	8	6	7

Source: Allied Dunbar National Fitness Survey (1992).

As is apparent from the above tables, women are less likely than men to participate in sport and may reject some activities because they do not consider themselves to be the 'sporty type'. Promoting activities such as walking, cycling, swimming and exercise classes may be important in encouraging women to take more exercise.

Women's role as carers (particularly in the 16–34 age range) limits the time available to participate in certain types of physical activity. As stated above, 31% of women and 15% of men reported this as their main barrier.

Promoting home-based activities, such as doing the housework in a continuous block of 30 minutes, using exercise DVDs and walking to the shops instead of taking the car, will help to make exercise opportunities more readily available.

Time pressures because of work were mentioned more by young and middle-aged men than women (men 39% and 40%, women 24% and 25%). Promoting activities that can be incorporated into the working day, such as walking or cycling to and from work, climbing the stairs and taking a brisk walk during a lunch break, may help to make physical activity opportunities more readily available.

Injury or disability problems are more frequent barriers for older men (men 32%, women 24%). Promoting the idea that a physically active lifestyle does not need to include team or individual sport and emphasising the health benefits and social opportunities that can be accrued from adopting a moderately active lifestyle might help motivate older men.

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Barriers to exercise in the fitness environment

Few studies have specifically investigated the barriers that exist in the gym or fitness setting for sedentary people. However, empirical observations indicate that the factors below should be taken into consideration when planning and coaching an exercise programme, to avoid noncompliance.

- Complexity of exercise movements – keep the movements simple and gradually build up the skill levels to increase confidence (eg, when inducting a client on a treadmill, gently increase the speed, gradient or duration. In an exercise to music or studio setting ensure, alternatives are introduced in a positive and encouraging way).
- Speed of exercise movements – avoid quick and uncontrolled movements that could increase the risk of injury and trauma to the joints and surrounding tissues. Have the client focus on exercising at a preferred or comfortable pace (eg, have the client self-select a pace for the workout on a treadmill. In a group situation, ensure the individual can work at a level that suits his or her needs).
- Choice of activities – focus the exercise programme on the client's activity preferences, wants and needs. It is pointless to include exercises the client dislikes; the focus must be on exercises the client enjoys doing.
- Graduated progression of exercise intensity – ensure that workloads, repetitions and sets are increased progressively in accordance with the client's exercise goal.
- Start-up resistance levels – take into consideration the client's current physical capabilities. On fixed resistance machines, if the initial resistance is too much, use dumbbells or offer an alternative exercise for the same body parts. In a body-conditioning class, offer easy versions of exercises, such as a box press-up rather than a full press-up.
- Set-up procedures for cardiovascular machines – be aware of 'techno-fear', keep the instructions short and simple and let the client do the programming. Then check that the client has understood how to programme the machine correctly. In group situations, use 'layering' techniques while building choreography; bite-size chunks of complexity are easier to deal with.
- Use rating of perceived exertion to monitor intensity alongside heart rate: alternatively, ask clients to exercise at the preferred level of exertion that they feel they can maintain for the relevant period.
- Establish realistic starting goals – the client must believe the goal is attainable. Confidence breeds confidence, and the current adherence literature indicates that exercise goals in the first three months should be achievable, measurable, time-framed and realistically challenging to promote compliance.
- Inform and educate the client about safe and effective exercise technique – use handouts, posters, videos or mini lectures to explain the risks, benefits and effectiveness of certain exercises or exercise programmes.
- Keep the sessions varied to avoid boredom – vary the programme goals or the programme (eg, use time, distance or calorie goals, or offer steady state, interval and fartlek programmes. In an exercise to music setting, change the choreography regularly).
- Use social support structures – social support can emanate from a wide variety of sources (eg, instructors, family, friends, workout buddies, peers, interest groups, etc), as well as through a number of other channels (eg, face-to-face, via the phone, etc.). The available adherence evidence indicates that social support has a profound role to play in the adoption and maintenance of exercise programmes.
- Keep the exercise sessions fun and enjoyable – how clients perceive their exercise experience may depend upon the instructor's ability to create a positive expectation. Let clients know that their enjoyment is important. Simply asking 'What would make exercise fun or enjoyable for you?' can elicit the client's criteria for making the sessions enjoyable.

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Responding to a client's barriers

When dealing with barriers, try not to be judgemental or dismissive. To the individual concerned, this is a serious problem. Respect the client's point of view and take time to explore the pros and cons of their barriers and be empathetic and prepared to listen. Use positive body language and good listening and verbal skills to convey a professional image. Give feedback and support; above all, negotiate a realistic solution to the problem.

Consider the different types of social support that may be available to the client (eg, the support of others, such as family, friends, a training partner or perhaps attending group exercise session or the using services of a personal trainer). Discuss how these may help to overcome their barrier and aid motivation and adherence.

Try to establish a sense of self-responsibility with the client. Once discussion and agreement have taken place, clients must take responsibility themselves. Make them feel positively supported and able to work around any barriers that may occur.

It is important to help clients to explore the pros and cons of their barriers, and instructors need to take care not to dismiss these barriers as excuses. This approach just shifts the client into a defensive mode and generally makes the client more resistant to change.

Respect for the client's view is an absolute prerequisite for facilitating positive behavioural change. We all see the world differently, and being empathetic with others means acknowledging them and their view of the world. It is not necessary to agree with a client's view; however, an instructor should recognise and respect it. Research onto addictive behaviours has shown that persuasive logical argument is generally not very effective. Paradoxically, acceptance of people as they are seems to free them to change.

Therefore, when responding to the client's barriers, instructors must ensure they do the following:

- build rapport
- listen carefully to what is being said
- check the content regularly, with open and reflective questions
- encourage self-responsibility
- encourage freedom of choice.

It is imperative to avoid 'expert' mode when discussing the how to of overcoming barriers. Remember that the clients know what is best for them and how to realistically achieve it. They just need the chance to articulate the issues and to resolve any ambivalence to change.

What gets people moving and stay motivated?

The key to getting a person moving is to find ways in which the individual is self-motivated enough to sustain that change. The underlying concept of motivation is that a driving force exists within the individual to achieve an exercise goal. The easiest way to tap into this driving force is to establish what it is that the client enjoys doing. Data from the ADNFS (1992) reveals that the four major motivational factors for taking exercise are to:

- feeling in good shape physically
- improving or maintaining health
- feeling a sense of achievement
- getting outdoors.

The following table highlights the various results for men and women. The first column (A) shows the percentage that gave the factor a high personal score. The second column (B) shows the percentage that gave the factor a high score in terms of the ability of exercise to achieve it.

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Motivating factors for exercise among men and women aged 16–69 years				
Factors important as personal goals, achievable through exercise	Men		Women	
	A	B	A	B
1. To feel in good shape physically	88	75	89	73
2. To improve or maintain health	87	74	89	71
3. To feel a sense of achievement	87	74	89	71
4. To get outdoors	84	62	83	60
5. To look good	64	50	82	64
6. To control or lose weight	60	62	72	67
7. To have fun	78	53	76	52
8. To relax and forget about your cares	82	48	85	42
9. To feel independent	77	39	82	45
10. To get together and to meet new people	67	42	73	48

A = percentage who gave the factor a high personal goal score
B = percentage who gave high score on achievement through exercise

Source: Allied Dunbar National Fitness Survey (1992).

This data highlights that the motivation to comply with an exercise programme is influenced by a wide range of factors. Some of these factors may be out of the client's control; others may be factors that the client is completely unaware of. What is obvious is that the types of strategy used to enhance adherence during the initial critical phase (the first three months) may well differ from those most useful in maintaining exercise in the long run.

Instructors can help address the motivational needs of a client during the initial phase by addressing the following issues:

- working with the client on strategies for overcoming barriers
- increasing the client's confidence – agreeing rewards, giving praise and encouragement, looking at ways of incorporating social support and commitment, etc.
- agreeing SMART goals
- agreeing action plans
- promoting autonomy (personal independence) and interdependence (relational skills with others and sharing common principles)
- promoting adherence strategies to include differentiation between dependant, independent and interdependent relationships.

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Additional factors

1. To clarify client expectations – in a neutral manner, clarify the client's exercise expectations and discuss the pros and cons of adopting and maintaining the new exercise behaviour. If the individual's expectations are unrealistic, such as 'If I do legs, bums and tums classes for two months, I'll lose all this excess weight on my hips and thighs', resolve these expectations, as they can lead to noncompliance when unfulfilled. Above all, resolve expectations in a non-judgemental way.

2. To establish realistic expectations – inform clients about the realities of beginning an exercise programme and let them know that initially they will probably get hot and sweaty; they might even feel some mild discomfort in their muscles after the first few exercise sessions, which is perfectly normal.

3. To establish the client's previous exercise history, exercise preferences and needs – this can simply be done by a questionnaire. Questions of interest include the types of exercise programme clients have participated in (frequency, duration and intensity) previously, the length of time of participation, reasons for quitting, what expectations and goals they hope to accomplish and how quickly, current preferences regarding types of exercise, potential roadblocks ahead based on past experience, constraints with respect to time, injuries and other issues.

4. To plan for relapse – such as the 'New Year's resolution effect' while addressing expectations, activity preferences and needs, inform clients that relapses are the norm. For example, relapses due to illness, work schedules, holidays, family commitments, etc. are inevitable. Preparing clients ahead of time for high-risk situations can help to prevent them from dropping out when unplanned breaks interrupt their schedule. Create a fallback plan.

5. To set appropriate and realistic exercise goals – seek agreement on the specific types of activity that best fit the client's objectives, time, commitments and personal lifestyle. Decide which activities best fit the client's daily routine, and help the client to set goals that the client feels are sufficient and realistically challenging. Establish a measurable target (eg, a specified distance per session, a calorie goal or a set time per session).

6. To provide feedback – feedback early in the exercise programme can be an extremely powerful reinforcer. Feedback can take many forms: physiological-based feedback could include changes in maximum oxygen uptake, resting heart rate or perceived exertion, whereas behavioural feedback can include regular recording of attendance and exercise logs. Having clients maintain their own records also helps to ensure that they share responsibility with the instructor for the exercise programme.

7. To establish a sense of self-responsibility and to use a social support system – clients need to understand that their goals are their goals. The exercise programme is a self-development project and an instructor's prime job is to support clients in reaching their goals. The use of varied social support structures, such as a buddy or contact at the club, can help to create an environment that is going to support the client in adopting and maintaining the new behaviour.

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Social support

Social support can play a major role in motivating clients to adhere to a new exercise programme. Family and friends can support clients by adapting their behaviour and assisting with caring for dependants, etc. Other participants can assist with adherence, as the exercise environment can become a place to socialise with others in the same position and with similar interests. Buddy systems and training partners can be extremely effective as a support and motivational tool. Clients are more likely to stay motivated and to adhere to an exercise programme if they enjoy the content and find it fun and engaging. Instructors should ensure that they discuss exercise preferences and include them in the programme, as well as avoiding exercises that the client dislikes. The instructor must also consider previous exercise history and ensure that the programme is pitched at the right intensity for the level of fitness and to achieve the goals. Focus on what the client has achieved by adding incentives and rewards.

These could include one or any combination of the following:

- praise, enthusiasm and encouragement from the instructor
- challenges (eg, gym challenge)
- review sessions that show the client how they have improved
- providing information on the health benefits of regular exercise
- social events
- external rewards, such as prizes or treats for achieving a certain goal
- internal rewards, such as the feel-good factor for achieving goals
- taster sessions.

Bear in mind that a motivated client is a successful client!

Key points for barriers and motives for exercise

- Physical activity levels in England are low, and sedentary people generally hold negative views about physical activity.
- Work reasons, a loss of interest and time needed to do other things are the main factors that stop people from regular participation in moderate to vigorous sport or physical activity.
- The main barriers to exercise are: 'I'm not the sporty type', 'I need to rest and relax in my spare time', and 'there is no one to do it with'.
- The major motivational factors for taking exercise include: to feel in good shape physically, to improve or maintain health, to feel a sense of achievement and to get outdoors.
- The main barriers in the gym environment are complexity and speed of exercise movements, exercises being too intense too soon, lack of understanding of machine set-up, boredom and lack of support.
- The instructor must always listen and demonstrate empathy to avoid losing rapport with clients. If the issues are too complex, refer the client to a relevant expert.
- It is important to create an agenda and to set an action plan and goals appropriate to the client's needs.
- The client must be involved in the whole process to ensure adherence and ownership of the programme.

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Theories and concepts of behaviour change

All people are individuals, and so each one behaves differently. For some, being physically active is a way of life. However, for many individuals, activity is not part of their lifestyle or thoughts.

There are many theories, or models, of individual behaviour. These models were originally developed to help explain how individuals choose a healthier behaviour, such as increasing activity levels or eating a nutritionally balanced diet.

The main role of the instructor in this field is to help individuals to understand and reach their goals of the benefits of positive health behaviour. Knowledge and understanding of how these concepts work can help the instructor to understand how clients can develop and change behaviour patterns. By discussing a client's current behaviour patterns and initial desires to become more active, it will then be possible to assist the client in working towards those desired goals.

This may be an appropriate time to review other behaviours that may have a negative impact on the health of the individual, such as a poor diet or smoking. However, there may be times when an instructor needs to recognise his or own limitations in this field and refer a client to a health professional who has specific experience in behaviour change, especially when dealing with clients with multiple negative behaviour patterns.

Most importantly, to be effective in helping individuals to change to a more positive pattern of behaviour, the instructor must be empathetic and non-judgemental at all times.

Objectives

By the end of this section, the learner should be able to:

- identify the main determinants of physical activity
- understand that changing behaviour is a complex process and there are several theoretical models of behaviour change that require further research to understand more comprehensively
- explain the three stages of growth to empower clients to be responsible for changing their attitude towards physical activity.

Patterns of behaviour

Patterns of behaviour are developed over a period of time. Therefore, attempting to change them may not be an easy task for some individuals. The two main areas that influence individuals' behaviours are sociology and psychology. Sociology focuses on the way that the individual interacts within society, whereas psychology focuses on the individual's thoughts and behaviours.

Society is governed by policies, rules and regulations that make it difficult to change the environment we live or work in. However, we are in control of how we individually cope with these, in the ways in which we think and act towards such issues.

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Changing behaviour

A wide range of theories has been developed to explain all aspects of human behaviour. Each theorist has attempted to explain why individuals behave in certain ways in given circumstances. Although most of these theories are successful in their diagnosis of some aspects of human behaviour, no one theory can explain all aspects, suggesting that the individual is a very complex being.

Effectively, when instructors ask an individual to commit to a training programme, instructors are asking them to change their behaviour. It sometimes seems as though behavioural change is a single event that takes place at a moment in time and thereafter becomes fixed. People decide one day that they will join a gym, stop smoking, lose weight and they do it. However, there is a wealth of psychological research that has identified that behavioural change truly is a process that can be extremely lengthy and is characterised by a series of stages.

Theories regarding motivation and ability to change habits can be found in behaviour change models. These classify how people make changes and construe change as a process involving progress through a series of cyclic stages of change. Many do not succeed in their efforts to establish and maintain lifestyle and activity changes and relapse (ie, move in and out of the cycle at different stages and different times). It is therefore important for fitness instructors to have an understanding of people's perception of the reasons why they feel they cannot start or continue exercising in order to be able to develop strategies and counter arguments for overcoming those barriers and to help them in moving through the stages of change until the change becomes permanent.

Initially, many of these behaviour change models were developed for the field of psychology, rather than specifically for physical activity and exercise. However, it is worth researching the various models and extracting from them what might be appropriate to each chosen situation.

Suggested research:

- Theory of reasoned action (Ajzen and Fishbein, 1975)
- Theory of planned behaviours (Ajzen, 1988)
- The health belief model (Rosenstock, 1966)
- Health locus of control (Wallston, Wallsotn, Kaplan and Maides, 1976)
- Social cognitive theory (Bandura, 1977a)
- Transtheoretical model (Prochaska and DiClement, 1982)

Empowering clients to change

When an instructor first starts to work with a client, the instructor will be relied on for advice, support and motivation. The aim of the fitness professional should be to empower clients to be responsible for their own training and their attitude towards adhering to their programme. In order to empower clients, there are three stages of growth that every person goes through. These include:

1. **Dependent** – initially, clients are completely dependent on instructors. They do not yet have the skills to become more active without the instructor's help and are totally reliant on providing information about becoming more physically active, their training programme, motivation and adherence. However, instructors do not want their clients to remain dependent, as this in itself may become a barrier if the instructor is not always there. A natural progression would be for the instructor to enable their clients to become independent.

2. **Independent** – this is when the clients are no longer as reliant on instructors for their needs and have accepted responsibility for their training and adherence. They have become self-motivated individuals who are regularly active and do not rely on instructors for motivation and adherence. However, being totally independent can be isolating for an individual. A natural progression from here would be to become interdependent.

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3. **Interdependent** – although clients are now independent individuals, they still need intervention from others. They will need instructors to reassess their training programme and to give them ongoing advice. They need others, such as a buddy or training partner, to communicate with and discuss their progress and adherence. Interdependence cannot happen unless the client has already been independent. Independence is a necessary stage. If clients have skipped the independence stage, they are probably still dependent, even if it is not apparent.

As outlined above, it is crucial for instructors to encourage clients to become interdependent. Some people may feel that needing others is a sign of weakness, but with interdependence, the essence is really about working with others to achieve a common goal. It is empowering, and it is a choice born of strengths and respect. Interdependence is essentially wanting the best for others: valuing, trusting and cherishing their unique abilities, while still being secure about one's own.

Key points for behaviour change

- Patterns of behaviour are developed over a long period of time for adults. Attempting to change behaviour can be difficult.
- There is a range of theories and concepts that has been used by psychologists in behaviour change.
- Changing client behaviour requires the instructor to be empathetic and non-judgemental.
- Empowering clients to change is a three-stage process: dependant, independent and interdependent.

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Goal setting

Goal setting is a familiar tool within the health and fitness industry for helping individuals to adhere to exercise. There are many types of programme and goals. Some programmes are so focused on goal setting that they even insist the client has a specific goal from the outset. However, this can be a challenge to some clients because they have not had the opportunity to explore the possible outcome from the get-go.

Objectives

By the end of this section, the learner should be able to:

- understand the importance of setting SMART goals
- state what information the instructor needs to gather from the client and its importance in the process of goal setting
- explain why it is important to make the client part of the process of goal setting.

What is the importance of goal setting?

Before a training programme begins, the instructor needs to establish the training aims. Nearly 50% of people who start a training programme drop out within the first few months. One of the reasons for this is that they never really established what they were trying to achieve from the outset.

Below is a series of questions that can be utilised to help with the goal-setting process. They can be used as a guide to check for a clear understanding of the client's perspective:

What is your goal?

When do you want to achieve this by?

How will you know when you have achieved it?

What will you see, hear and feel?

What skills do you need to learn?

For whom do you want to achieve this?

Who will support/not support your efforts?

What will you need to change in order to reach your goal? Intrinsic motivations are more likely than extrinsic to produce a successful outcome. It is the role of the instructor to encourage clients to want to achieve a goal for themselves and not because others tell them that they should. It is important that clients take responsibility for their fitness motivation. Clients will then have a greater chance of achieving their goals, increasing activities of daily living, maintaining their programme and adhering to exercise.

A great deal of thought is required in order to write a meaningful training programme that will give the maximum benefit from the time spent training. People undertake training for many reasons.

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They might be one or a combination of the following:

- **physical** – fitness, weight management, to improve a specific sporting activity or component of physical fitness to meet specific needs
- **psychological** – mental and emotional, well-being, stress management
- **lifestyle** – health, mobility, improving or managing medical conditions
- **social** – to make friends, develop their social network
- **adherence** – changing behaviour towards physical activity/exercise and developing positive habits for long-term participation.

When setting goals for a client, it is best to ensure that they are a part of the process. This can help them to take personal responsibility for their own fitness and motivation. By doing this, they are more likely to adhere to the programme and achieve their goals.

An instructor should meet with the client and discuss the following:

- their expectations and fears
- specific personal goals
- available time
- their level of commitment
- personal information (eg, PAR-Q, health screening and informed consent)
- their personal motivation
- any current or perceived barriers.

SMART goals

Whatever the client's reasons for becoming more physically active, setting SMART short, medium and long-term goals can help them to achieve them. Timing and commitment needs to be realistic.

SMART stands for:

Specific

Measurable

Achievable/agreed

Realistic

Time-framed

Specific

Be specific when working with the client as to exactly what they want to achieve. Go beyond the superficial reasons. Question and explore vague statements such as to 'tone up' or to 'lose weight'. This will enable both instructor and client to focus on achieving a specific result. Long-term goals are the end result and are more often realised if short and medium-term goals are set along the way.

Measurable

Having set the short, medium and long-term goals the instructor should then discuss a system for measuring the success of achieving them throughout the training programme. Encourage the client to use a training diary to monitor and measure their progress, as this will allow even the smallest of changes to be recorded. Specific variables such as the exact resistance, number of sets and reps should be recorded in each training session. A quality rating of the training session based on how your client felt the session went (1 as poor and 10 as good) and whether they achieved the aims is a good indicator when assessing progress against the agreed short-term and long-term goals.

Initial assessment records (eg, body fat percentage, body weight, circumference measurements, etc.) should be reassessed at agreed intervals to monitor progress. Also periodic reviews and the analysis of training logs and diaries can help the instructor to assess whether the exercise prescription has been successful in meeting the client's goals.

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Achievable/agreed

The instructor should discuss the training aims with the client. The instructor may have to negotiate these to ensure that they are realistic for the client. Agree the following with the client:

- short-term goals
- medium-term goals
- long-term goals
- when the training programme will start
- how often the training programme will be reviewed
- what potential barriers may arise
- what will happen if any of the goals are not met.

Be careful not to set goals that are too far out of reach for the client. They may start with the best of intentions, but if they do not believe that they can achieve them, subconsciously this will stop them from even giving it their best and will result in failure. It is always better to underestimate than to overestimate what one feels the client is capable of achieving. In this way, if the client's goals are exceeded or achieved more quickly than expected, it will not only motivate them to continue but will also make them feel that they have been given an exemplary service.

Realistic

Be realistic about what an individual can achieve. Consider the client's physical capabilities, such as age and body type. Discuss their lifestyle habits and how the training programme will fit in with available time, family, occupation and other commitments.

Time-framed

If a goal has no deadline, it can easily be put off. Timed goals are more often achieved than open goals, therefore it is important to decide and agree a time to start and end the programme. Set a clear time scale for reaching the short-, medium- and long-term goals, times when the instructor will analyse the client's training diary and complete body assessment records.

Note: The 'achievable' and 'realistic' components are often quite subjective and influenced by factors such as client motivation, injury and unforeseen circumstances. Instructors can, however, use their knowledge and experience to make reasonable estimates about what a client can achieve within a certain timeframe.

Goal setting and screening will enable the instructor to build an invaluable picture of the client as an individual. Part of this process should include establishing any barriers to starting, maintaining and adhering to the training programme.

If a barrier presents itself during the goal setting/screening phase, the instructor should consider planning intervention strategies (ie, an action plan), to reduce the impact of the barrier on the programme. For example, if the client has planned to take a holiday during the programme, the instructor must consider how this will impact the programme and the client's goals. The instructor must ensure that the programme is suitable for the client to carry on with when they return and that the goals are still achievable.

It may be that the client has no obvious barriers at the beginning of a programme. However, there may be times during the programme that a barrier presents itself. It is important to identify it swiftly and deal with it appropriately in order to keep the programme on track to meet the set goals. Barriers can be more easily identified if the instructor asks specific questions, writes them down and agrees a solution with the client.

Key points for goal setting

- It is important to create an agenda and to set an action plan and goals appropriate to the client's needs.
- Setting SMART goals can help to achieve short-, medium- and long-term training goals.
- The client must be involved in the whole process to ensure adherence and ownership.

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Client retention

The value of the fitness industry in the UK is estimated at approximately £3.6 billion (Fitness Industry Report, 2007) and boasts that in excess of 1.8 million people are members of health and fitness clubs (National Audit of Fitness Consumers, 2006). Additionally, there has been an increase in the number of new public and private fitness facilities. This has led to a reported 3% growth in club memberships since January 2006 (Fitness Industry Report, 2007).

With over 90% of the UK population living within two miles of a public or private health and fitness facility (FIA State of the Fitness Industry Report, 2010), the provision for keeping fit and healthy is apparently more accessible and attainable than ever before.

Objectives

By the end of this section, the learner will be able to:

- define client retention
- recognise the importance of client retention
- state the factors that affect client retention
- identify the role of the fitness professional, the client and the fitness facility in contributing to client retention.

What is client retention?

When applied to exercise, client retention can vary in meaning depending on the stakeholder. A significant stakeholder is the individual who wants to become fitter or lose weight, working towards some fitness, health or lifestyle goal. Once the goal has been achieved, the issue for the individual is whether to continue to exercise, thereby retaining the fitness benefits. To the client, their personalised wants and goals must be central to any provision of health and fitness instruction, support or facilities.

The measure of client's success is likely to relate to their wants and goals in seeking an exercise and fitness solution. Becoming fitter or slimmer may be a declared target for the client, and their expectation is that the fitness professional or facility is there to help them to achieve their goals.

To the fitness facility, 'member retention' is an organisational objective and measured in terms of member retention rates and financial targets. Therefore, a fitness instructor who works within a fitness club would have to balance the exercise adherence needs of the client against the member retention and financial goals of the facility. For example, the village hall instructor has an interest in keeping numbers high in order to cover costs and make a profit.

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Why do clients stop attending?

Learning the reasons why clients stop attending is a crucial question for increasing retention rates and helping people to move towards their fitness goals. However, many individuals may not give an accurate reason for leaving or may state one reason when, on closer inspection, there appears to be a number of factors that cause the member to leave the gym (IHRSA, 1988).

Some of the reasons why people leave their health and fitness clubs include:

- financial
- personal
- situational
- facility-related
- customer service.

Financial reasons

In order for the monthly membership fee or paying for a block of classes to be economically viable, the client must be able to justify this payment with regular and sustained usage. Therefore, if the clients fail to attend regularly, then they are more likely to perceive that the membership is poor value for money.

Personal reasons

Over time, clients may lose interest in their training and stop attending the gym or class, therefore finding it increasingly more difficult to justify the membership fees. The reason for this may be as simple as not having a training partner to promote regular attendance, meaning that a habit has not been developed in order to keep attending.

Situational reasons

Illness or external factors, such as changing job or moving house, can often precede a client's or member's cancellation. The member may have even decided to change to another form of exercise, such as training at home or running outdoors.

Facility-related reasons

Common complaints from ex-members are that they were dissatisfied with staff, overcrowded facilities, unresponsive club management and cleanliness of facilities. This shows that fitness club managers, staff and other fitness professionals need to work together to produce a cohesive, caring customer experience to ensure customer retention.

By monitoring and evaluating the service, facilities can assess membership retention rates and strive towards maintaining an economical and viable business. Members who use the club more frequently are more likely to remain members for longer. If the teams within the clubs do their jobs well, then adherence to exercise programmes will be maintained, subsequently leading to achievement in fitness goals as well as increasing retention rates.

Customer service issues

Customers need to feel that the club or instructor is giving them the level of service that they want and expect. Any shortfall in this might push them in the direction of a competitor. If members feel that the club's cleanliness is not up to scratch or that the group fitness sessions are overcrowded, they are more likely to leave (IHRSA, 1998). Members want to get results (whatever they may be) and need their efforts to be recognised by the club and its staff.

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Customers who actively want to come to the club and who regularly use its facilities often tell others how good the whole experience is. This gives the fitness club or class an unrivalled marketing advantage. If the experience is a positive one, the customer is more likely to continue its patronage and tell friends, family and colleagues about the fantastic club, class or instructor. Similarly, members who perceive that they have received poor service may be even more eager to spread the word.

Members want to feel part of the club or class environment. By establishing social activities and targeted programmes, this will help to achieve this. Events such as party theme nights and 'young at heart' targeted programmes for the older member help to create a feeling of value for the member. Simply by saying 'thank you' to clients for attending, and asking for their opinions, either directly or by using suggestion boxes and feedback events, help all participants to feel included, no matter how long they have been a member.

Participants can feel further valued if the facility creates well-designed fitness programmes and classes that recognise their fitness, social and emotional needs. Programmes such as the penetration of personal training into clubs have been shown to increase retention (IHRSA, 2000).

Strategies such as regular communication and review sessions have shown to increase both exercise adherence and member retention. Newsletters, emails, membership surveys and even birthday cards will all help towards making the member/participant feel valued and thus have an impact on retention rates (IHRSA, 2000).

Key points for client retention

- Client retention has a variety of meanings depending on the stakeholder, the individual potential member, the instructor and the health and fitness facility.
- Less than 50% of new exercisers maintain their exercise programmes through their first six months.
- Membership retention is related to keeping members for longer periods.
- The main factors that affect membership retention appear to be not using the facility, getting bored or unhappy with the facilities on offer, falling out with members of staff or finding another fitness facility that better suits their needs.
- Reviewing members' programmes on a regular basis contributes towards higher retention rates.
- The client should be involved in choosing the type of exercise to increase exercise retention.
- Regular communication and review sessions have both been shown to increase exercise.

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Useful websites

National Institute for Health and Clinical Excellence
www.nice.org.uk

WHO | World Health Organization
www.who.int

American College of Sports Medicine
acsm.org

Register of Exercise Professionals (REPs')
www.exerciseregister.org.

HSE: Information about health and safety at work
www.hse.gov.uk

Safe guarding and other legislation
Legislation.gov.uk
www.legislation.gov.uk

For up to date agencies
www.homeoffice.gov.uk/agencies-public-bodies/dbs/

Start active, stay active: a report on physical activity
www.dh.gov.uk/en/Publicationsandstatistics/Publications

NHS Choices – The eatwell plate
www.nhs.uk/livewell/goodfood/pages/eatwell-plate.aspx

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