



Manual

# Active IQ Level 3 Extended Diploma in Personal Training

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# Applied anatomy and physiology for exercise, health and fitness

## Aim

To recognise and understand each of the anatomical systems and how they relate to the physiological functions associated with exercise, health and fitness.

## Learning outcomes

By the end of this unit, you will:

- Know the structure and function of the cardiovascular system in relation to health and fitness.
- Know the structure and function of the skeletal system in relation to health and fitness.
- Know the structure and function of the myofascial system in relation to health and fitness.
- Know the structure and function of the nervous system in relation to health and fitness.
- Know the structure and function of the endocrine system in relation to health and fitness.
- Understand the role of the energy systems in relation to physical activity, exercise and training.
- Know the structure and function of the digestive system in relation to health and fitness.

# Introduction

In order to understand how the human body can be affected by exercise and physical activity, the skilled personal trainer must have a good foundation of anatomical and physiological knowledge.

## Anatomy

The study of the structures of the human body

## Physiology

The study of the functions of the human body

In an attempt to understand the complexity of the human form, it is helpful to appreciate each body system in isolation. However, it is also important to recognise that systems need to be integrated and interdependent to achieve the diversity of function required of the human body. No tissue, organ or system truly functions in isolation.

# Section 1: The cardiovascular system

## The heart

The heart is a muscular pump which transports blood to the tissues via the blood vessels. It is about the size of a man's clenched fist, and it is located behind and to the left of the sternum.

The walls of the heart consist of three layers:

- The **pericardium**: This layer forms a protective sac around the heart and is also known as the epicardium.
- The **myocardium**: This layer is the largest with the greatest mass and is formed from cardiac muscle. The left layer of myocardium is much thicker than the right so that it is able to pump blood around the body.
- The **endocardium**: This is the inner lining of the heart wall; it is formed of epithelial tissue resting on a connective tissue base.

The heart is divided by the septum (the central wall) into separate left and right halves.

- The **right** half receives blood from the body and pumps blood to the lungs.
- The **left** half receives blood from the lungs and pumps blood to the body.

The left half of the heart has thicker, more muscular walls than the right half to enable it to pump blood the larger distance around the body.

There are four chambers in total:

- The two upper chambers (**atria**) receive blood from the veins.
  - The left atrium receives oxygenated blood from the pulmonary vein.
  - The right atrium receives deoxygenated blood from the superior and inferior venae cavae.
- The two lower chambers (**ventricles**) pump blood into the arteries.
  - The left ventricle pumps oxygenated blood around the body via the aorta.
  - The right ventricle pumps deoxygenated blood to the lungs via the pulmonary artery.

The upper atria are smaller and less muscular than the lower ventricles. This is because the atria have a receptive function that does not require the muscular force of the ventricles.



### POINT OF INTEREST

### ROOT WORDS

Many anatomical terms are made up of root words which give away the function, location or structure of the subject.

- **peri** = 'around'
- **myo** = 'muscle'
- **endo** = 'inside'
- **cardium** = 'heart'

## Heart valves

Heart valves are formed from tough connective tissue and are made up of cusps, or flaps, that cover the entrance or exit to a vessel or chamber. They open and close passively, either sucked into place or blown open depending on the differential pressure in each chamber or vessel.

- **Semilunar valves** lie between the ventricles and arteries and prevent backflow of blood from the chamber to the vessel. The aortic semilunar valve separates the left ventricle and the aorta, and the pulmonary semilunar valve separates the right ventricle and pulmonary artery.
- **Atrioventricular (AV) valves** lie between the atria and ventricles and prevent backflow of blood from the upper to lower chambers. The left AV valve is also known as the bicuspid valve (two cusps) or the mitral valve. The right AV valve is also known as the tricuspid valve (three cusps).

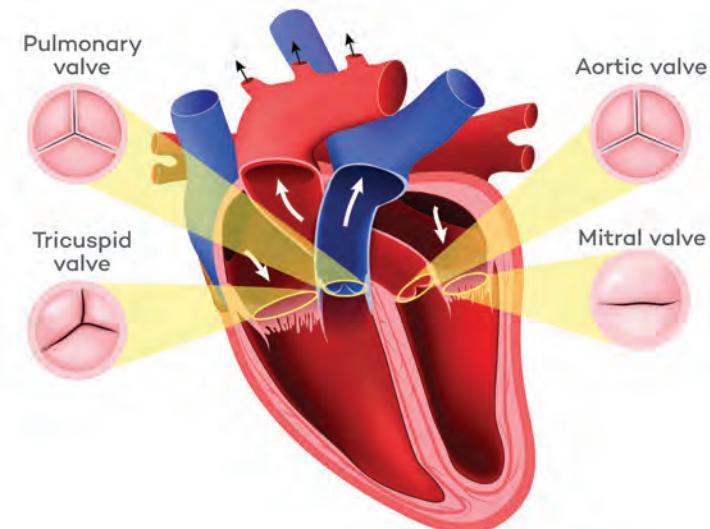


Figure 1.1 The valves of the heart

## Contraction of the heart

### SA node

The stimulation starts in the sinoatrial (SA) node.



### Atria contract

The interconnected cardiac muscle fibres pass the impulse across the atria.



### AV node

The atrioventricular (AV) node is stimulated and allows the full contraction of the atria before stimulating the ventricular muscle to contract.



### Ventricles contract

The AV node stimulates the ventricular muscles to contract.

The heart is stimulated to contract by a complex series of integrated systems. The heart's pacemaker – the sinoatrial (SA) node – initiates the cardiac muscle contraction. The SA node is located in the wall of the right atrium (see Figure 1.2). The heart muscle is stimulated to contract about 72 times per minute.

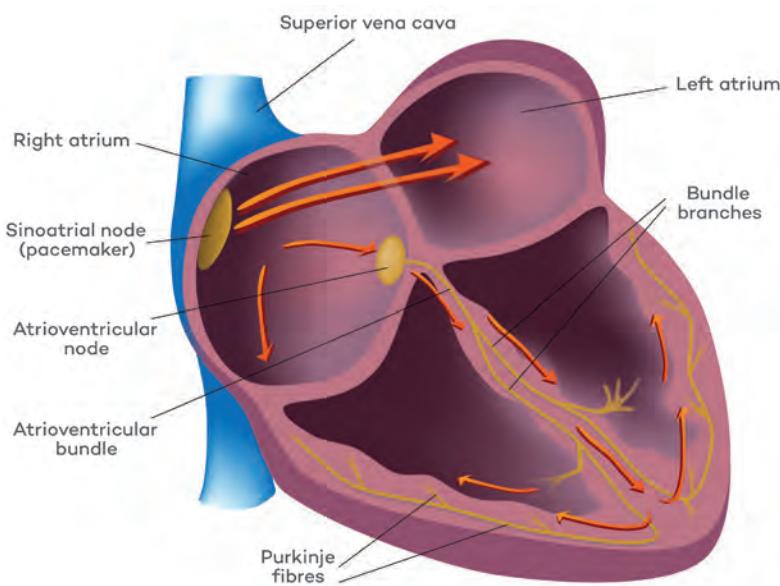
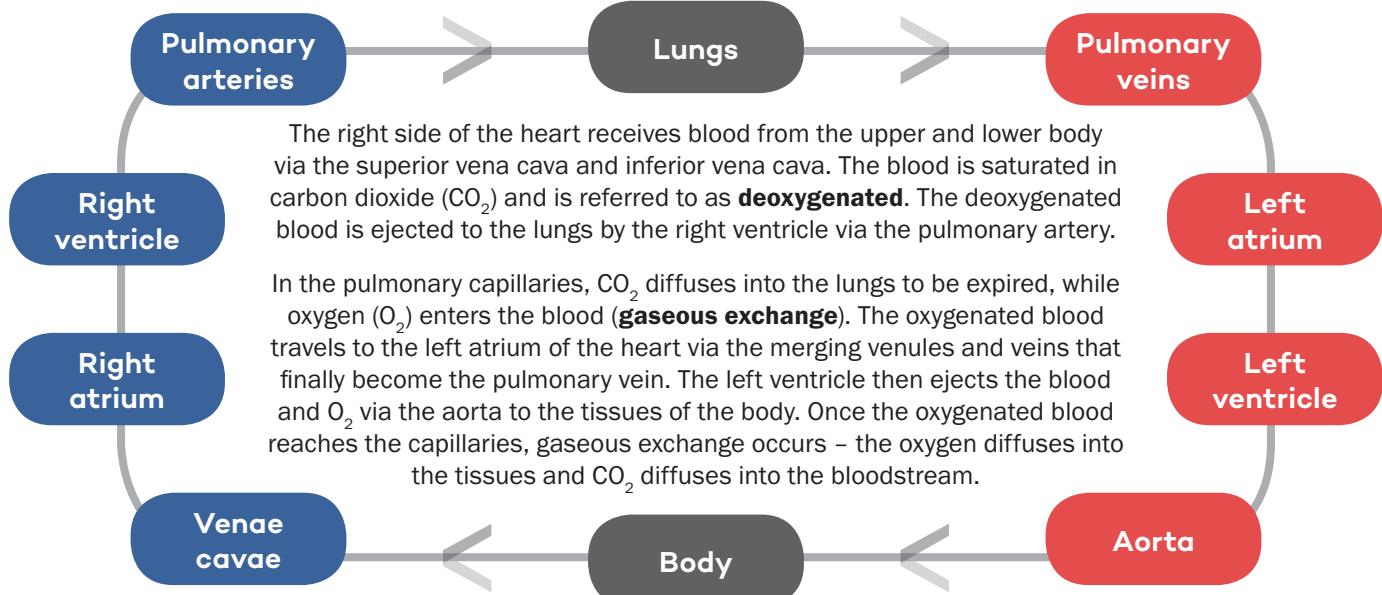


Figure 1.2 The contraction of the heart

## Circulation



## Atherosclerosis

In a healthy blood vessel, blood flows smoothly to reach its target tissue or organ and supply it with the nutrients and oxygen it requires for optimal function. Vascular disease is the narrowing of the blood vessels, and it is one of the main causes of death in the developed world. It is triggered by inflammation within blood vessels and the subsequent accumulation of mineral, protein and fat deposits. This creates a build-up of plaques on vessel walls which can ultimately lead to a blockage that can severely restrict, or completely prevent, blood flow. As a consequence of this, tissues and organs can be starved of vital nutrients and oxygen.

Vascular disease is most commonly caused by the hardening of arteries – a condition called **atherosclerosis** (see Figure 1.3). Atherosclerosis is initiated by the inflammatory response to vessel damage that creates plaques using cholesterol, protein and mineral deposits in an attempt to heal the area.

As plaques build up, the artery wall becomes thicker, harder and less elastic. The artery narrows as a consequence of the build-up and cannot effectively stretch to accommodate blood.

A lack of blood flow as a result of atherosclerosis can cause target tissue death unless those tissues are supplied by blood from alternative arteries.

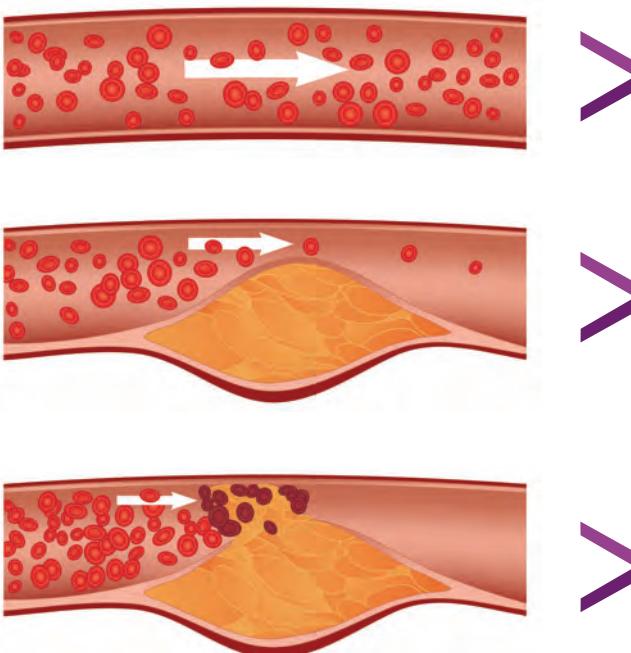


Figure 1.3 Atherosclerosis

### 1 – Inflammation

Known as the ‘fatty streak’ stage because this is how the condition first becomes visible.

Damage (e.g. caused by smoking or hypertension) initiates an inflammatory response.

### 2 – Narrowing

The body tries to repair the damaged area using cholesterol, proteins and minerals.

These substances build up, creating a ‘plaque’ that thickens and hardens the artery walls.

The artery is narrowed by the plaque build-up.

### 3 – Blockage

The plaques build up so much that they rupture and release cholesterol and connective tissue into the artery.

The body’s protective mechanism creates a blood clot around the rupture which further scars, hardens and can block the entire artery. These are called ‘complicated lesions’.

**POINT OF  
INTEREST****ROOT  
WORDS**

- **myo** = 'muscle'
- **cardial** = 'heart'
- **infarction** = 'obstruction'

Myocardial infarction – an obstruction in the heart muscle.

- **cerebro** = 'brain'
- **vascular** = 'blood vessels'

Cerebrovascular accident – a blood vessel in the brain is blocked.

Atherosclerosis commonly affects the arteries of the heart and brain and produces varying symptoms depending on the tissues involved. Coronary atherosclerosis can be associated with chest pain on exertion that settles with rest. This is referred to as **angina pectoris** which literally means 'strangles chest' and is the direct result of reduced blood flow to the heart muscle.

If a coronary artery is completely blocked, the area of the heart which is deprived of blood will die, causing a heart attack (myocardial infarction).

Blockages in small arteries in the brain deprive areas of the brain of blood, resulting in a stroke (cerebrovascular accident).

A combination of genetic and lifestyle factors (such as family history, lack of exercise, stress, unhealthy diet, being overweight and smoking) play a role in the damage and gradual build-up of plaque within the vessel walls.

## Blood pressure

Blood pressure is a measure of the force that blood applies to the walls of the arteries as it flows through them.

Blood pressure is measured in millimetres of mercury (mmHg) and is expressed using two numerical readings. The optimal blood pressure reading is written as 120/80mmHg (one hundred and twenty over eighty). These two numbers represent the systolic and diastolic blood pressures respectively.

**Systolic blood pressure (SBP)** is the pressure exerted on the artery walls when the cardiac muscle is contracting and pumping blood. This is the higher of the two numbers and is usually noted first. It is caused by the increased volume of blood flowing through the arteries with each beat, which increases the pressure within the arteries.

**Diastolic blood pressure (DBP)** is the pressure exerted on the artery walls when the heart is in a relaxed state. The heart goes through this period of relaxation (or diastole) to allow the chambers of the heart to fill with blood prior to contraction. The diastolic blood pressure is always the lower of the two readings.

Blood pressure is an expression of arterial blood flow and the peripheral resistance the blood encounters as it flows around the body. It can therefore be expressed in the following equation:

$$\text{Blood pressure} = \text{Cardiac output} \times \text{Total peripheral resistance}$$

**Cardiac output** is the volume of blood pumped out by the heart in one minute (ml/min).

**Total peripheral resistance** is the resistance the blood vessels offer to blood flow. The greater the resistance, the higher the blood pressure. Peripheral resistance is increased by constriction or decreased by dilation of the blood vessels (arteries and arterioles).

## Blood pressure classification

It is normal for blood pressure to fluctuate throughout our daily lives due to variable levels of exertion or stress. **Hypertension** is the term used to describe blood pressure that is consistently higher than healthy resting levels. A high SBP provides an indication of the strain on the blood vessels when the heart is pumping blood. If DBP is high, it indicates that the blood vessels have little chance to relax between heartbeats. Measuring blood pressure provides an indication of the health of the vascular system and an overall gauge of a person's health.

The optimal resting blood pressure is defined by the American College of Sports Medicine (ACSM, 2014) as 120/80mmHg. When discussing blood pressure with a client, it is always useful to find out how they have their blood pressure taken. If their readings are being taken in a clinical environment then the results are likely to be more accurate than if they are taken at home by the client. If classification is unclear, it is recommended that the client is classified in the higher of the risk categories to ensure safety.

Category	Systolic (mmHg)	Diastolic (mmHg)	Recommendation
Low.	<100	<60	Seek medical guidance prior to exercising.
Optimal.	120	80	If the client has no other causes for concern, exercise is recommended.
Stage 1 hypertension.	140	90	Seek medical guidance prior to exercising.
Stage 2 hypertension.	160	100	Seek medical guidance prior to exercising.
Severe hypertension.	180	100	It is a complete contraindication to advise a client to exercise. Any medically recommended exercise should be performed in an appropriate environment under specialist supervision.

Table 1.1 Blood pressure classifications (BHF, 2010; NICE, 2011; ACSM, 2014)

## The effects of exercise on blood pressure

### Immediate effects

When exertion increases, the demand for oxygen and nutrients rises. As a consequence, cardiac output will increase to service that demand. As increased volumes of blood are pumped through the vessels, vasodilation occurs to limit the rise in systolic blood pressure (SBP). SBP will still naturally rise in line with increasing levels of exertion.

In contrast, diastolic blood pressure may remain stable, or decrease slightly, as the vasodilation remains consistent while the blood flow reduces between heartbeats.

Individuals with hypertension or vascular disease (e.g. atherosclerosis) may experience an increase in diastolic pressure as a result of an impaired vasodilatory response.

### Valsalva manoeuvre

Heavy weight training and isometric exercise have been shown to significantly increase both systolic and diastolic blood pressure.

It is important for individuals to maintain a regular breathing rhythm when performing these exercises to avoid the Valsalva effect. This effect is caused by the Valsalva manoeuvre (breath holding during heavy lifting that creates excessive straining). This is a manoeuvre whereby the mouth and nose are closed while air is forced against a closed airway. This results in the build-up of pressure and tension which can restrict the blood flow to the brain.

It has long been reported that the Valsalva manoeuvre only increases blood pressure, but more recent investigations have shown that the Valsalva manoeuvre has more complex effects on blood pressure. The initial increase in strain caused by the Valsalva manoeuvre and surrounding intense muscle contractions has been shown to slightly increase blood pressure. There is then a decrease in blood pressure as venous return becomes reduced. This can cause dizziness or fainting. Once the strain is released, blood pressure shoots up as the body overcompensates in its attempt to normalise blood flow.

This rapid increase in blood pressure can be dangerous to an individual with high blood pressure (hypertension) or cardiovascular disease (e.g. atherosclerosis, hypercholesterolaemia) as their system may struggle to cope with the flush of blood and the rapid rise in blood pressure following constriction. The Valsalva effect can drastically heighten the risk of a cardiovascular event such as a heart attack or stroke.



### POINT OF INTEREST

### ROOT WORDS

- **vaso** = ‘blood vessels’
- **dilate** = ‘widen’
- **constrict** = ‘narrow’

Vasodilation – widening of blood vessels.

Vasoconstriction – narrowing of blood vessels.

## Long-term effects

Aerobic exercise performed regularly over time has been shown to reduce systolic and diastolic blood pressure by 5-7mmHg in mild and moderate hypertensives.

Current ACSM guidance (2014) states that the focus of an exercise programme for a person with mild to moderate hypertension should be aerobic exercise. Moderate-intensity resistance training can be incorporated into a programme, but their guidance is that it should be used to supplement and bring variety to a cardiovascular programme. For this reason, circuit training can be useful as it can be designed to achieve similar physiological effects to aerobic training (increased heart rate and limited strain on the vessels).

In addition to the positive changes in blood pressure, exercise can have a positive effect on blood lipids, which can further enhance the overall health of the cardiovascular system, including reduced risk of atherosclerosis.

Exercising regularly can help to reduce the level of LDLs (low density lipoproteins) whilst increasing the levels of HDLs (high density lipoproteins). This rebalancing of the blood lipids can help to avoid the deposit build-up that leads to atherosclerosis.

## Cardiovascular benefits of exercise

Traditionally it has been reported that only aerobic endurance training will elicit cardiovascular benefits. In reality, any exercise which places increased demand on the cardiovascular system will result in physiological adaptations that will better enable the system to cope with the imposed demands.

Certain types of cardiovascular training, including aerobic endurance and anaerobic methods (e.g. interval training), specifically manipulate intensity to challenge the cardiovascular system. These forms of training can therefore have a maximal impact on the adaptations of this system.

Resistance training can have a much more variable impact on the cardiovascular system. Traditional forms of strength and hypertrophy training will result in an increased cardiovascular demand as the body responds to the intermittent demands for intense muscle activation and recovery, but the extremely short work periods combined with long rest periods will limit the cardiovascular effects. In contrast, resistance training methods which involve the performance of many repeated resistance exercises, combined with little rest and performed in a circuit style, will increase the cardiovascular demand.

Table 1.2 describes the physiological adaptations which take place in response to exercise that increases cardiovascular demand, and these adaptations will result in the following improvements on cardiovascular performance and efficiency:

- An improved blood supply to the body's tissues.
- A lower resting heart rate.
- A lower relative heart rate when exercising.
- An improved aerobic capacity ( $\text{VO}_2 \text{ max}$ ).
- Higher aerobic/anaerobic thresholds.
- A greater performance potential.

Heart	Blood vessels
<ul style="list-style-type: none"> <li>Increased size of the heart muscle (left ventricular hypertrophy).*</li> <li>Increased strength of contraction (stronger heart).</li> <li>Increased stroke volume (more blood ejected in one contraction/heartbeat).</li> <li>Increased cardiac output (more blood ejected in a minute).</li> <li>Decreased risk of cardiovascular disease.</li> </ul> <p>*Please note: The size of the heart itself does not significantly increase, only the musculature.</p>	<ul style="list-style-type: none"> <li>Increased blood vessel size.</li> <li>Reduced resting systolic and diastolic blood pressure (SBP and DBP).</li> <li>Favourable change in blood lipids (increased high density lipoprotein and reduced low density lipoprotein and triglycerides).</li> <li>Increased haemoglobin.</li> <li>Increased blood volume.</li> </ul>
Lungs	Muscles
<ul style="list-style-type: none"> <li>Increased functional capacity during exercise.</li> <li>Improved gaseous exchange (diffusion of respiratory gases).</li> <li>Increased vital capacity.</li> <li>Increased maximal O<sub>2</sub> uptake.</li> </ul>	<ul style="list-style-type: none"> <li>Increased number of capillaries in the muscles enabling better transport of oxygen and removal of waste products.</li> <li>Increased enzymatic function within muscle cells.</li> <li>Increased size and number of mitochondria.</li> </ul>

Wilmore and Costill, 1999; ACSM, 2014.

Table 1.2 Long-term cardiovascular and respiratory adaptations to cardiovascular training

Based on the physiological adaptations listed in Table 1.2, it is clear that exercise is very important when considering the health of the cardiovascular system.

It is also important that the body returns to a relaxed state to avoid sustained stress which can be extremely damaging. By incorporating relaxation exercises at the end of a session, or relaxation sessions into a weekly programme, an individual can improve their ability to balance the increased demands with activities that ease the stresses placed upon the cardiovascular system. This can be extremely beneficial in the long term as it incorporates specific time to allow the body to recover and capitalise on the benefits of the exercise.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- Label the diagram of the heart, identifying the full names, locations, structures and functions of the following:
  - The four chambers of the heart.
  - The SA and AV nodes.
  - The left and right AV valves.
  - The semilunar valves.
  - Major arteries taking blood from the heart.
  - Major veins bringing blood back to the heart.
- Using the left side of the heart as the start point, describe the flow of blood around the body, detailing all blood vessels and the type of blood they carry.
- Identify the three stages of atherosclerosis, and in your own words, describe what happens in each stage.
- Complete the following formula and describe all three terms in your own words:

**Blood pressure =** \_\_\_\_\_ **x** \_\_\_\_\_

- Describe systolic and diastolic blood pressure and the effect different types of exercise can have on each in the short and long term.
- What is the blood pressure classification for each of the following readings, and what guidance would you give to an individual who reported each reading?

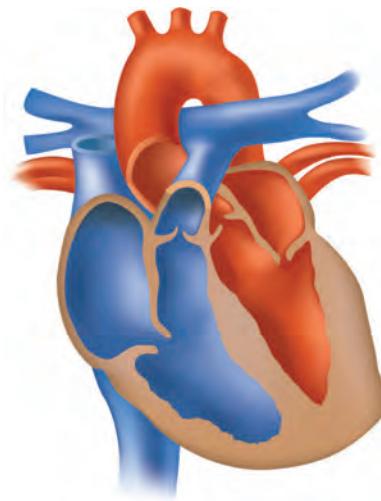
**123/82mmHg**

**98/52mmHg**

**147/98mmHg**

**185/115mmHg**

- Make a list of the physiological adaptations which occur as a consequence of increased cardiovascular demand.
- Make a list of the benefits an individual may experience as a consequence of regular cardiovascular exercise.
- Explain the different types of exercise that would have a positive effect on the cardiovascular system and why they have this effect.



# Section 2: The musculoskeletal system

## The skeletal system

### Planes and axes of motion

The skeletal system works in three basic planes and axes. All joint movements can be described as working through one plane and/or axis, or a combination of two or three planes and/or axes (see Figure 2.1).

- **Plane of motion** – An imaginary flat surface that represents an anatomical cross-section along which movement occurs.
- **Axis of motion** – A theoretical point around which rotation occurs.

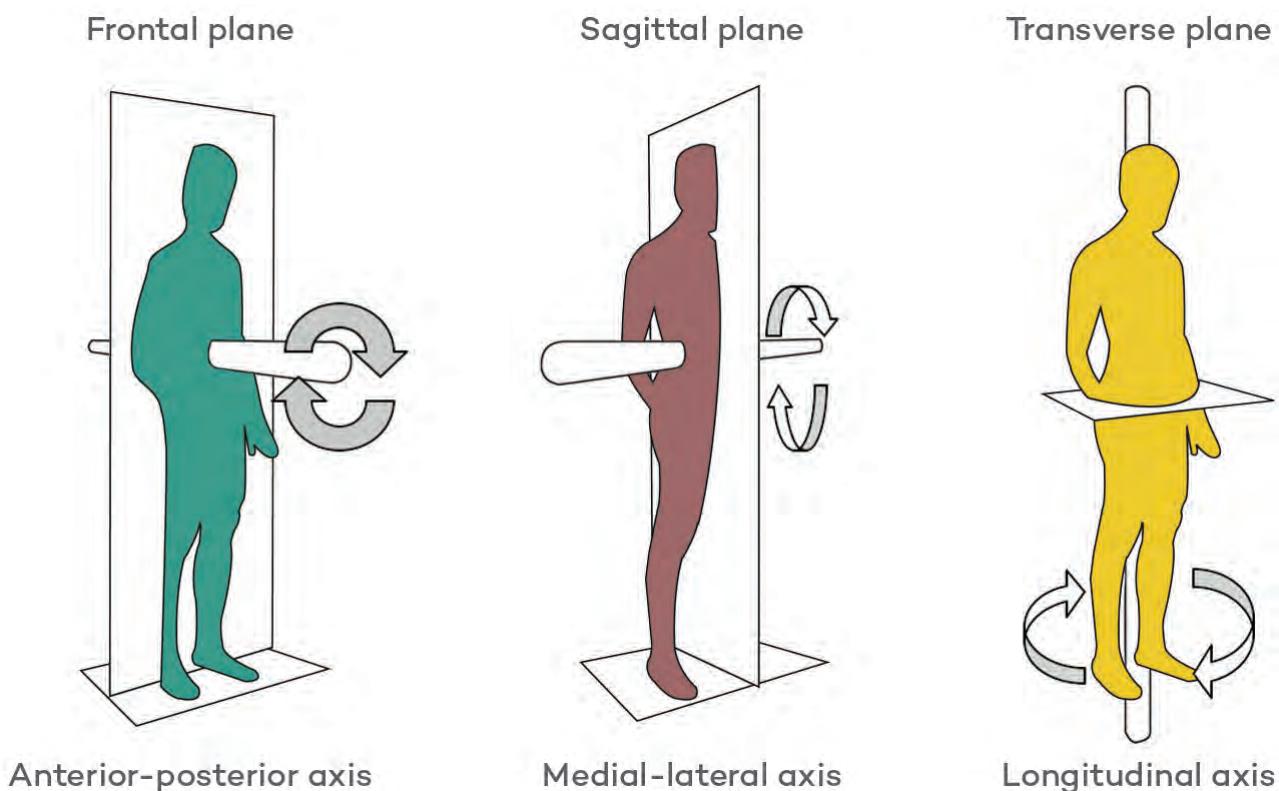


Figure 2.1 Planes and axes of motion

- The frontal plane is vertical and divides the body into anterior and posterior parts. The anterior-posterior axis passes through the frontal plane. Movements include abduction and adduction.
- The sagittal plane is vertical and divides the body into left and right parts. The medial-lateral axis passes through the sagittal plane. Movements include flexion and extension.
- The transverse plane is horizontal and divides the body into upper and lower parts. The longitudinal axis passes through the transverse plane. Movements through this plane and axis are rotational.

Joint	Sagittal plane/ medial-lateral axis	Frontal plane/ anterior-posterior axis	Transverse plane/ longitudinal axis
Shoulder joint.	Flexion – extension.	Abduction – adduction.	Internal – external rotation. Horizontal flexion – extension.
Shoulder girdle.	Protraction – retraction.	Elevation – depression.	
Elbow.	Flexion – extension.		Pronation – supination.
Spine.	Flexion – extension.	Lateral flexion – extension.	Rotation.
Hip.	Flexion – extension.	Abduction – adduction.	Internal – external rotation.
Knee.	Flexion – extension.		
Ankle.	Plantarflexion – dorsiflexion.	Inversion – eversion.	

Table 2.1 Main joints and movements available in each axis

It is usually easy to identify the plane or axis when describing simple movements (see Table 2.1).

Circumduction, which can be performed at the shoulder, wrist, hip and ankle, is actually a combination of simple movements (flexion, extension, adduction and abduction) and as such it occurs in the sagittal and frontal planes (medial-lateral and anterior-posterior axes).

More complex whole-body movements or exercises commonly occur in all three planes and axes. It may be simpler to describe the dominant plane or axis only, but an understanding of the component parts of each movement or exercise is still beneficial when considering clients' abilities and programming (see Table 2.2).

Whole-body movement	Joint actions	Dominant plane of motion/axis	Rationale
Walking.	Plantarflexion – dorsiflexion. Inversion – eversion. Knee and hip flexion – extension. Hip internal – external rotation. Spinal rotation. Shoulder and elbow flexion – extension.	Sagittal plane. Medial-lateral axis.	The major movements to propel the body forwards during walking occur in the sagittal plane. The frontal and transverse plane movements are minimal and enable the major sagittal movements.
Throwing a ball with force.	Plantarflexion – dorsiflexion. Inversion – eversion. Knee and hip flexion – extension. Hip internal – external rotation. Spinal rotation. Shoulder and elbow flexion – extension.	Transverse plane. Longitudinal axis.	In order to create the force required to throw the ball, the body must rotate in a coordinated manner. The elbow flexion and extension required to actually release the ball is a small part of the movements required to generate the force.

Table 2.2 Whole-body movements, joint actions, and dominant planes and axes of motion

## Joint ranges of motion

'Normal' joint range of motion can be a challenge to define because range of motion is based on a combination of factors including:

- The passive range of motion available at a skeletal joint.
- The strength, length and elasticity of the ligaments that hold the bones together in a joint.
- The strength, length and elasticity of the muscles and tendons around a joint.

Despite the challenge, it is important for a skilled professional to understand the typical ranges of motion at each of the major joints in order to observe clients effectively and identify any potential movement limitations that may affect programming.

Joint action	Typical degrees of motion	Joint action	Typical degrees of motion
<b>Shoulder</b>			
Flexion.	160	Extension.	50
Internal rotation.	45	External rotation.	90
Abduction.	180		
<b>Elbow</b>			
Flexion.	160	Extension.	0
<b>Hip</b>			
Flexion.	120	Extension.	0-10
Abduction.	40	Adduction.	15
Internal rotation.	45	External rotation.	45
<b>Knee</b>			
Flexion.	140	Extension.	0
<b>Ankle</b>			
Plantarflexion.	45	Dorsiflexion.	20

Table 2.3 Typical active joint ranges of motion (American Academy of Orthopaedic Surgeons, 1983)

## The benefits and risks of weight-bearing exercise

Weight-bearing exercise is a term used to describe any form of exercise that requires the individual to take the weight of the body during its performance. For example, walking requires the weight of the body to be supported through the lower limbs. In contrast, swimming is non-weight-bearing as the weight of the body is supported by the buoyancy of the water.

The downward gravitational force of the body during weight-bearing exercise has benefits and risks which should be considered when planning and programming training sessions.

The benefits of weight-bearing exercise include:

- Development of increased bone mass.
- Reduction in loss of bone mass.
- Reduction in the risk of osteoporosis as a consequence of improved bone mass.
- Increased viscosity of synovial fluid.
- Increased synovial fluid production.
- Increased nourishment of the cartilaginous structures of a joint, provided by the increased synovial fluid production.
- Increased muscle and connective tissue strength, stability and coordination that may provide some protection against impact/falls/fracture injuries.
- Management and reduction of osteoarthritis symptoms in weight-bearing joints for some individuals.

The risks of weight-bearing exercise include:

- Possible increase in symptoms associated with osteoarthritis in weight-bearing joints for some individuals.
- Increased wear and tear as a consequence of improper loading associated with poor technique or misalignment during weight-bearing exercise.
- Increase in risk of osteoarthritis as a consequence of continued improper loading.
- Increased exposure to musculoskeletal injury due to the nature of the weight-bearing exercise.
- Possible increase in symptoms of rheumatoid arthritis in load-bearing joints, particularly during flare-ups.

As with all forms of exercise, it is important that the benefits and risks are weighed up for each individual client. For example, younger adults who are still developing their bone mass and post-menopausal women who are looking to limit loss of bone mass should engage in regular weight-bearing exercise in order to develop their peak bone mass as much as possible. In contrast, older adults who have osteoporosis (reduced bone mass) and/or sarcopenia (reduced muscle mass) may be at increased risk of injury caused by the increased weight-bearing requirements, falls risk and reduced support offered by weight-bearing exercise. For these individuals, non-weight-bearing exercise might be a better option.

## The myofascial system

### The structure of muscle

Human movement depends on the integrated activity of many systems, but the driving force is the muscular system.

 POINT OF INTEREST	ROOT WORDS
<ul style="list-style-type: none"> <li>• <b>myo</b> = 'muscle'</li> <li>• <b>fascia</b> = 'a sheet or band of connective tissue'</li> </ul>	
Myofascial – relating to the muscle and connective tissue that binds and surrounds muscle.	
<ul style="list-style-type: none"> <li>• <b>epi</b> = 'upon'</li> <li>• <b>peri</b> = 'around'</li> <li>• <b>endo</b> = 'inside'</li> </ul>	
Epimysium – around the muscle.	

A skeletal muscle is made up of many rod-like structures called **muscle fibres**, and these fibres run parallel along its length. Each series of these fibres is constructed from smaller parallel fibres and so on.

Surrounding and protecting muscles are a series of collagen-based membranes. The outermost membrane covers the whole muscle and is called the **epimysium**. Within the epimysium are bundles of muscle fibres called **fasciculi**. Each fascicle has its own outer sheath called a **perimysium**. Within each fascicle, each muscle fibre is separated by its own membranous sheath called the **endomysium**.

Individual muscle fibres are made up of **myofibrils** which contain the contractile proteins (or **myofilaments**) needed for force generation. These myofilaments are **actin** and **myosin**, and they are arranged in compartments, or chain-like lengths, called **sarcomeres**. These are the smallest units of muscle contraction.

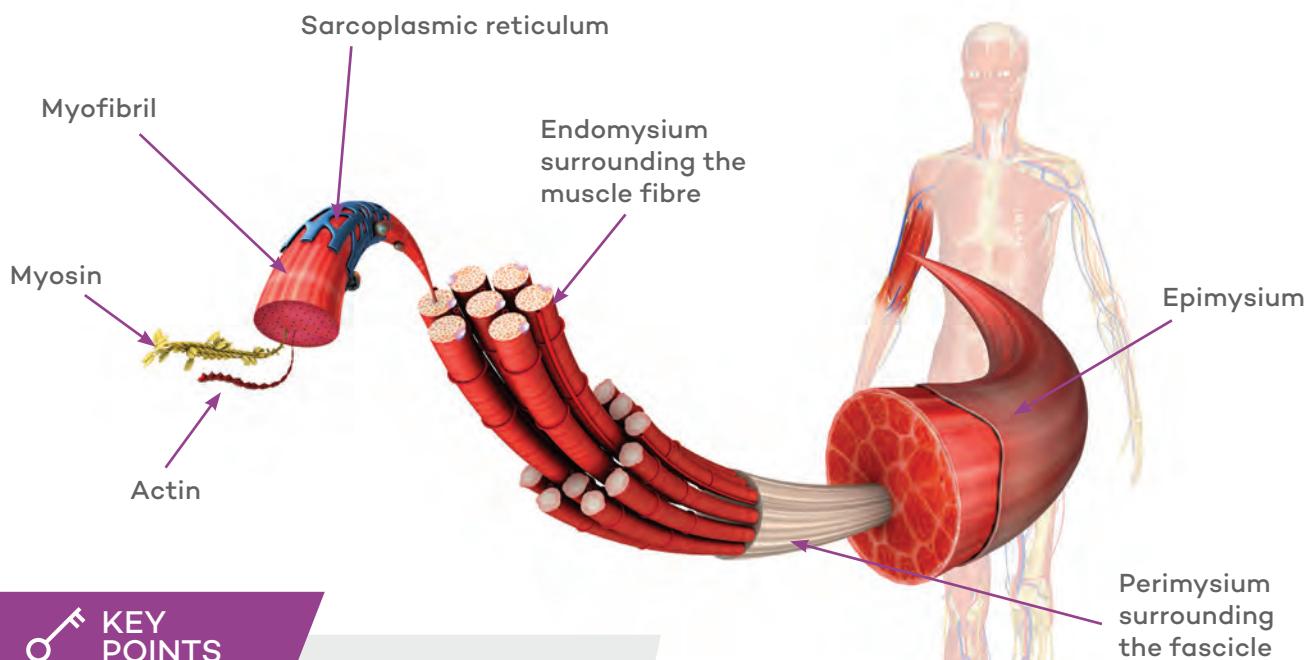
Other key structures in a myofibril include:

- **Sarcoplasmic reticulum** – the network of tubes that store the calcium reservoirs ready for release on demand.
- **Sarcolemma** – the muscle's cell membrane.
- **Sarcoplasm** – the cell fluid of the myofibril/sarcomere (in general circumstances this fluid is called cytoplasm).
- **Troponin** and **tropomyosin** – the molecules that block the binding sites on the actin filament.

The connective tissue/fascial layers are continuous throughout the length of the muscle fibres. They extend beyond the muscle fibres and converge to form tendons. Tendons are strong, inelastic, strap-like structures that attach muscle to the periosteum (tough fibrous layer that coats the bones). Muscular force is transferred from the muscles to the skeleton via tendons in order to generate movement.



Repeated sarcomeres, which appear under a microscope as light and dark bands, are what give skeletal muscles their striated appearance.



### KEY POINTS

- Each muscle is covered in a connective tissue called the epimysium.
- Bundles of muscle fibres called fasciculi are covered by the perimysium.
- Each muscle fibre is surrounded by the endomysium.
- Muscle fibres are made up of myofibrils.
- Myofibrils are segmented into compartments called sarcomeres.
- Each sarcomere contains myofilaments (actin and myosin).

Figure 2.2 The structure of a muscle

## The sliding filament theory and muscle contractions

Muscular contraction begins with the two contractile proteins (or myofilaments): actin and myosin. Actin (the thin filament) is anchored to the ends of the sarcomere and myosin (the thick filament) is located in the middle of the sarcomere.

Spiralling from the myosin filament is a series of ‘hook-like’ projections referred to as the **myosin heads**. During muscular contraction, these heads attach themselves to the actin and rotate, pulling on the filaments. This causes the actin to be drawn inwards, dragging the ends of the sarcomere together. This shortening process is referred to as the **sliding filament mechanism**. The characteristic contraction of muscles is caused by the simultaneous shortening of multiple sarcomeres.

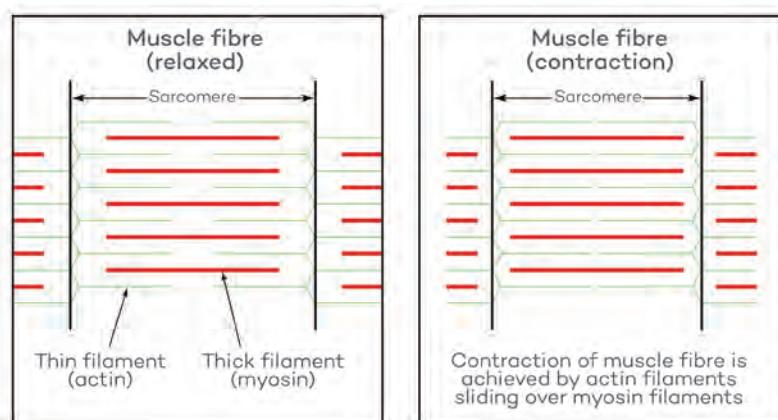


Figure 2.3 The sliding filament theory

## Myosin and ATP

The power to drive the myosin head is provided by **adenosine triphosphate (ATP)**. The ATP molecule primes the myosin by binding with the head. The energy from the ATP is almost immediately transferred to the head, rather like a finger cocking a gun. When the conditions are right, the myosin head will bind with the actin and rotate.

## Actin and calcium

Although the myosin head has been primed with energy from the ATP, it will be unable to bind with the actin without the presence of calcium. In a relaxed state, the myosin binding sites on the actin are blocked by a combination of other molecules (troponin and tropomyosin) that must be moved before myosin can be attached.

The interaction of the myosin heads with the actin is stimulated by input from the nervous system. Surrounding the myofibrils is a network of tubes called the **sarcoplasmic reticulum (SR)** that acts as a calcium reservoir. A muscle action potential travels along the sarcolemma (muscle cell membrane) to produce a nervous system stimulation of the SR, causing the tubes to release their calcium into the fluid surrounding the myosin and actin (sarcoplasm). The calcium causes the blocking molecules to move away from the myosin binding site, allowing the 'primed' myosin head to bind with the actin and rotate in what is referred to as the **power stroke**. At this point, ATP binds to the myosin head, releasing it from the actin binding site; this is called the **re-setting stage**.

### KEY POINTS

- Cocking phase** > The ATP molecule is broken down and primes the myosin head with energy so that once conditions are right the myosin can bind to the actin.
- Binding phase** > The action potential travels along the sarcolemma and stimulates the release of calcium ions from the sarcoplasmic reticulum. The calcium ions cause the troponin and tropomyosin to move away from the myosin-binding sites on the actin. The myosin heads bind with the actin-binding sites.
- Power stroke** > The myosin head rotates, pulling the actin towards the centre of the sarcomere to generate tension/muscle contraction.
- Re-setting** > ATP binds to the myosin head, releasing it from the actin binding site.

## Muscle fibre types

Table 2.4 describes the three different types of muscle fibre, their characteristics and activities which can be used to stimulate or train each fibre type.

Fibre type	Structural features	Functional features	Activities
<b>Slow twitch</b> Also known as: <ul style="list-style-type: none"> <li>• Type I fibres.</li> <li>• Slow oxidative fibres.</li> </ul>	<ul style="list-style-type: none"> <li>• Red in colour.</li> <li>• Have many capillaries.</li> <li>• Have many mitochondria.</li> <li>• Fibre diameter is the smallest.</li> <li>• High myoglobin content.</li> </ul>	<ul style="list-style-type: none"> <li>• Require high levels of oxygen delivery.</li> <li>• Produce low levels of force.</li> <li>• Produce long-term contractions.</li> <li>• Have a high fatigue resistance.</li> <li>• Function aerobically (with oxygen).</li> </ul>	<ul style="list-style-type: none"> <li>• Posture and stabilisation.</li> <li>• Endurance-based activities.</li> <li>• Low-to-moderate-intensity aerobic activities.</li> </ul>

Fibre type	Structural features	Functional features	Activities
<b>Intermediate</b> Also known as: <ul style="list-style-type: none"><li>• Type IIa fibres.</li><li>• Fast oxidative-glycolytic fibres (FOG).</li></ul>	<ul style="list-style-type: none"><li>• Red-pink in colour.</li><li>• Have many capillaries.</li><li>• Have many mitochondria.</li><li>• Fibre diameter is larger than slow twitch and smaller than fast twitch fibres.</li><li>• High myoglobin content.</li></ul>	Can adapt to respond to specific demands – this means they can function as slow or fast twitch depending on the demands placed upon them and the type of training and exercise performed.	
<b>Fast twitch</b> Also known as: <ul style="list-style-type: none"><li>• Type IIb fibres.</li><li>• Fast glycolytic fibres.</li></ul>	<ul style="list-style-type: none"><li>• White (pale) in colour.</li><li>• Have few capillaries.</li><li>• Have few mitochondria.</li><li>• Fibre diameter is the largest.</li><li>• Low myoglobin content.</li></ul>	<ul style="list-style-type: none"><li>• Require low levels of oxygen delivery.</li><li>• Produce high levels of force.</li><li>• Produce short-term contractions.</li><li>• Have a low fatigue resistance.</li><li>• Function anaerobically (without oxygen).</li></ul>	<ul style="list-style-type: none"><li>• Rapid, intense movements.</li><li>• Strength training.</li><li>• Sprinting.</li><li>• High-intensity anaerobic training.</li></ul>

Adapted from Tortora and Derrickson, 2009.

Table 2.4 Muscle fibre types



Myoglobin is similar to haemoglobin in that it is a protein that carries and stores oxygen, but it does this in the muscle (hence the prefix 'myo' as opposed to 'haemo' which means blood).

Type I and type IIb fibres work most effectively at opposite ends of the intensity scale. Type I fibres are the most aerobic in nature and as such they respond best to long-duration endurance activities performed at a lower intensity. Type IIb fibres are anaerobic in nature and they respond best to short bursts of high-intensity exercise with high force and power outputs.

Type IIa fibres, in contrast with the other fibre types, can be trained to take on the characteristics of the other fibre types depending on the training stimulus applied to them.

Table 2.5 explains the effects of different types of exercise on different muscle fibre types.

Exercise type	Effects
Aerobic long slow endurance training.	Type I or IIa fibres adapt by increasing: <ul style="list-style-type: none"><li>• Efficiency and work capacity.</li><li>• Number and size of mitochondria.</li><li>• Diameter size (hypertrophy).</li><li>• Aerobic enzyme levels.</li><li>• Capillary density.</li></ul> Type IIb fibres do not adapt to this type of training.
Anaerobic high-intensity training.	Type IIa and IIb fibres adapt by increasing: <ul style="list-style-type: none"><li>• Anaerobic enzyme levels.</li><li>• Phosphocreatine stores.</li><li>• Diameter size (hypertrophy).</li><li>• Contractile protein density.</li></ul> Type I fibres hypertrophy, but their function does not adapt to this type of training.

Table 2.5 Effects of exercise on muscle fibre types

## Joint musculature

### The shoulder joint and shoulder girdle

The shoulder joint is formed by the articulation of the scapula and humerus. The round head of the humerus interacts with the scapula to form a shallow ball and socket joint, which allows for a generous range of motion and a wide variety of potential joint actions.

Large superficial muscles, such as the pectoralis major, latissimus dorsi and the deltoids, provide the majority of movement at the shoulder joint.

The shoulder girdle consists of the scapula and clavicle.

In order to enable the complex and wide ranges of motion required at the shoulder, the shoulder joint and shoulder girdle must move in concert with one another.

The major muscles to the posterior of the shoulder girdle include the trapezius, rhomboids and levator scapulae muscles. To the anterior are the pectoralis minor and serratus anterior.

Beneath the superficial shoulder musculature is a smaller, more subtle arrangement of four muscles, cumulatively called the **rotator cuff**. Although they are not capable of generating much force, they play a fundamental role in stabilising and controlling movement at the shoulder. The four muscles of the rotator cuff are teres minor, supraspinatus, infraspinatus and subscapularis.

### The spine

The adult spinal column consists of 33 irregular bones which are divided into 5 main regions. When viewed from the side, these regions form distinct curves: the flexed (kyphotic) thoracic and sacrococcygeal curves, and the extended cervical and lumbar (lordotic) curves.

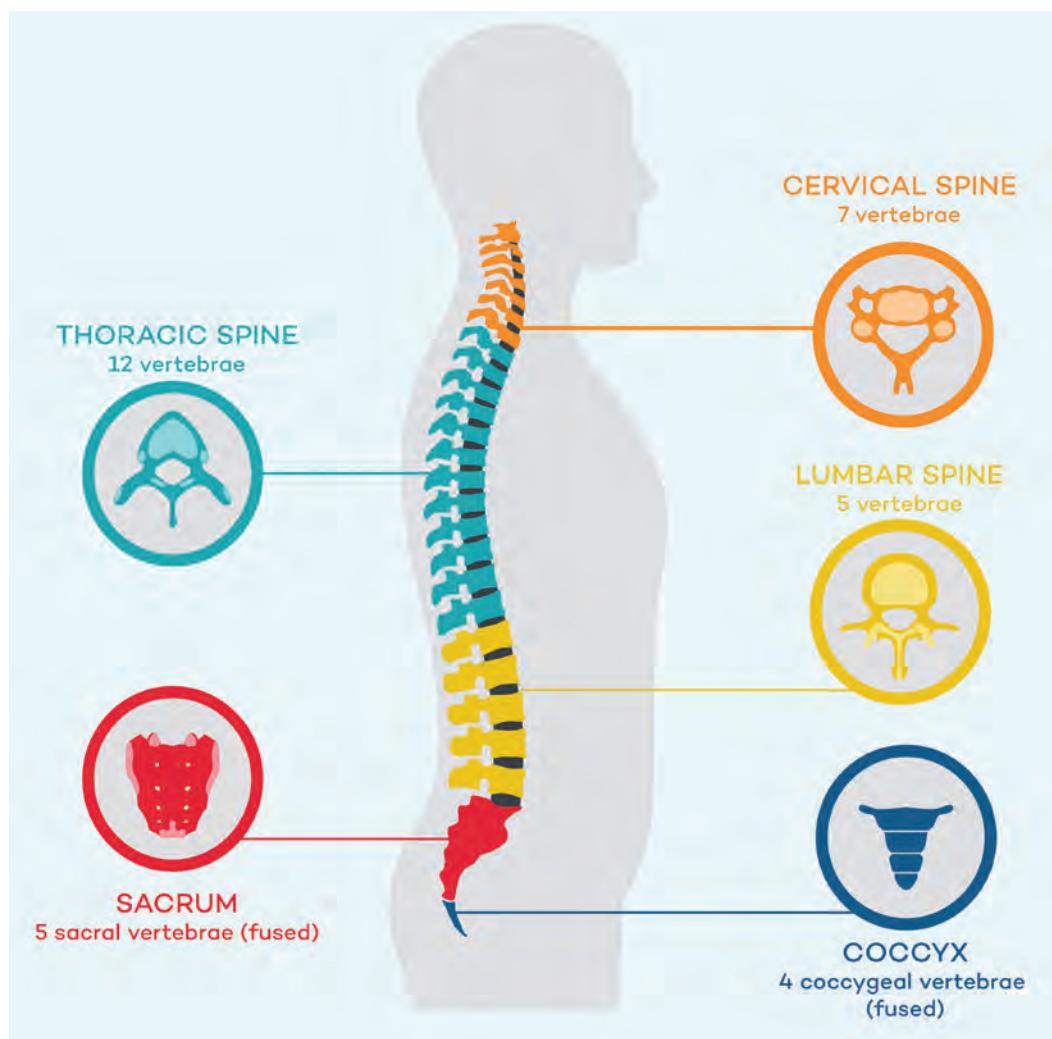


Figure 2.4 The regions of the spine

A typical vertebra consists of a vertebral body, a spinous process and two transverse processes (see Figure 2.5). When vertebrae are stacked on top of one another, they form two main types of joint. To the anterior are cartilaginous joints separated by intervertebral discs (intervertebral joints) and to the posterior are small synovial gliding joints, each with their own synovial capsule (facet joints).

The unique composition of the vertebral column means that, unlike other joints where movement can be isolated to one joint, the joints of the vertebral column work together to enable and limit specific movements. For example, the thoracic and cervical regions allow larger amounts of rotation whilst the lumbar region allows larger amounts of flexion. Considering the movement of the whole spine holistically, substantial ranges of both movements are possible.

The muscles of the trunk, spine or core can be roughly divided into three layers: outer, middle and inner. Each layer has its own focus and responsibility, but it is also important that all the core muscles work and communicate together for effective movement and stability. This integration creates a strong core unit which can support the forces of the limbs in the safest, strongest and most effective manner. If the core musculature does not contract in the right order (deep to outer layers) or the deeper muscles lack the required ability, this can lead to an over-reliance on large, more superficial muscles. Using these muscles to stabilise the trunk can create fatigue or spasms and is a common cause of low back pain.

Failure of the core muscles to function effectively together leaves the spine open to chronic dysfunction, wear and tear or even acute overload and injury.

Gross movement of the spine is mainly achieved by the outer layer of major superficial muscles (outer unit), including rectus abdominis, the external obliques, erector spinae, latissimus dorsi, the gluteals and adductors. Quadratus lumborum lies slightly deeper but assists the more powerful muscles to create movement around the spine and pelvis.

The middle layer of core musculature (inner unit) helps to provide stability and creates intra-abdominal pressure that stabilises the spine during movement. The middle layer muscles include the transversus abdominis (TvA), diaphragm, pelvic floor and multifidus. These muscles co-contract to create a non-compressible cylinder that stabilises the spine to provide a foundation from which limbs can optimally function. The diaphragm and pelvis form the top and bottom of the cylinder, whilst the TvA and multifidus form the cylinder walls.

Research has shown that activation of the inner unit occurs prior to the involvement of the extremities and that faulty recruitment increases the likelihood of low back dysfunction.

Even deeper lies the final layer of three muscles which link single vertebral segments. These muscles predominantly provide proprioceptive feedback about the position of the vertebral segments ('position sense'), however they also assist with segmental stabilisation and fine movements. These muscles are called intertransversarii (between transverse processes), interspinales (between spinous processes) and rotatores (from transverse process to spinous process to sense, create and limit rotation).

### **The hip joint**

The hip joint is a ball and socket joint formed by the articulation of the cup-shaped acetabulum of the pelvis with the head of the femur. The hip socket is much deeper than the shoulder socket because the hip joint needs to be stable and weight-bearing. The shoulder sacrifices stability for increased mobility, whereas the hip joint sacrifices mobility for increased stability.

The musculature of the hip can be roughly divided into those which primarily flex (e.g. the hip flexors and rectus femoris) or extend (e.g. gluteus maximus and hamstrings), and those which adduct (e.g. adductors, pectenae and gracilis) and abduct (e.g. gluteus medius, minimus and tensor fasciae latae), although many of the hip muscles are involved in other movements, especially rotation.

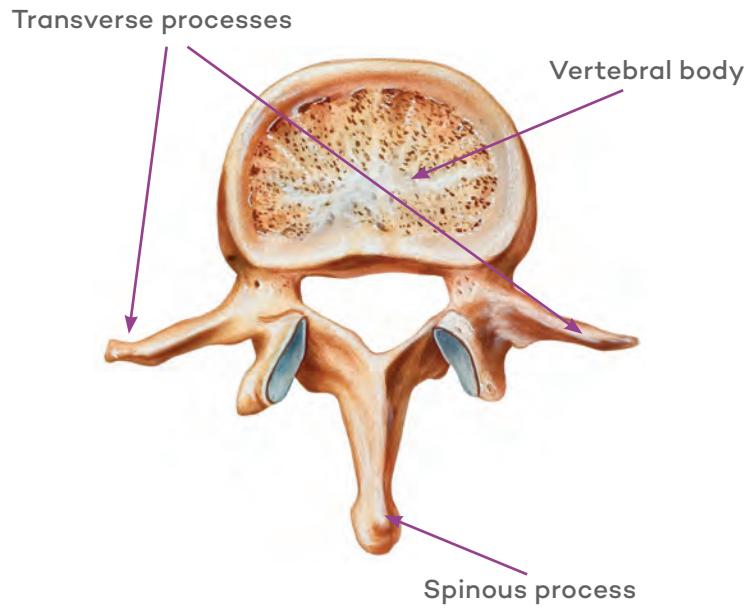


Figure 2.5 A typical vertebra

## The knee joint

The knee joint is a hinge that connects the femur to the tibia. During normal activities, such as walking, running or standing, the knee can tolerate considerable stress. Unfortunately, the knee often lacks the necessary support to avoid damage and is especially susceptible to injuries related to rotational forces, such as those seen in many sporting activities.

The primary movements of the knee joint are flexion and extension. The muscles associated with these movements can be considered flexors (e.g. biceps femoris, semitendinosus and semimembranosus or, collectively, the hamstrings) and extensors (e.g. rectus femoris, vastus intermedius, lateralis and medialis or, collectively, the quadriceps).

## Something extra

Although the knee joint is often thought to only be able to flex and extend, it can actually slightly rotate. This rotation is very slight and is not considered to be a movement capability.

During the final stages of knee extension, the tibia slightly rotates to 'lock' the knee joint into position. As this rotation occurs, the cartilage of the knee acts in a similar way to a car gasket to provide a clean seal between the femur and the tibia – this increases stability and is known as the 'screw home mechanism'.

## The major muscles of the body

### Origins and insertions

Each muscle has a recognisable start and end point.

**Origin:** The unmoving end of a muscle that is attached to a fixed bone/bones. The origin is described as the proximal attachment (i.e. the one nearest to the centre midline of the body) and this is usually the anchor point of the muscle. Muscles may have more than one origin (e.g. the triceps have three origins and the biceps have two).

**Insertion:** The end of a muscle that is attached to the bone that usually moves during a contraction. The insertion is described as the distal attachment (the one furthest from the centre midline). Muscles usually have a single insertion.

### The roles of muscles

Efficient human movement depends on the coordinated activity of whole groups of muscles and involves varying combinations of different muscle actions. In an attempt to distinguish between the diverse roles of muscles during movement, they can be placed into the following categories:

**Agonists/prime movers:** These are the muscles that cause a desired action (e.g. the biceps brachii during a bicep curl).

**Antagonists:** These are the muscles that oppose the agonist. During normal muscle function, the antagonist usually relaxes whilst the agonist contracts (e.g. the triceps during a bicep curl).

**Synergists:** These are the muscles that assist the movement of the prime mover (e.g. the hamstrings act as synergists for the gluteus maximus during hip extension).

**Fixators:** These are the muscles that stabilise the body during a movement (e.g. the abductors and adductors stabilise the hip in the frontal plane during lunging movements).

	Location	Origin	Insertion	Primary concentric actions
Deltoids.	Shoulder.	Clavicle and scapula.	Upper humerus.	Abduction, flexion and extension, horizontal flexion and extension, internal and external rotation of the shoulder joint.
	Teres minor.	Lateral border of scapula.	Upper humerus.	Adduction, external rotation and stabilisation of the shoulder joint.
	Supraspinatus.	Superior surface above the spine of scapula.	Upper humerus.	Abduction and stabilisation of the shoulder joint.
Rotator cuff.	Infraspinatus.	Posterior surface below the spine of scapula.	Upper humerus.	Adduction, horizontal extension, external rotation and stabilisation of the shoulder joint.
	Subscapularis.	Anterior surface of the scapula.	Upper humerus.	Internal rotation, adduction and stabilisation of the shoulder joint.
	Teres major.	Shoulder.	Upper humerus.	Extension, adduction and internal rotation of the shoulder joint.
	Levator scapulae.	Upper back and neck.	Transverse processes of C1-C4.	Superior angle of the scapula.
Biceps brachii.	Front of the upper arm.	Anterior surface of the scapula.	Upper radius.	Elevation of the shoulder girdle, lateral flexion and extension of the neck.
	Back of the upper arm.	Posterior upper humerus and the scapula.	Upper ulna.	Flexion of the elbow, supination of the forearm and flexion of the shoulder.
Triceps brachii.	Sides of the back.	Lower 7 thoracic vertebrae, inferior angle of the scapula, thoracolumbar fascia and the iliac crest.	Anterior upper humerus.	Extension of the elbow, extension and abduction of the shoulder joint.
Latissimus dorsi.	Upper back.	Base of skull, spinous processes of C7-T12.	Lateral clavicle and upper surface of the scapula.	Adduction, extension and internal rotation of the shoulder joint.
Rhomboids.	Major.	Mid back.	Spinous processes of T2-T5.	Elevation, retraction and depression of the shoulder girdle, extension, lateral flexion and rotation of the neck.
	Minor.	Mid back.	Spinous processes of C7-T1.	Medial border and inferior angle of the scapula.
Pectoralis major.	Chest.	Medial clavicle and sternum.	Upper humerus.	Retraction and elevation of the scapula.
				Retraction and elevation of the scapula.
				Flexion, horizontal flexion, adduction and internal rotation of the shoulder joint.

	<b>Location</b>	<b>Origin</b>	<b>Insertion</b>	<b>Primary concentric actions</b>
Pectoralis minor.	Chest.	Anterior surface of 3rd-5th ribs.	Coracoid process of the scapula.	Depression and protraction of the scapula.
Serratus anterior.	Side of the torso.	Surface of upper 8 or 9 ribs.	Anterior surface of medial border of scapula.	Protraction of the scapula.
Erector spinae.	Either side of spine.	Sacrum, ilium, ribs and vertebrae.	Ribs, vertebrae and base of the skull.	Lateral flexion and extension of the spine.
Iliocostalis (3 erector spinae muscles).	Either side of spine.	Sacrum, ilium and posterior surfaces of ribs 1-12.	Posterior surface of ribs 1-12 and transverse processes of the cervical vertebrae.	Lateral flexion and extension of the spine.
Longissimus (3 erector spinae muscles).	Either side of spine.	Transverse processes of the lumbar and thoracic vertebrae.	Ribs and transverse processes of the thoracic and cervical vertebrae and mastoid process.	Lateral flexion and extension of the spine.
Spinalis (3 erector spinae muscles).	Either side of spine.	Spinous processes of the upper lumbar and thoracic vertebrae.	Spinous processes of the upper thoracic and cervical vertebrae.	Lateral flexion and extension of the spine.
Multifidus.	Either side of spine.	Sacrum and transverse processes of lumbar, thoracic and cervical vertebrae.	Spinous processes of 2nd-4th vertebrae above each origin.	Extension and rotation of the spine.
Quadratus lumborum.	Lower back.	Iliac crest.	12th rib and transverse processes of L1-L4.	Lateral flexion and extension of the spine and laterally tilts the pelvis.
Rectus abdominis.	Along the centre of the abdomen.	Pubis.	Cartilage of 5th-7th ribs and base of the sternum.	Flexion and lateral flexion of the spine and posteriorly tilts the pelvis.
Internal obliques.	Sides of the abdomen.	Iliac crest and thoracolumbar fascia.	Lower 3 ribs and the fascial connection to the linea alba.	Rotation and lateral flexion of the spine.

	<b>Location</b>	<b>Origin</b>	<b>Insertion</b>	<b>Primary concentric actions</b>
External obliques.	Sides of the abdomen.	Outer surface of the 6th-12th ribs.	Iliac crest, the pubis and the fascial connection to the linea alba.	Rotation and lateral flexion of the spine.
Transversus abdominis.	Abdomen.	Iliac crest, thoracolumbar fascia and lower 6 ribs.	Pubis and fascial connection to the linea alba.	Compresses and supports the abdominal contents.
Diaphragm.	Beneath ribcage.	Base of the sternum, inner surface of the lower 6 ribs and the upper 3 lumbar vertebrae.	Central tendon of diaphragm.	Draws the central diaphragmatic tendon downwards increasing volume of the thorax.
Intercostals.	Between ribs.	Inferior border of the ribs and costal cartilages.	Superior border of the rib below.	Elevate ribs to aid inspiration and draw ribs down to aid expiration.
Hip flexors.	Iliacus.	Through the pelvis and onto the femur.	Iliac fossa.	Flexion and external rotation of the hip.
	Psoas major.		Transverse processes of T12 –L5.	Lesser trochanter of the femur.
Gluteus maximus.	Bottom.	Coccyx, sacrum and iliac crest.	Upper femur and iliotibial band.	Extension, external rotation and abduction of the hip.
Abductors.	Gluteus medius.	Outside of upper thigh.	Upper lateral surface of the ilium.	Anterior fibres – abduction and internal rotation of the hip. Posterior fibres – extension and external rotation of the hip.
	Gluteus minimus.		Lateral surface of the ilium.	Anterior surface of greater trochanter of the femur.
	Piriformis.	Posterior hip.	Anterior surface of the sacrum.	Superior surface of greater trochanter of the femur.
	Tensor fasciae latae.	Outer thigh.	Anterior iliac crest.	Lateral upper tibia via iliotibial band (ITB).
				Flexion and abduction of the hip.

	Location	Origin	Insertion	Primary concentric actions
Adductors.	Adductor magnus.	The base of the pubis and ischium.	Mid to lower femur.	Adduction, internal rotation and extension of the hip.
	Adductor longus.	Anterior pubis.	Mid femur.	Adduction and internal rotation of the hip.
	Adductor brevis.	Anterior pubis.	Upper femur.	Adduction and internal rotation of the hip.
	Pectenous.	Anterior, superior pubis.	Posterior, upper femur.	Adduction and flexion of the hip.
	Gracilis.	Anterior, inferior pubis.	Medial, upper tibia.	Adduction and internal rotation of the hip and flexion of the knee.
	Sartorius.	Front and inner thigh.	Anterior superior iliac spine (ASIS).	Flexion, abduction and external rotation of the hip, flexion and internal rotation of the knee.
Quadriceps.	Rectus femoris.	Anterior inferior iliac spine (AIIS).	Anterior, upper tibia via the patella.	Flexion of the hip and extension of the knee.
	Vastus lateralis.	Greater trochanter and lateral surface of the femur.	Anterior, upper tibia via the patella.	Extension of the knee.
	Vastus intermedius.	Anterior and lateral surface of the femur.	Anterior, upper tibia via the patella.	Extension of the knee.
	Vastus medialis.	Medial surface of the femur.	Anterior, upper tibia via the patella.	Extension of the knee (especially last 20° motion).
Hamstrings.	Biceps femoris.	Ischium and posterior surface of the femur.	Head of the fibula.	Extension and external rotation of the hip and flexion of the knee.
	Semitendinosus.	Ischium.	Upper, medial surface of the tibia.	Extension of the hip, flexion of the knee and tilts the pelvis posteriorly.
	Semimembranosus.	Ischium.	Upper, medial surface of the tibia.	Extension of the hip, flexion of the knee and tilts the pelvis posteriorly.
Gastrocnemius.	Calf.	Posterior, lower femur.	Calcaneus.	Plantarflexion of the ankle and flexion of the knee.
Soleus.	Calf.	Upper, posterior tibia.	Calcaneus.	Plantarflexion of the ankle.
Tibialis anterior.	Front of lower leg.	Lateral, upper tibia.	1st metatarsal and medial tarsal.	Dorsiflexion and inversion of the ankle.

Table 2.6 Muscle locations, origins, insertions and actions


**KEY POINT**

The roles that muscles play in certain movements can vary depending on other compound movements that are occurring and the specific function or dysfunction of an individual. Only common roles are displayed in Table 2.6 (e.g. prime mover, fixator or synergist).

For example, the hamstrings may act as synergists during hip extension when the gluteus maximus is the prime mover. But when hip extension is combined with knee flexion, the hamstrings are required to act as prime movers at the knees, therefore their role as synergists for hip extension may be limited and the erector spinae may have to increase its synergistic role. In contrast, when the gluteus maximus is not functioning appropriately as a prime mover, the hamstrings and erector spinae can take over as the prime movers for hip extension.

This potential for role change, and that this could be functional or dysfunctional in certain circumstances, is an essential concept for the skilled professional to understand.

## Delayed onset muscle soreness (DOMS)

Delayed onset muscle soreness (DOMS) is the term used to describe the aches and pains felt in muscles after exercise. DOMS usually occurs 24-72 hours after exercise. The specific physiological cause of DOMS is unclear, although theories suggest that it may be a combination of one or more of the following:

- Muscle spasm.
- Micro-tears in connective tissue or muscle.
- Inflammation.
- An influx of enzymes into the fatigued area.

What does appear to be clear is that DOMS is much more likely to occur after unfamiliar exercise or exercise which includes a significant amount of eccentric loading or large increases in intensity.

Symptoms of DOMS can include:

- Mild to severe muscle soreness and pain.
- Loss of mobility in the local area.
- Muscle tension.
- Some muscle spasms or inflammation, although this is likely to be less severe than it would be if a mild injury had occurred.

Various recovery strategies have been researched, and they show different levels of success. No strategy has been shown to aid recovery from DOMS consistently in a range of circumstances. The recovery strategies that are thought to have a positive effect on DOMS in some circumstances include:

- Cold treatment.
- Heat treatment.
- Massage.

Since the effectiveness of recovery strategies has proven to be limited and inconsistent, it may be more appropriate to try to prevent the occurrence of DOMS in the first place. Again, these strategies have demonstrated limited success. It also appears that some people are more likely to experience DOMS than others. General guidance, however, recommends the following to try to limit the onset:

- Carry out cool-down and stretching activities at the end of every exercise session.
- Rest or reduce the intensity of any exercise for the sore body part for one to two days following a workout that may cause DOMS.
- Progress exercise gradually.
- Gradually introduce unfamiliar exercises into a programme.

## Connective tissue

Connective tissue can be defined as any tissue which supports, binds or protects organs or body parts. Using this definition, muscle, bone and blood are all categorised as connective tissue.

The connective tissue of the myofascial system is usually defined as tissue which connects, binds or supports joints and musculature. Using this definition, connective tissue includes:

- Tendons.
- Ligaments.
- Cartilage.

Myofascial connective tissue (tendons, ligaments and cartilage) is mainly made up of collagen fibres combined with a smaller proportion of elastin fibres. Collagen fibres provide a tough structure because they effectively resist stretch. Elastin fibres provide the elasticity of a structure, allowing a tissue to stretch and expand before returning to its original shape.

Connective tissue which must maintain its shape and withstand compressive forces (e.g. fibrocartilage) has high levels of collagen fibres and relatively few elastin fibres. Connective tissue which needs to be able to stretch and expand (e.g. artery walls, epiglottis and some highly flexible ligaments) contains higher proportional levels of elastin.

### Tendons

Tendons attach muscle to bone across a joint and transmit the force produced by the muscle. They are made of tough, inelastic connective tissue comprised of bundles of **collagen fibres**; these give tendons their shiny white appearance. Tendons emerge from the connective tissue of muscles and stretch past the muscle fibres to attach into the periosteum of bone. For example, the Achilles tendon attaches the calf muscles to the heel bone and the quadriceps tendon crosses the knee joint and attaches to the tibia.

Tendons are usually thought of as thin strap- or cord-like structures (e.g. the Achilles tendon), but they can also form flatter sheets. In these circumstances, a tendon may be called a **fascia** or an **aponeurosis**. One example of a fascia is the thoracolumbar fascia in the lumbar spine, which is an attachment for the large latissimus dorsi muscle. Aponeuroses tend to be smaller than fascia, and the most notable are those found in the palms of the hands and soles of the feet.

### Ligaments

Ligaments are made of tough collagen combined with variable amounts of elastin; together they create a fibrous tissue which is strung together in a cord- or strap-like formation. The extensibility of a ligament depends on the amount of elastin contained within the fibres. Ligaments are extremely strong and can withstand a lot of tension, mainly due to the orderly parallel formation of their collagen fibres. However, prolonged tension or repetitive incorrect movement patterns causing excessive stretching can permanently damage the fibres.

Ligaments can be an integrated part of a joint capsule (capsular) or they can be separate, providing additional joint stability without the integration (extracapsular).

Ligaments have four main functions within the body:

- Attaching and connecting bone to bone in all joints.
- Enhancing joint stability.
- Guiding joint motion and alignment.
- Preventing excessive or unwanted motion in the joint.

### Cartilage

**Cartilage** is a dense, durable and tough fibrous connective tissue that is able to withstand compression forces. The two major components of cartilage are collagen (tough fibres) and elastin (stretchy fibres). There are three types of cartilage found in the body, each fulfilling a separate function:

- **Hyaline cartilage** is the tissue that forms the temporary skeleton of the foetus, which is eventually replaced by bone when calcium is deposited during foetal and childhood development. It is found at the ends of the long bones that meet to form the synovial joints. Hyaline cartilage has a high proportion of collagen fibres to provide strength and structure.
- **Fibrocartilage** is thicker and stronger and has limited distribution within the body. It forms various shapes according to its role. It acts like a shock absorber in cartilaginous joints and is made up of mostly collagen fibres.
- **Elastic cartilage** is similar to hyaline cartilage, although it has more fibres and most of these are made up of elastin as opposed to collagen. Elastic cartilage has the ability to return to its original shape. It is found in the tubes of the ear and the epiglottis and larynx in the throat; these are all places that require maintenance of a specific shape.



### POINT OF INTEREST

Blood supply is one of the major factors in the healing process of any injury. Bone and muscle tissue often heal fairly easily and quickly because they have a healthy blood supply.

Ligaments, tendons and cartilage have a poor blood supply, which limits their healing potential.

Cartilage has a particularly low nutrient supply and relies on the nourishment provided by synovial fluid. For this reason, it is common for fibrocartilage to require surgical removal if it becomes torn.

## Posture, dysfunction, injury and the function of the musculoskeletal system

In order to move efficiently and effectively, the systems of the body must work together in a coordinated manner. Although all systems can have some influence, three key systems directly affect movement:

- Nervous system.
- Skeletal system.
- Muscular system.

The nervous system must ensure that the directions given for voluntary movement patterns are precise, clear and coordinated in order to initiate the appropriate muscle contractions.

The muscular system must be able to receive the nervous stimulation and contract the right muscles in the right order, using the right contractions at the right time and with the right force to pull the levers of the skeletal system in an effective manner.

The skeletal system must allow the appropriate movements to enable efficient joint movements.

If one of these systems fails to function efficiently and effectively, it will directly affect each of the other systems and the quality, effectiveness or efficiency of movement will be reduced.

### For example

- If the abdominal and spinal stabilising muscles contract late, or ineffectively, when core stabilisation is required, the skeleton will be placed under increased stress. Other movement-focussed muscles which are more efficient at producing force will then be required to take the strain and compensate for the inefficient stabilisation. The movement muscles, that consist of higher proportions of type II muscle fibres, are then more likely to fatigue as the demands placed upon them require endurance. This can result in a lack of movement quality at the beginning of the exercise as the stabilisers have not yet 'kicked in' and a lack of movement quality at the end of the exercise as the movement muscles fatigue.
- If the knee joint is misaligned and the patella is not able to move easily along the appropriate groove, then the knee's range of motion will be limited by mechanical restrictions and potentially by pain and discomfort.
- If the muscles around the knee create an excessive inward pull during a squat exercise, the knee joint will be placed under excessive stress each time this exercise is repeated. Over time this may lead to damage and injury.

## Posture

Whether statically or dynamically standing, sitting or lying, each joint and area of the body has an optimal (or neutral) position where the least stress is placed on the joints and the rest of the body. This is termed 'neutral' or 'optimal' posture.

Wherever possible, optimal posture should be maintained throughout all movements, however as the human body adapts to the demands placed on it, there are many factors which can influence posture in the short and long term. These include occupation, body weight, height, lifestyle, activity habits and any degenerative disease or previous injury.

For example, an individual who spends a significant amount of their day sitting at a desk may begin to adapt to the seated position. Commonly observed postures in individuals who spend much of their day sitting include:

- Forward-poking head.
- Thoracic hyperkyphosis (rounded, protracted shoulders).
- Elevated shoulders.
- Adapted hip and pelvic positions that mimic a slouched sitting position and may appear as a posterior pelvic tilt (due to shortened hamstrings) or an anterior pelvic tilt (due to shortened hip flexors).

Individuals with upper body postural dysfunction also generally exhibit limited thoracic rotation and extension which restricts the mobility of the arms and the ability to reach overhead. This in turn increases the risk of shoulder injury. These postures also restrict movement in the ribcage, which can impair ventilation and breathing mechanics.

Abdominal obesity tends to shift the centre of gravity forwards, which can increase the chance of developing an excessive lumbar curve (lumbar hyperlordosis).

Postural distortions lead to faulty loading patterns which increase strain on the related structures. This changes the way the muscles are able to work together to produce force and stabilise to prevent unwanted movement. As a result, this could create further adaptations and distortions cumulatively affecting an individual's ability to function, including in the following ways:

- Altered length-tension relationships between the agonist and antagonist (muscle shortening and muscle weakness).
- Altered joint stress as joint movement becomes dysfunctional.
- Altered sensory input and motor output.
- Long-term aches, pains and increased likelihood of injury due to the reduced efficiency of movement and increased stress.



### KEY POINT

Muscles are thought to have an optimal length-tension relationship. This is the relationship between the length of a muscle and the force that fibres can produce at that length.

When a muscle fibre is stretched or shortened, the overlap of actin and myosin is affected. If there is too much, or too little, overlap it limits the amount of force a contraction of the fibre can produce.

When a muscle is in an optimal position with an optimal length-tension relationship, there will be an optimal overlap of actin and myosin and therefore a maximal force can be produced.

## Common postural distortions

**Kyphosis** refers to the outward curve of the thoracic spine.

**Lordosis** refers to the inward curve of the lumbar spine.

These terms are often used to describe excessive curvature, but normal curvature of the thoracic region is kyphotic in nature and normal curvature of the lumbar region is lordotic. For this reason, the following terms can be used to distinguish dysfunction:

- **Hyperkyphosis** – an excessive curve of the thoracic spine.
- **Hypokyphosis** – a flattened curve of the thoracic spine.
- **Hyperlordosis** – an excessive curve of the lumbar spine, also known as a ‘hollow back’.
- **Hypolordosis** – a flattened curve of the lumbar spine.

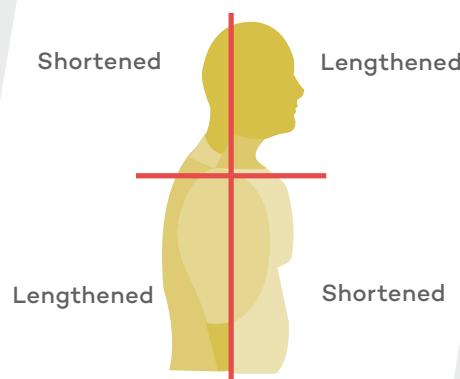
The term **scoliosis** is of Greek origin and means ‘crooked’ or ‘bent’. A scoliotic spine has an excessive lateral curvature.

### Upper crossed syndrome

Upper crossed syndrome refers to a hyperkyphotic spinal position combined with protracted shoulders and a forward-poking head. The shortened and lengthened areas caused by this syndrome can be divided by a cross shape (see Figure 2.6), which is where this condition gets its name.

#### Shortened/dominant/overactive muscles

- Scalenus
- Sternocleidomastoid
- Upper trapezius
- Levator scapula
- Pectoralis major
- Anterior deltoids
- Latissimus dorsi
- Teres major
- Subscapularis
- Pectoralis minor



#### Lengthened/inhibited/underactive muscles

- Deep neck flexors (longus capitis and colli)
- Serratus anterior
- Lower trapezius
- Middle trapezius
- Teres minor
- Infraspinatus
- Supraspinatus
- Thoracic erector spinae

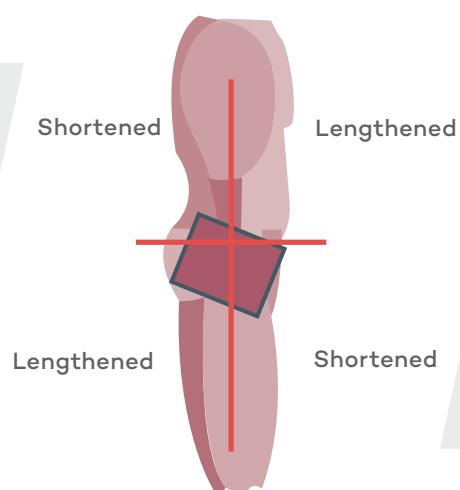
Figure 2.6 Upper crossed syndrome

### Lower crossed syndrome

The shortened and lengthened regions caused by lower crossed syndrome can again be divided by a cross shape. This condition is characterised by an anterior pelvic tilt and hyperlordosis (see Figure 2.7).

#### Shortened/dominant/overactive muscles

- Iliopsoas
- Lumbar erector spinae
- Rectus femoris
- Adductors
- Tensor fasciae latae
- Quadratus lumborum
- Lumbar multifidus



#### Lengthened/inhibited/underactive muscles

- Rectus abdominis
- Obliques
- Transversus abdominis
- Gluteus maximus
- Gluteus medius
- Gluteus minimus

Figure 2.7 Lower crossed syndrome

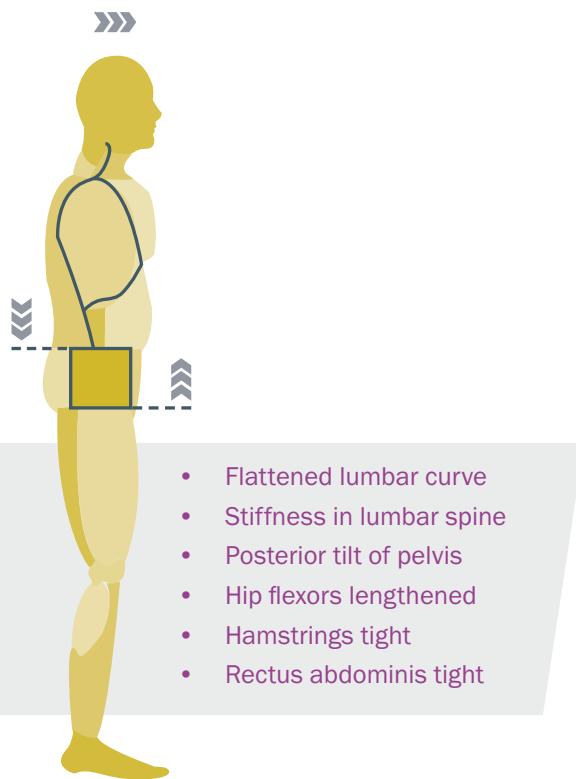


Figure 2.8 Flat back

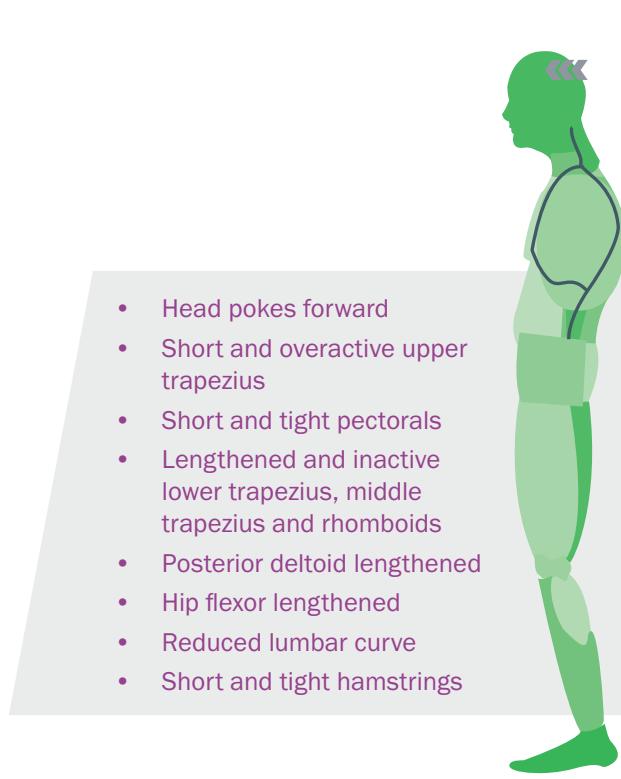


Figure 2.9 Sway back

### **Flat back posture**

Flat back posture can be identified by distinctive hypolordosis (see Figure 2.8). This posture is often associated with a loss of flexibility and mobility in the lumbar spine and is a common consequence of painful movement avoidance.

### **Sway back posture**

This posture appears as though the upper body has slumped down and forwards from the waist (see Figure 2.9). It is actually a flattened lumbar curve combined with a posterior lean of the lower thoracic vertebrae leading to a hyperkyphotic posture in the upper back. The lower back then posteriorly tilts to compensate, often accompanied by hyperextended knees that bear the stress of the anterior slump.

### **Slumped posture**

Slumped posture is a combination of hyperkyphosis and hypolordosis; the secondary curves of the spine are diminished, almost as if the posture is trying to return to the foetal position. This type of posture is most often seen in a sitting position, but it is just as easily transferred into standing (see Figure 2.10). The characteristics of a slumped posture include the almost visual lack of tone in the musculature as the body attempts to relax the muscles and allow the skeletal system to take the strain.

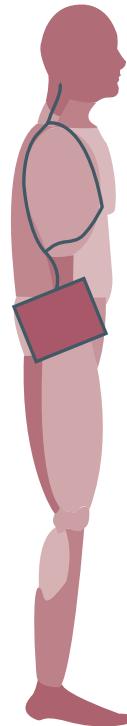


Figure 2.10 Slumped

## Common injury risk

During consultations and sessions, skilled professionals will be presented with various levels of information relating to past and present injuries, signs and symptoms. This is why it is essential that a skilled professional has a good knowledge of the signs and symptoms of common injuries, whilst understanding how to maintain professional boundaries. Professionals with no specialist medical training must not try to diagnose a condition, but if they're presented with a current concern, they must be prepared to refer to an appropriate medical professional who can investigate, diagnose and treat as required.

Although a skilled professional cannot diagnose a current injury, they can use their knowledge and understanding of injuries, signs and symptoms to inform effective exercise programming and planning. Through an understanding of the movements which place the most stress on involved structures and the activities which are likely to increase the risk of injury, a skilled professional can help to:

- Prevent injury in the first place by developing strengths and weaknesses and addressing any movement dysfunctions early in a training programme. For example, if a client's knees cave in during squats, their trainer can include static developmental adductor stretches in each workout to try and limit this movement dysfunction.
- Return the body to normal function following an injury (once medical guidance advises a return to exercise). For example, a client who experienced an ankle sprain in their history may benefit from balance training to build the stabilisation at the ankle, therefore reducing the risk of future ankle sprains.
- Reduce the likelihood of scenarios where the risk of injury is significantly increased. For example, if a footballer is at increased risk of a cruciate ligament injury due to the agility requirements of their sport, their trainer can add activities to increase controlled agility to their programme.

### Muscle and tendon strains

A muscular or tendinous strain occurs when a muscle or tendon is excessively overloaded or stretched, causing a tear.

Strains are very common, particularly in an active sporting environment due to the explosive and uncontrolled nature of movements that can be a challenge to stabilise. Damage often occurs at the musculotendinous junction (where the tendon extends from the muscle) and can vary in severity depending on the quantity of fibres involved and the degree of damage.

Common muscle and tendon strains include:

- **Ruptured Achilles tendon** – The complete tearing of the Achilles tendon that connects the gastrocnemius to the heel bone. It is common for an Achilles tendon rupture to occur with no specific cause, although it is thought that movements which apply excessive force or stretch (e.g. excessive plantarflexion or dorsiflexion at explosive, high speeds) may contribute.

### Ligament sprains

A sprain is usually caused by unnatural joint movements or impact which causes overstretching and tearing of the ligament (e.g. excessive rotation of the knee or an impact which pushes the knee into excessive adduction or abduction).

Common ligament sprains include:

- **Inversion or eversion sprains** – Damage caused to the lateral and/or medial ankle ligaments, often caused by ankle instability that allows excessive inversion or eversion.
- **Medial or lateral collateral ligament sprains** – These injuries are caused by excessive adduction or abduction at the knee joint. These sprains usually occur as a consequence of an impact, but joint instability may also cause an injury to these structures.
- **Anterior or posterior cruciate ligament sprains** – These injuries are often caused by uncontrolled, explosive changes in direction that apply excessive force to the passive ligaments holding the tibia and femur together.

## Tendinopathies

In the past, the generic term for tendon injuries was tendinitis (e.g. Achilles tendinitis), but in recent years this term has been replaced by **tendinopathy**. Tendinopathy is used to describe a range of tendon conditions, including overuse, tears, micro-tears and degeneration. Although the root word 'pathy' describes non-inflammatory conditions, tendinopathy is used even when the inflammatory process has been initiated in a tendinous structure. The preferred use of tendinopathy as the generic term is probably due to the reduced blood flow in tendinous structures, so the likelihood of any inflammation (as is characteristic of tendinitis) is reduced.

Tendon injuries are one of the most common types of injury and are often caused by repetitive overuse or overstretching. Tendons are designed to be able to stretch and recoil with the actions of muscles; however, they do have 'elastic limits' (the point at which a flexible structure cannot stretch any further and is likely to rupture).

Common tendinopathies include tendinitis, tendinosis and tenosynovitis. These can all vary in severity and are likely to be caused by chronic repetition of poor exercise technique or chronic joint misalignment.

Common tendinopathies include:

- **Golfer's and tennis elbow** (medial and lateral epicondylitis respectively) – These injuries are often caused by chronic repetition of eccentric lengthening of the forearm muscles during the swing, contact and follow-through phases of movement. This can lead to inflammation and damage to the tendons that attach to the elbow.
- **Runner's knee** – Also known as iliotibial band (ITB) syndrome, the inflammation and pain is caused by the constant rubbing of the ITB over the distal femur. If the knees tend to adduct and internally rotate as well, this rubbing can be exaggerated further.

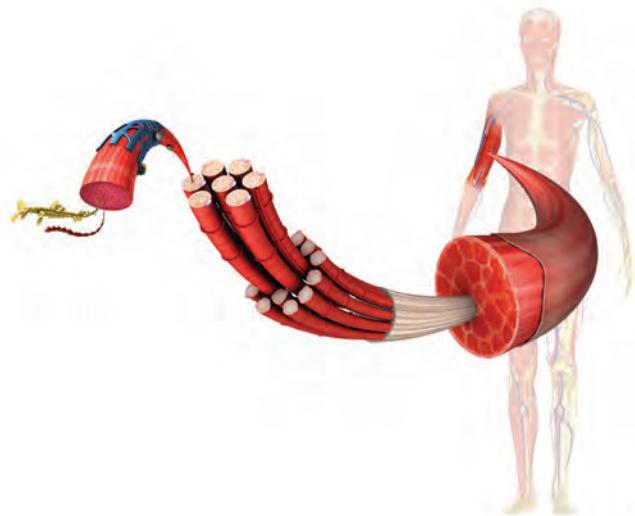
## Other common injuries

- **Frozen shoulder** – Also known as shoulder impingement or adhesive capsulitis. Symptoms include pain and limited range of motion in the shoulder. The causes of this condition are usually chronic, develop over a period of time and can include activities and movements which lead to a reduction in the space between the head of the humerus and the scapula (e.g. hyperkyphosis caused by excessive and imbalanced training of the pectorals).
- **Cervicalgia and lumbago** – These are the medical terms given to general, non-specified neck pain and low back pain respectively. These conditions can be caused by multiple factors, but chronic poor posture or exercise technique can increase the stress applied to these areas.
- **Disc herniation** – When an intervertebral disc is compressed, it is designed to flatten and stiffen to resist the force. In some cases a disc can bulge and be pinched by the surrounding vertebrae, causing pain. In extreme cases the nucleus of the disc can be forced out from the inner aspect of the disc during the bulge, which causes the disc to herniate or prolapse. An individual with a herniated disc is likely to experience significant physical impairment and neurological symptoms (e.g. sciatica).
- **Sciatica** – This is the medical term for referred pain from the spine that travels down the leg. This could be caused by a specific or non-specific low back condition.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Move each of your joints to identify the possible movements and the planes and axes of motion for each movement.
- Observe another individual moving each joint to identify their active range of motion at each joint. Compare the results with the norms table (Table 2.3) on page 17.
- Make a list of the benefits and risks of weight-bearing exercise, and identify the types of clients who may benefit from the introduction of weight-bearing or non-weight-bearing exercise methods to their programmes.
- Label the diagram to identify each of the structures of muscle.
- In your own words, describe the sliding filament theory and the physiological processes which make up the sliding filament mechanism.
- Make a list of the characteristics of the three types of muscle fibre and identify activities that can be used to train each fibre type.
- Identify the muscles which cross each major joint and describe their origins, insertions and actions.
- Describe DOMS in your own words, including the possible causes and the actions which may help to reduce or prevent the onset.
- Describe the structure and function of each type of myofascial connective tissue.
- Demonstrate neutral posture and make a list of key technique points that may help a client to adopt the optimal position.
- Demonstrate each of the common postural distortions and work out which muscles are shortened and lengthened in each position.
- In your own words, describe common injuries and any movements which may increase the risk of injury or may need addressing post-rehabilitation.



# Section 3: The nervous system

The nervous system is responsible for sending, receiving and processing nerve impulses throughout the body.

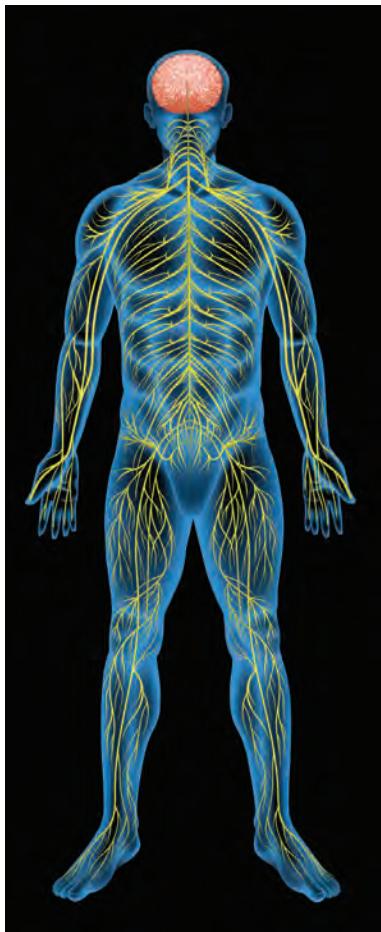
At its simplest level, the nervous system is a communication network, and this network can be broken down into three basic functional elements:



- **Sensation** – The nervous system gathers information from the environment. There are a vast array of sensors spread throughout the body which continually gather information about the internal environment (e.g. blood CO<sub>2</sub> levels) and the external environment (e.g. air temperature).
- **Integration** – The central nervous system deciphers the received information and interprets it in order to decide on the appropriate response (these ‘decisions’ are voluntary or automated).
- **Response** – The nervous system is responsible for initiating the appropriate response (e.g. muscular contraction or glandular secretion).

The nervous system is made up of a network of neurons (nerves) and works with other systems to coordinate the necessary functions. There are millions of neurons throughout the human body and they connect to the spinal cord and the brain, which is where the body processes the impulses and initiates the appropriate reaction.

## Components of the nervous system



There are two major divisions of the nervous system: the central nervous system (CNS) and the peripheral nervous system (PNS).

The CNS consists of the brain and spinal cord. All the other neural elements (many of which are branches of nerves outside the spinal cord) make up the PNS.

### Central nervous system (CNS)

The central nervous system is the control base for the whole nervous system. It consists of the brain and the spinal cord which are surrounded by three membranes called **meninges**. A clear watery fluid called **cerebrospinal fluid** is found between these membranes; its role is to protect, cushion and help to maintain the homeostasis of the CNS.



Homeostasis – the process used by the body to maintain a stable internal environment.

The largest part of the brain, the **cerebrum**, is divided into two hemispheres. The cerebrum is responsible for mental activities, sensory perception (e.g. pain, touch and sight), and control and initiation of voluntary muscle contraction.

The lower, smaller part of the brain is the **cerebellum** which is also divided into two hemispheres. The cerebellum acts as a memory bank for learnt skills and is mainly responsible for the coordinated actions of muscle groups.

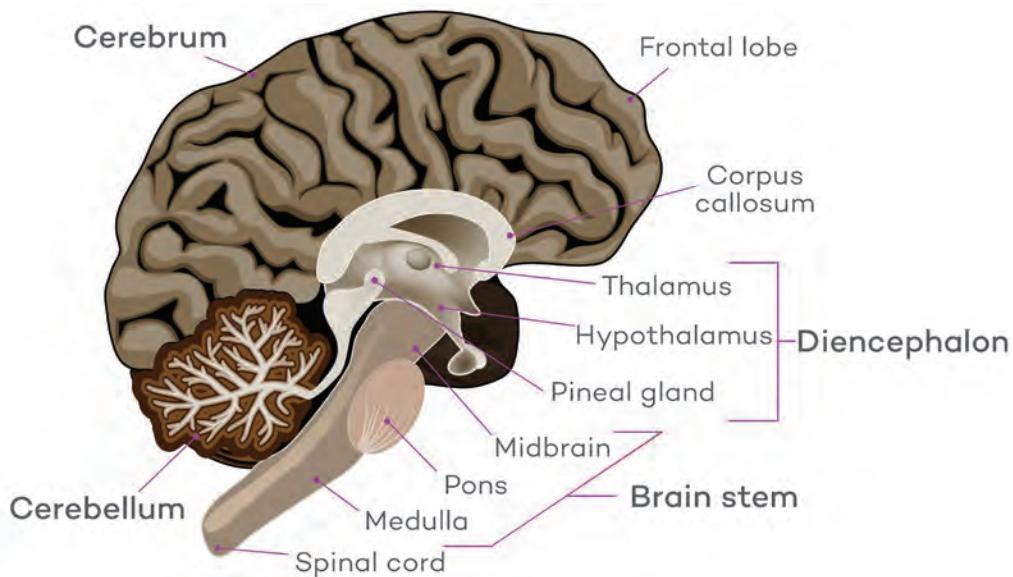


Figure 3.1 The brain

The spinal cord is the communication link between the brain and the PNS. It can also integrate information in some circumstances, in order to produce reflexive responses without input from the brain.

The neurons of the CNS are called **interneurons**. This category of neurons includes the spinal cord and nerves of the brain itself. Interneurons pass signals from one neuron to another.

## Peripheral nervous system (PNS)

The PNS connects the CNS with all the tissues of the body. Peripheral nerves are divided into sensory neurons and motor neurons.

**Sensory neurons (afferter neurons)** carry messages to the CNS from the sensory receptors. The CNS will use this valuable information to decide on the best course of action.

**Sensory receptors** are spread throughout the body and provide feedback on the internal and external environments.

**Motor neurons (effector neurons)** transmit impulses from the CNS to organs, muscles and glands. This will cause an action to occur (e.g. a muscle contraction or hormone secretion).

Emerging from the spinal cord, the first branches of the PNS contain both sensory and motor neurons and include 12 pairs of cranial nerves and 31 pairs of spinal nerves.

## Subdivisions of the PNS

There are two divisions of the PNS:

- The **somatic** nervous system controls the voluntary, conscious movement of the skeletal muscles (e.g. standing, walking or lifting a weight).
- The **autonomic** nervous system controls the involuntary systems of the body (e.g. the heart, digestive system and endocrine glands) and therefore controls the unconscious regulation of homeostasis. This system also has two further subdivisions:
  - **Sympathetic:** also known as the ‘war’ or ‘fight or flight’ system as it is responsible for speeding up internal processes in preparation for activity.
  - **Parasympathetic:** also known as the ‘peace’ or ‘rest and digest’ system as it is responsible for slowing down internal processes to rest and recover.

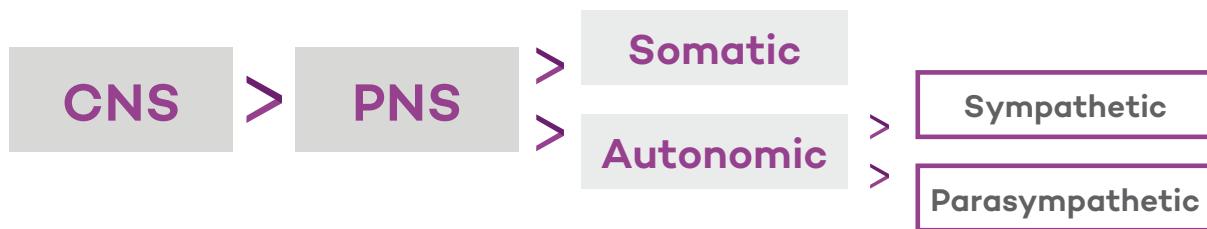


Figure 3.2 Subdivisions of the PNS

## The structure and function of a neuron

Nerve cells (or neurons) are responsible for transmitting electrical messages, essentially behaving like a cable or wire. The distance travelled by the signal can be short (e.g. from one part of the CNS to another) or relatively long (e.g. from the bottom of the feet to the lumbar region). Nevertheless, all neurons possess the same fundamental anatomical features (see Figure 3.3).

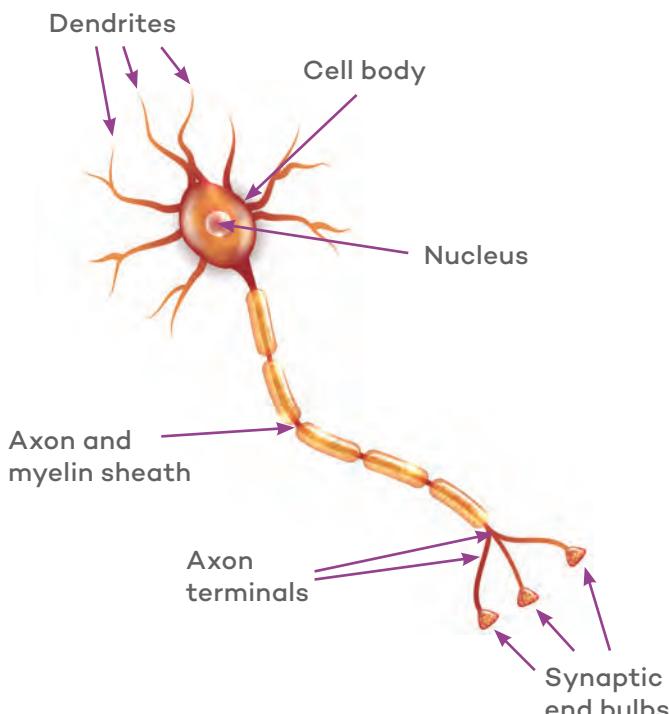


Figure 3.3 A neuron

**Dendrites** – These small, branch-like projections carry incoming action potentials; they allow the neuron to communicate with other cells or perceive the environment. They can be found on one or both ends of a nerve cell, and it is dendrites that actually ‘sense’ the stimulus (e.g. heat, cold, pain, pressure or touch).

**Cell body (soma)** – This regulates cell activity and contains all the necessary components of the cell, including the nucleus (which contains DNA), endoplasmic reticulum and ribosomes (for building proteins) and mitochondria (for making energy). If the cell body dies, the neuron dies.

**Axon** – This long, cable-like projection transmits action potentials by carrying electrochemical messages (nerve impulses) along the length of the cell. Axons within peripheral sensory and motor neurons are covered with a thin, insulating layer called a **myelin sheath** (like the rubber casing that insulates an electrical wire). This insulating layer helps to speed up the action potential as it travels along the axon. At the end of the axon is the **axon terminal**; this is the interface between the neuron and other cells (such as other neurons or muscle cells). Embedded right at the end of axon terminals are **synaptic end bulbs** which is where the neurotransmitter (the substance that transmits the action potential to the next structure) is released.

## Transmission of action potentials

The term **action potential** describes the wave of electrical activity that passes along electrically excitable cells, such as those found in nerves and muscles.

An action potential travels from the dendrites, through the nucleus, down the axon and into the axon terminal. The synaptic end bulbs release the neurotransmitter (which in muscles is acetylcholine (ACh)) into the synaptic cleft or gap. The ACh then diffuses across the space between the axon terminals and the muscle cell membrane. It binds with specialised receptors on the muscle membrane, which in turn triggers a muscle action potential. This activates the process that leads to the sliding filament mechanism and muscle contraction.

## Motor units and their recruitment

A motor unit is made up of one motor neuron and all the muscle fibres it stimulates. In order for a contraction to occur, the stimulus needs to be strong enough to trigger an action potential. If the action potential is strong enough, it will spread through all the muscle fibres innervated by the motor neuron. Conversely, if the stimulus is not strong enough, there will be no action potential and no muscle contraction. Motor units cannot vary the amount of force they generate; they either contract maximally or not at all. This is called the '**all or none law**'.

As motor units are either maximally contracted or not contracted at all, the number of muscle fibres associated with any single motor unit varies between different muscles with different purposes.

For example, a single motor unit found within the large vastus medialis muscle of the thigh will have a large number of fibres as it is required to generate high levels of force with minimal fine control. This allows a single action potential to initiate a large, forceful muscle contraction.

In contrast, a single motor neuron found within the small lateral rectus muscle of the eye will have a much smaller number of muscle fibres. This smaller motor unit will generate less force and enable fine movement control.

Motor units can be stimulated in isolation or simultaneously with other motor units, depending on the action and force required. Control of force is achieved through a combination of adjusting the number of motor units recruited and the frequency of their stimulation. As more motor units are recruited and the frequency of stimulation increases, muscle tension increases. Many motor units can be stimulated at the same time to achieve a short, sharp, strong contraction; an alternating sequence of stimulation over a longer period of time will achieve a less intense, longer contraction.

Motor units are recruited in order of size (the number of fibres and the type of fibres within the motor unit). The smallest motor units contain few type I muscle fibres and generate small forces to produce fine movements. These are recruited first. Intermediate motor units are recruited in addition to the small motor units when moderate forces are required. They can contain type I, IIa or IIb fibres (each motor unit contains one type of fibre). Large motor units contain large numbers of type IIb fibres and these are only recruited in addition to small and medium motor units to produce large amounts of force.

Coordinating motor unit activity is fundamental to optimising force generation and exercise performance.

## The structure and function of key proprioceptors

Sensory receptors provide a wide variety of information for the nervous system. In order to do this effectively, there are many specialist types of receptors which each perform a specific function in a specific location. For example, **interoceptors** and **exteroceptors** provide feedback on the internal and external environments respectively.

**Proprioceptors** are of key consideration for skilled professionals as they provide information about the position of the body and joints and the state and positioning of muscles. These sensory receptors can also be called **mechanoreceptors** as they provide feedback on mechanical stimuli (e.g. touch, pressure, stretch or position).

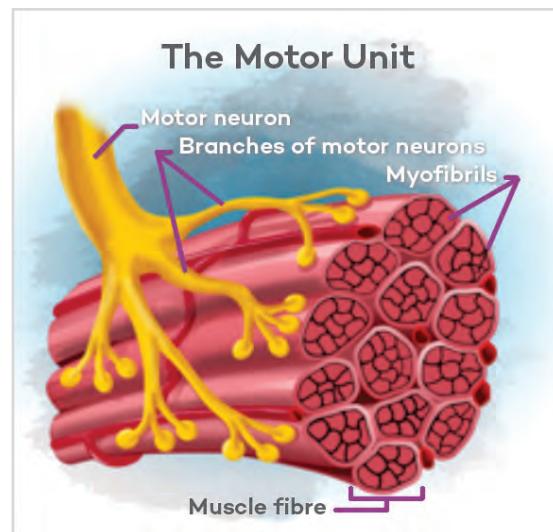


Figure 3.4 A motor unit



Figure 3.5 Golgi tendon organs and muscle spindles

In order to understand the way muscles function, there are two key proprioceptors to consider (see Figure 3.5):

- **Muscle spindles** monitor the length of skeletal muscles and the rate of change in muscle length. Muscle spindles are located deep within muscles and are wrapped around individual muscle fibres like coiled springs. This means that when a muscle is stretched a muscle spindle stretches and is stimulated to provide feedback.
- **Golgi tendon organs (GTOs)** monitor the tension within skeletal muscles and the rate of change in muscle tension. GTOs are located at the musculotendinous junction (where the tendon emerges from the muscle). This means they are perfectly located to sense the build-up of tension in muscles and tendons.

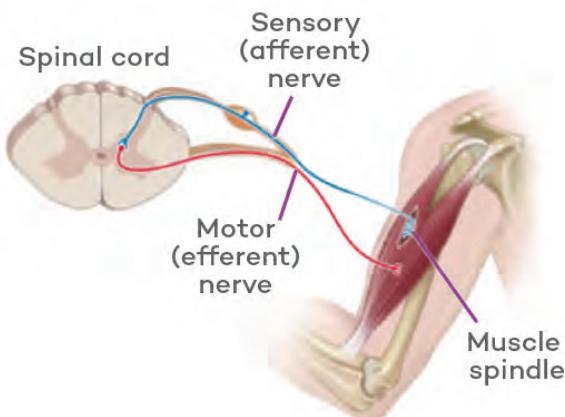


Figure 3.6 The stretch reflex

**The stretch reflex and reciprocal inhibition**

When a muscle is stretched and changes length, the 'coils' of the muscle spindles are pulled apart. This stimulates the muscle spindle to send a signal to the spinal cord; this in turn sends a signal to a motor neuron which relays an action potential to the muscle. This triggers a shortening contraction of the muscle which is a protective mechanism for preventing muscle tears caused by overstretching. This process is called the **stretch reflex** (or the myotatic reflex).

Muscle spindles are stimulated proportionally to the speed of stretch, i.e. they fire at a higher rate if the muscle is lengthened at a faster rate – this response will be more intense and the counteractive muscular contraction will be stronger.

In order to prevent damage to the antagonist muscle when an agonist contracts, an inhibition of the antagonist occurs. As the excitatory signal passes through the spinal cord, an inhibitory interneuron is stimulated which causes a relaxation in the antagonist muscle. This process is called **reciprocal inhibition** and it is an integrated part of the stretch reflex.

### The inverse stretch reflex and autogenic inhibition

When a muscle contracts it pulls on the tendon, creating tension within that tendon. The GTO senses the change in tension and sends a signal to the spine which has an inhibitory effect on the same muscle's motor neurons. This causes a relaxation in the tense muscle and is called **autogenic inhibition** or the inverse stretch reflex.

### The role of muscle spindles and GTOs in movement and exercise

The muscle spindles and GTOs are continually activated during human movement to provide the CNS with valuable information about muscle length and tension. The muscle spindles also assist with normal human movement as they trigger a mild stretch reflex that creates a contraction to counteract a mild muscle stretch. The GTOs respond just after the engagement of a muscle to inhibit contractions and allow the opposite action to be performed. In other words, muscle spindles and GTOs act like the on and off switches for muscle activity during exercise and movement. The functional, cyclical outcomes of muscle spindle and GTO on/off effects are often termed **the stretch-shortening cycle**.

The role of the proprioceptors in movement is further highlighted in higher intensity exercise (e.g. plyometrics). During explosive movements, the rapid lengthening of muscle activates an intense firing of the muscle spindles. This causes an intense reflex contraction of the muscles. When combined with the elastic recoil of the connective tissues, these proprioceptors enable more explosive and efficient concentric contractions.

## Neuromuscular adaptations to exercise

There are a number of changes that occur within the neuromuscular system as a consequence of exercise. Most types of training affect the nervous system as it is the controlling communication network of the body and if one body system (e.g. the muscular system) is being trained, so is the nervous system.

Adaptations in the neuromuscular system can have dramatic effects on the body and lead to improvements in speed, acceleration, coordination, strength, endurance and most other aspects of fitness. In fact, in the early stages of training, it is thought that the majority of improvements are likely to be the result of changes in the way the CNS controls and coordinates movement.

When performing a movement, exercise or activity, our senses provide constant feedback regarding limb position, force generation, muscle coordination and the performance outcome (i.e. whether the movement was successful). Regular repetition of the movement, exercise or activity will lead to adaptations in the CNS allowing more efficient and effective overall performance.

It is also important to note, however, that if a movement is performed with poor technique, the CNS is being trained to perform that movement poorly. This will result in a progression of poor technique rather than an improvement of movement quality.

Proprioceptors (muscle spindles and GTOs) can also be trained to maximise their effectiveness and efficiency. If full range of motion, explosive plyometric training is regularly performed, the firing threshold of the muscle spindles can be lowered and the motor units can become more coordinated in their contractions. This leads to more efficient and powerful explosive movements that maximise the effects of the stretch-shortening cycle.

In contrast to explosive, dynamic effects, the proprioceptors can also be manipulated to encourage and allow the lengthening of muscles. When moving into a static stretch position, there is inevitably a firing of the muscle spindles and the muscle contracts against the stretch. After holding the stretch for a period of time, the GTOs can initiate autogenic inhibition and this has a desensitising effect on the muscle spindles which induces a relaxation in the stretched muscle. This then allows the stretch to be taken further and range of motion to be increased.

Advanced stretching protocols (e.g. proprioceptive neuromuscular facilitation (PNF)) use the relaxing effects of the GTOs to enable further development of flexibility. For example, when performing contract-relax-agonist-contraction (CRAC) PNF stretches, the contraction of the muscle being stretched increases the tension and the GTOs are stimulated to desensitise the muscle spindles; this creates an increased relaxation that allows further flexibility development.

In summary and in line with the specificity principle, neuromuscular adaptations will be specifically related to the type of training and activities performed. For example, if training includes repetition of explosive plyometrics, then the CNS will adapt to become more efficient at performing the coordinated stretch-shortening cycles required to repetitively explode (e.g. sprinting). Training that involves complex movements (e.g. floor gymnastics) will develop inter and intramuscular coordination specific to the practised movements that will lead to improvements in performance. Training that focusses on maximal strength will develop the rate of simultaneous motor unit recruitment (power lifting), whereas endurance training will develop the ability to recruit motor units in an alternating sequence without fatigue (marathon running).

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- Draw a diagram of the nervous system to break it down into each of its component parts.
- Identify the differences between the central and peripheral nervous systems, the somatic and autonomic nervous systems, and the sympathetic and parasympathetic nervous systems.
- Identify the three different types of neuron and describe their functions.
- Explain what proprioceptors are and give two examples.
- Draw a diagram of a neuron, labelling all the component parts.
- Draw a diagram of a motor unit and explain in your own words what is contained within a motor unit.
- In your own words, explain the 'all or none law'.
- In your own words, explain the size principle of motor unit recruitment.
- In your own words, explain the stretch reflex and the inverse stretch reflex.
- Perform an exercise session and for each exercise/component explain what is happening to the muscle spindles and GTOs.
- Perform an exercise session and for each exercise/component explain the processes of autogenic and reciprocal inhibition (the stretch and inverse stretch reflexes).
- Review different types of training and identify how they can benefit the neuromuscular system.
- Select a sport and describe two training sessions focussing on neuromuscular adaptations that can be used to improve sporting performance.

# Section 4: The endocrine system

## The role of the endocrine system

Along with the nervous system, the endocrine system helps to maintain homeostasis. Instead of using action potentials, however, the endocrine system exerts its influence via **hormones** (chemical messengers).

Hormones are chemicals released into the bloodstream to help control and manage the internal environment of the body. Hormones are derived from amino acids, steroids or occasionally fatty acids and are released from various glands around the body, known as the **endocrine glands**. Different hormones have different chemical shapes which determine the effects they will have.

The chemical messages from hormones are slower than the electrical messages (action potentials) of the nervous system. Cell response times to a specific hormone can range from a few seconds to 30 minutes, depending on concentration levels. However, although neural stimulus is very rapid, it does not last; endocrine stimulus can last for hours, days or even longer.

### How hormones work

#### KEY POINT

Hormones are chemical messengers (the key) that affect specific target cells (the lock).



To fully understand how the endocrine system works, the way hormones function around the body must first be appreciated. The process begins when an endocrine gland receives a stimulus that requires a response. The response is initiated by releasing a hormone into the surrounding bloodstream. Hormones are transported around the body, seeking out specific target cells. Each type of hormone is attracted to particular receptors within the target cells which, in turn, will only be triggered by the 'right' hormone (in the same way that a lock can only be opened with the right key). Once the released hormone reaches a target cell, it docks at the cell's receptor site; this initiates the desired response in the cell or group of cells.

Finally, when the hormone response has had the desired effect, there is usually a feedback loop between the targeted tissue and the initiating endocrine gland which reduces or stops the hormone production.

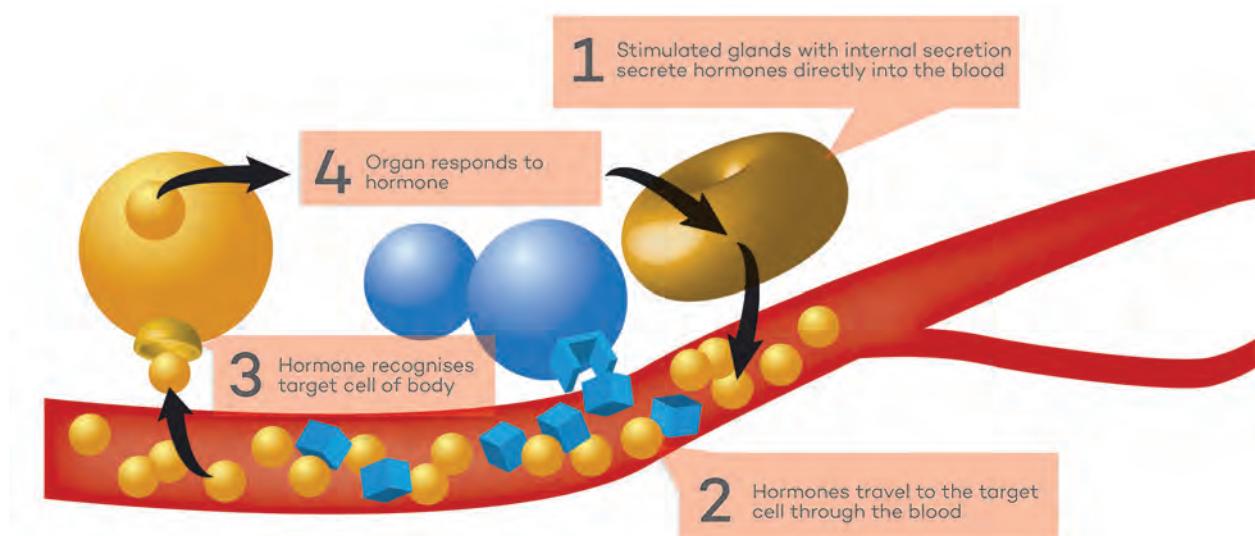


Figure 4.1 How hormones work

## Major endocrine glands

The majority of the endocrine system and its related functions are governed by a number of specialised glands that are scattered throughout the body. These glands produce the hormones that help to maintain the body's delicate internal environment (homeostasis).

Figure 4.2 shows the locations of the major endocrine glands and Table 4.1 explains the glands and their functions.

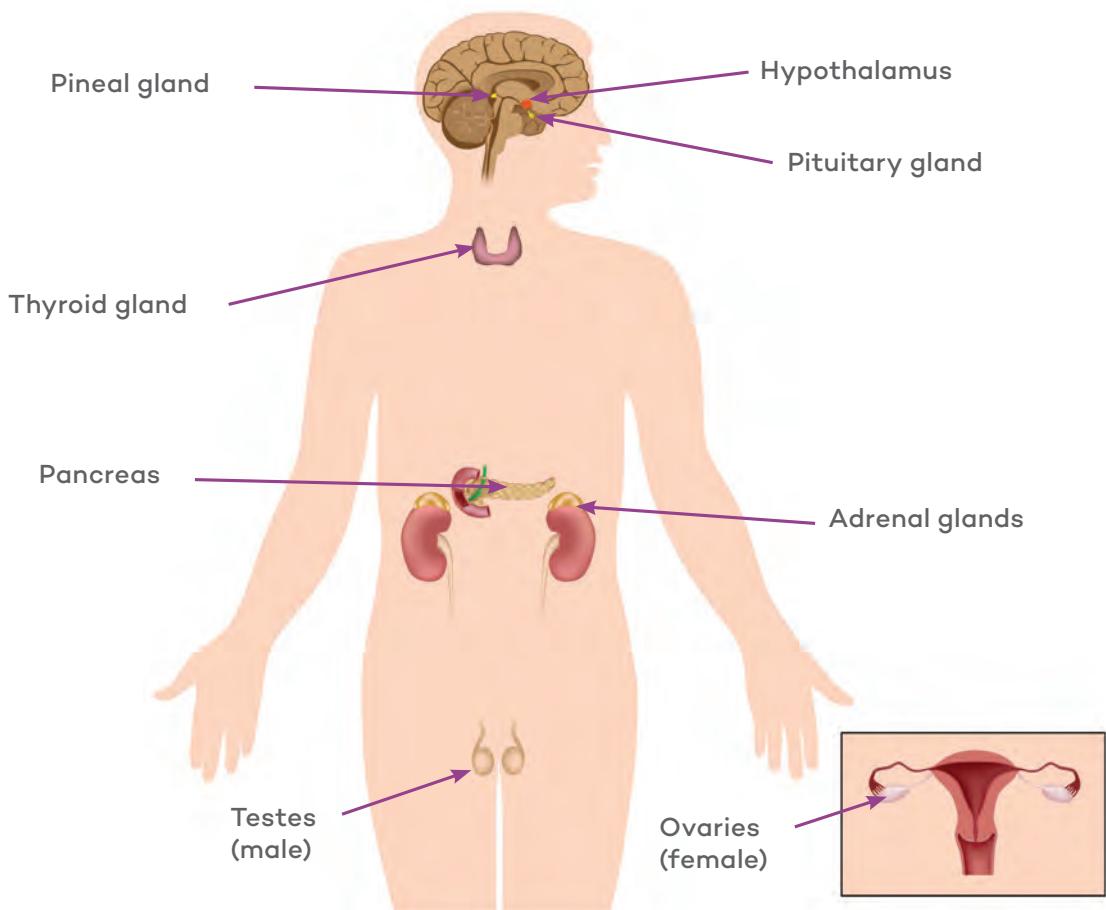


Figure 4.2 The major endocrine glands

Gland	Functions of the gland and associated hormones
<b>Hypothalamus and pituitary</b>	<p>The pituitary gland is often referred to as the 'master gland' because it releases so many hormones into the bloodstream. The truth is that the pituitary gland also has a master, the hypothalamus. The hypothalamus controls the pituitary gland by discharging 'releasing' and 'inhibiting' hormones to start or stop circulation. A tiny system of capillaries between these two glands facilitates this continuous communication.</p> <p>The pituitary gland is formed of anterior and posterior lobes. The posterior lobe stores hormones synthesised in the hypothalamus ready for release. The anterior lobe produces a range of hormones which have an effect on tissues, organs and other endocrine glands around the body.</p> <p>These hormones include:</p> <ul style="list-style-type: none"> <li>• Thyroid-stimulating hormone – stimulates the thyroid gland to release thyroxine.</li> <li>• Adrenocorticotropic hormone (ACTH) – stimulates the adrenal glands to secrete their steroid/stress hormones.</li> <li>• Growth hormone.</li> </ul>

Gland	Functions of the gland and associated hormones
<b>Thyroid</b>	This gland is controlled by the hypothalamus via the pituitary and the release of thyroid-stimulating hormone. The thyroid gland has two lobes – one on either side of the trachea. This gland isn't usually palpable, but in some cases it can become enlarged. This is called a goitre. Hormones released by this gland have an effect on metabolism, growth and muscle function (via blood calcium levels) and include: <ul style="list-style-type: none"> <li>• Thyroxine.</li> <li>• Calcitonin (opposes the action of the parathyroid hormone).</li> </ul>
<b>Pancreas</b>	The pancreas is both an exocrine and an endocrine gland, which means that in addition to producing hormones (endocrine) it produces digestive enzymes which are released into the small intestine. The endocrine function is performed by clusters of cells called the islets of Langerhans. The pancreas produces hormones which regulate blood sugar, including: <ul style="list-style-type: none"> <li>• Insulin.</li> <li>• Glucagon.</li> </ul>
<b>Adrenal</b>	There are two triangular-shaped adrenal glands – one on top of each kidney. Each adrenal gland has a medulla and a cortex and each part has distinct functions.  The adrenal medulla is the central portion of the gland; it produces stress hormones which help the body in times of pressure, initiating the ‘fight or flight’ response. These hormones are called catecholamines and include: <ul style="list-style-type: none"> <li>• Epinephrine (adrenaline).</li> <li>• Norepinephrine (noradrenaline).</li> </ul> The adrenal cortex is the outer portion of the gland. It produces a type of hormone called corticosteroids, which include: <ul style="list-style-type: none"> <li>• Cortisol.</li> </ul>
<b>Ovaries and testes</b>	The two female ovaries produce eggs for reproduction and produce the reproductive hormones: <ul style="list-style-type: none"> <li>• Oestrogen.</li> <li>• Progesterone.</li> </ul> These hormones are created in variable amounts throughout the menstrual cycle. When the egg is in development, oestrogen is produced. Once the egg has been released, progesterone levels increase and oestrogen decreases. This change in hormone levels facilitates the preparation of the womb in case the egg is fertilised. If the egg is not fertilised, production of both hormones stops, initiating a period where the lining of the womb falls away, ready to begin the cycle again.  The male testes lie behind the penis in the scrotum and have two main functions: they produce sperm and reproductive hormones (mainly testosterone).

Table 4.1 Glands and their associated hormone functions

# Key hormones, their roles and actions

## Insulin and glucagon

The primary role of insulin and glucagon is to regulate glucose levels by counterbalancing one another's actions. After a meal containing carbohydrates, digestion breaks the food down and the glucose is absorbed into the bloodstream. The rise in blood glucose levels informs the body that the pancreas needs to release insulin. The insulin travels to target tissues, such as muscle, bone and adipose tissues. Once there, it signals for cellular channels to open to allow the glucose to move from the blood into the cells so it can be used. This reduces blood glucose to normal levels.

At the other end of the spectrum, after a long period without food or after prolonged activity, glucose levels may drop below optimal level. This time, the pancreas releases glucagon which stimulates the liver to break down glycogen. Glycogen is a large molecule which is basically a stored form of glucose. This release of glycogen helps to restore flagging blood glucose to a more suitable level.

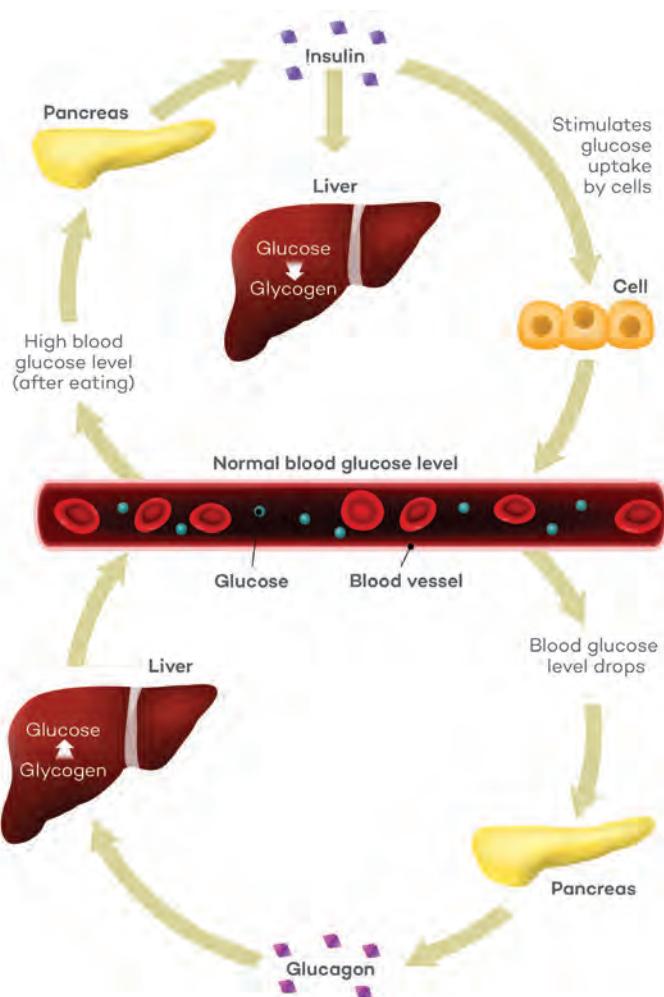


Figure 4.3 The action of insulin and glucagon

## Testosterone and oestrogen

The sexual glands in males and females release important hormones that bring about the physical changes typically witnessed during puberty. In females, the ovaries release oestrogen, and in males, the testes release testosterone. These hormones also support health during adulthood. They govern vital functions related to growth, repair and storage in the body.

Testosterone in both males and females plays a part in stimulating the growth of muscle tissue, whereas oestrogen influences fat storage around the hips, buttocks and thighs. Males produce up to ten times more testosterone than females, and this is primarily responsible for the development of the male secondary sexual characteristics, such as facial and body hair and greater muscle mass. Women of reproductive age have significantly higher levels of oestrogen than males, giving rise to female secondary sexual characteristics, such as breast development and regulation of the menstrual cycle.

Both hormones also play a role in directing bone growth during puberty and in adulthood. The correct balance of sex hormones is necessary for health as a teenager and as an adult.

## Catecholamines and corticosteroids

The adrenals are small glands that sit on top of the kidneys. They are divided into an inner and an outer layer. The inner layer (or adrenal medulla) produces a category of hormones called the **catecholamines**. The outer layer (the adrenal cortex) produces a category of hormones called the **corticosteroids**.

The adrenals are well located on top of the kidneys as they have a direct link to the major blood vessels of the body. This allows their valuable hormones to circulate and have an effect very quickly.

Adrenaline is the most well-known hormone in the catecholamine category. Adrenaline and noradrenaline are released from the medulla when life necessitates a typical ‘fight or flight’ response; they are the hormones of action as they increase heart rate, blood flow, and breathing and alertness levels, rapidly preparing the body for action.

The primary corticosteroid released from the adrenal cortex is cortisol. Cortisol helps to provide reserves in the body for managing stress, whether mental, physical or emotional. Cortisol is primarily catabolic, and it helps to break down carbohydrates and fats to provide energy for the body during stressful periods. It offers support during short-term bouts of stress. Long-term chronic stress and the resulting excess cortisol can lead to deterioration in health by creating an imbalance in the endocrine system.

Aldosterone is another of the corticosteroids released from the adrenal cortex. It helps to regulate the balance of sodium and potassium in the blood; these minerals play a major role in maintaining the water balance in the bloodstream.

## Growth hormone and thyroid hormones

Growth hormone is released directly from the pituitary gland. Growth hormone is primarily an anabolic hormone and it stimulates growth in all areas of the body. In particular, growth hormone drives bone growth during puberty, but it also stimulates protein synthesis in muscle tissue and helps to break down and release fat tissue from storage sites around the body for oxidation.

The thyroid hormones are not released directly from the pituitary but from the thyroid gland located in the upper chest, although it is secretions from the pituitary that stimulate the thyroid gland to release important thyroid hormones. Thyroid hormones are primarily responsible for human metabolism, but they also help to regulate several processes, including the use of oxygen to produce cellular energy, the maintenance of body temperature and overall metabolic rate.

Both growth and thyroid hormones have a very broad influence on the way the body operates and maintains good health, so it's vital that they are kept at the correct levels. Low thyroid function has become a well-recognised disorder leading to low metabolism, fatigue, depression, sensitivity to cold and weight gain.

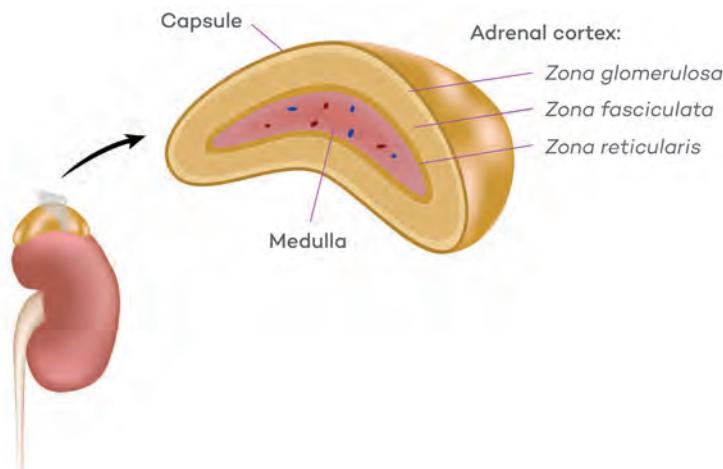


Figure 4.4 The adrenal glands

## Lifestyle factors affecting endocrine health

The main aim of the endocrine system is to maintain homeostasis at all times. As the effects of hormones can be slow and long-term in comparison with the nervous system, the endocrine system always attempts to make small adjustments via the release of hormones in order to restore internal stability. Large adjustments could potentially throw the system out of balance.

The endocrine process is similar to the way in which a car is driven on a straight road. The car and the road are never perfectly straight, therefore in order to maintain a safe position on the road, the driver performs continual minor adjustments. If the driver begins to make excessive adjustments, there is an increased risk of overcompensation which can lead to the car swerving more and more across the road. Eventually, the safe position will be lost and the car is likely to crash. The endocrine system performs in a similar way. For example, when blood sugar levels are high after a meal, the body releases as little insulin as it can in order to rebalance these levels. If the amount of insulin released is too high, the blood sugar levels could drop significantly and the demand for glucagon would be increased. If the same occurs and the amount of glucagon released is too high, the blood sugar levels are likely to rise above the previous high levels. This means the body becomes more and more out of balance with every adjustment. This can be damaging and dangerous in the long term.

Activities of daily life can significantly affect the body's balance (homeostasis) as they introduce a variety of demands from which the endocrine system has to attempt to recover in a balanced and measured way.

For example:

- **Poor nutrition** can affect the ability of the body to produce hormones from amino acids (proteins) and fatty acids. It can also affect the storage, release and usage of nutrients for energy, for example:
  - Excessive intake of sugary and fatty foods will unbalance the interactions of glucagon and insulin. Over time the body appears to compensate by reducing the sensitivity of the insulin produced in an attempt to calm the wild blood sugar and lipid level variations. This leaves the individual at risk of type 2 diabetes and high blood sugar (hyperglycaemia), which in itself is toxic to the body and can be life-threatening.
- **The consumption of stimulants, drugs and artificial hormones** can impact the endocrine system over time by affecting the ability of the naturally produced hormones to reach, or connect with, their target cell receptors. The resultant effects could also be harmful, for example:
  - Excessive intake of diuretics (e.g. coffee, alcohol or diuretic drugs) or excessive water consumption will affect the dilution of essential minerals and nutrients in the blood. Hormones such as aldosterone will then be excessively activated to compensate which could then lead to overhydration or dehydration.
  - The intake of testosterone by women for bodybuilding purposes can lead to an increase in the development of male characteristics (e.g. facial hair and deeper voice). In contrast, the intake of excess oestrogen can increase the development of female characteristics (e.g. breast development).
- **Prolonged stress** will stimulate the excessive release of cortisol which will affect the breakdown of carbohydrates and fats, in turn affecting other hormones and hormonal responses.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- In your own words, explain the role of the endocrine system and how it sends messages around the body.
- In your own words, explain how hormones connect with target cells.
- Identify the locations, structures and functions of the following, including which key hormones are released from each gland:
  - Hypothalamus and pituitary gland.
  - Adrenal glands.
  - Pancreas.
  - Ovaries and testes.
- In your own words, explain the functions of the main hormones in the body, to include:
  - Growth and thyroid hormone.
  - Testosterone and oestrogen.
  - Corticosteroids and catecholamines.
  - Insulin and glucagon.
- Review different aspects of an individual's lifestyle and identify how they might affect the health of the endocrine system.
  - Identify ways in which the body will attempt to maintain or return to homeostasis following each of the lifestyle activities.
  - Identify external factors which can be applied (e.g. medical treatments or lifestyle adjustments) to attempt to maintain or return to homeostasis following each of the lifestyle activities.

# Section 5: Energy systems

Energy cannot be created or destroyed, it can only be converted from one form to another. The body, like all machines, requires energy for movement, to produce force, to generate heat and to grow or repair tissue. The body uses energy in the form of **adenosine triphosphate (ATP)**. This is the energy currency of the body.

ATP is synthesised from the macronutrients in food:

- Carbohydrates in the form of glucose.
- Fats in the form of fatty acids.
- Proteins in the form of amino acids.

These chemical substances are also known as **energy substrates**.

All three of these macronutrients (or substrates) play an important part in the complex process of ATP production. Although glucose and fatty acids are the preferred energy sources, proteins can be used in extreme circumstances, e.g. when glycogen stores (glycogen is the stored form of glucose) are depleted or food is scarce.

ATP releases the energy required to drive the sliding filaments in muscular contractions. As long as the ATP supply is sufficient to meet demands, muscular activity can continue. To meet these demands, the body has three energy systems that work together in an integrated manner:

- The **aerobic system** (also known as the oxidative system).
- The **lactate system** (also known as the anaerobic glycolysis system).
- The **creatine phosphate system** (also known as the phosphocreatine system – CP or PC system).

## Structure of ATP

ATP is an energy-rich compound composed of one adenosine molecule bound to three phosphate molecules. Energy is stored in the bonds that link the phosphate molecules to the larger adenosine molecule. When one of the high energy bonds is broken, energy is released and the myosin heads nod to draw in the actin (sliding filament theory). Following this reaction and release, adenosine diphosphate (ADP) and one free phosphate molecule remain. The myosin head then binds with another ATP molecule and another contraction is possible. Whilst ATP is available, more contractions are possible.

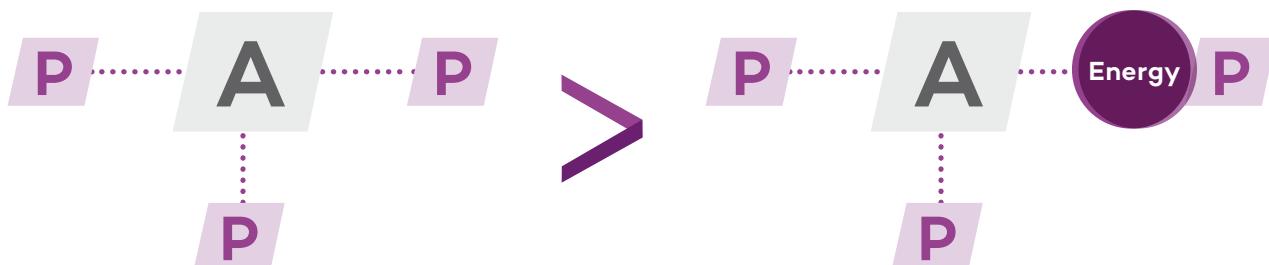


Figure 5.1 Energy release from ATP

The store of ATP within the muscles is very limited. Without resynthesis, ATP stores would only last approximately one to two seconds. The three energy systems provide the mechanism by which ADP is converted back into ATP, ready for reuse.

# Energy systems and ATP resynthesis

## Aerobic system

Aerobic simply means ‘with oxygen’ and refers to the energy system that resynthesises ATP through the complete breakdown of glucose and fatty acids in the presence of oxygen. The aerobic system dominates during low-to-moderate-intensity activities (up to 75% maximum heart rate), and it is essential when recovering from higher-intensity activities.

When activity intensity is low, oxygen is relatively plentiful and is sufficient to allow the complete breakdown of fats and carbohydrates. The process of aerobic energy release occurs in the mitochondria of the muscles.

The by-products of this aerobic process are carbon dioxide ( $\text{CO}_2$ ) and water. Carbon dioxide is expired as breath and an increased breathing rate allows for the increased intake of oxygen alongside the increased expulsion of  $\text{CO}_2$ . Water can be made available to cells or it is excreted in sweat or during exhalation.

Carbohydrates and fats are usually in abundance within the body, so the aerobic energy system can be used for almost a limitless length of time. There are, however, limits on the rate of aerobic ATP synthesis.

When exercise intensity increases past the point at which sufficient oxygen can be taken in to allow the complete aerobic breakdown of nutrients, the lactate system will begin to assist ATP production to ensure that exercise and activity can continue. The aerobic system does not stop working at this point, it continues to work whilst the lactate system provides additional support. The higher aerobic fitness an individual has, the higher the intensity that can be maintained with minimal support from the lactate system.

Assuming there are no other confounding factors, the recovery time from aerobic exercise will be the time taken to replenish fuel stores.

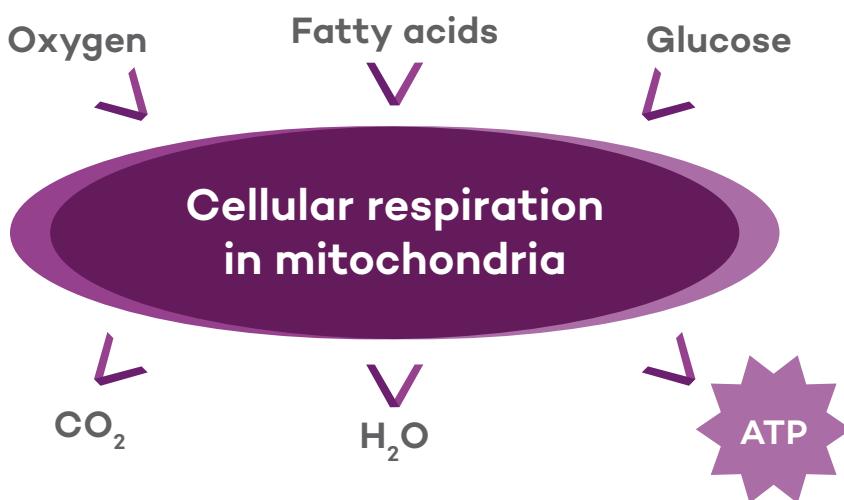


Figure 5.2 ATP resynthesis using the aerobic energy system

## Fuel and the aerobic system

Whether at rest or exercising aerobically, both fat and carbohydrate are required by the body, just in varying proportions. Fat is commonly said to ‘burn in a carbohydrate flame’, meaning that fat cannot be broken down without the presence of carbohydrate.

At rest or during low-intensity activity, most aerobic energy is supplied by fatty acids. As exercise demands increase and ATP is required more quickly, glucose will begin to contribute more to the process. This is because fats yield more ATP than carbohydrates but they do it at a slower rate.

## Lactate system

The lactate system essentially bridges the gap between the aerobic and the CP systems. It allows for more rapid ATP resynthesis by partially breaking down glucose without the presence of oxygen. This process is quicker than aerobic synthesis, but the inefficient breakdown means that it yields much less ATP per molecule of glucose.

Even at rest, small amounts of ATP are produced using the lactate system; consequently there is always a small amount of lactate present in the blood. During low-to-moderate-intensity activity, energy requirements are easily met using the aerobic system so lactate levels remain relatively unchanged. When the energy demands become too great for the aerobic system to manage, the body will begin to increase its reliance on the lactate system and blood lactate levels will start to rise. This is called the 'onset of blood lactate accumulation' (OBLA) and it is an indication that lactate is being produced faster than it can be transported away for uptake or utilisation. At OBLA lactate levels will rise, but if exercise does not increase in intensity, the lactate levels will stabilise at this increased level.

If intensity levels increase further, there will be another key point at which lactate levels begin to continuously increase, even if exercise intensity remains stable. This is called 'maximal lactate steady state' (MLSS).

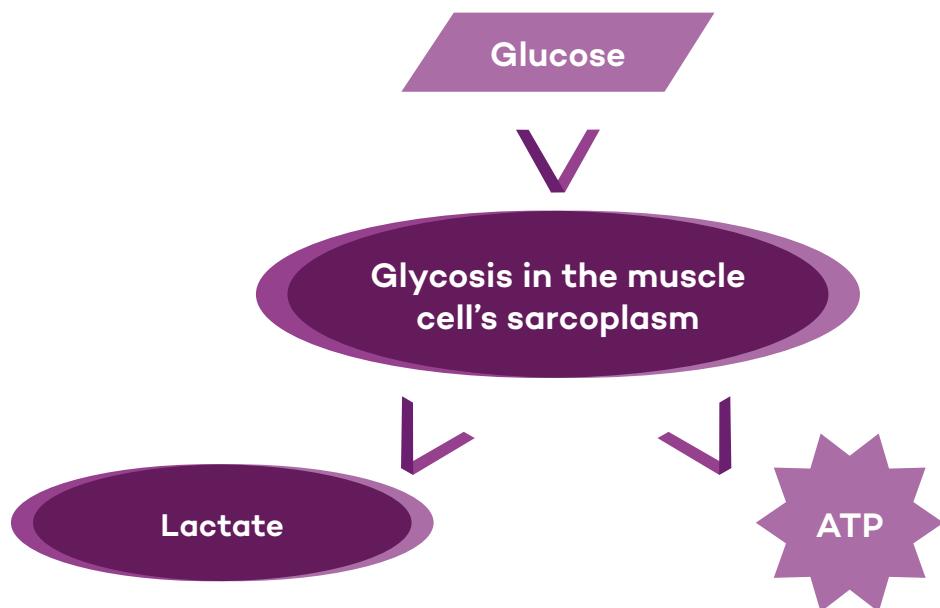


Figure 5.3 ATP resynthesis using the lactate energy system

It was traditionally thought that blood lactate had a fatiguing effect on the muscular system, leading to a reduction and eventual cessation of muscular activity and exercise. It is now thought that lactate is not responsible for feelings of fatigue, and that it can actually provide an efficient energy substrate (fuel) that can be used aerobically and anaerobically (Hall et al., 2016).

Even though blood lactate does not appear to be the cause of the fatigue seen at these intensity levels, it is clear that OBLA and MLSS are indicators of an intensity level which cannot be sustained. An individual working at these levels would have to reduce the intensity of the exercise or introduce rest periods (e.g. interval training). Typically, the lactate system can sustain moderate-to-high-intensity exercise at 75-95% of an individual's maximum heart rate (HRmax) for a period of one to three minutes.

Recovery from this type of activity can vary from 20 minutes to 2 hours, depending on intensity and duration.

### Something extra

Research has shown an increase in hydrogen ions ( $H^+$ ) when individuals are working predominantly in the lactate system (75-95% HRmax). This increase is associated with the production of lactate. The  $H^+$  build-up creates a drop in pH levels in the blood called metabolic acidosis. It was previously thought that this acidosis inactivates various enzymes involved in energy production and can interfere with muscles' contractile ability (McArdle et al., 2001).

It is now suggested that acidosis might have a protective effect by:

- Increasing the release of oxygen from haemoglobin in the blood.
- Increasing the stimulation of breathing rates.
- Increasing muscular blood flow.

These effects can improve the transport, uptake and utilisation of oxygen (Hall et al., 2016) and may help to preserve the contractile ability of muscles.

## The creatine phosphate (CP) system

For high-intensity, short duration activities, ATP resynthesis needs to occur very quickly. As ATP stores within the muscles are depleted within the first couple of seconds, the CP system utilises intramuscular (within the muscle) stores of creatine phosphate in order to resynthesise the ATP molecules for reuse. This chemical reaction is very rapid, but CP stores are limited. CP stores in a muscle are approximately 3-6 times more plentiful than ATP stores, so they are depleted in a maximum of 10-12 seconds.

As this system is derived exclusively from chemical energy stored within the muscles, the process requires no oxygen (anaerobic) and places no immediate demands on macronutrient stores.

### Something extra

Research indicates that a poor diet could limit CP stores, whilst resistance training and creatine supplementation could increase free creatine and phosphocreatine stores. It is worth noting that the long-term effects of creatine supplementation are still unclear.

Once depleted, the stores of CP need to be replenished. This occurs when the body is at rest and there is a surplus of ATP being produced aerobically. Creatine, which is either synthesised in the liver and kidneys or consumed (primarily as meat or fish) is transported to the muscle fibres where the surplus ATP converts creatine into creatine phosphate.

Depending on the intensity and duration of activity, CP and ATP stores are 50% restored after approximately 30 seconds and fully restored after approximately 5 minutes' rest.

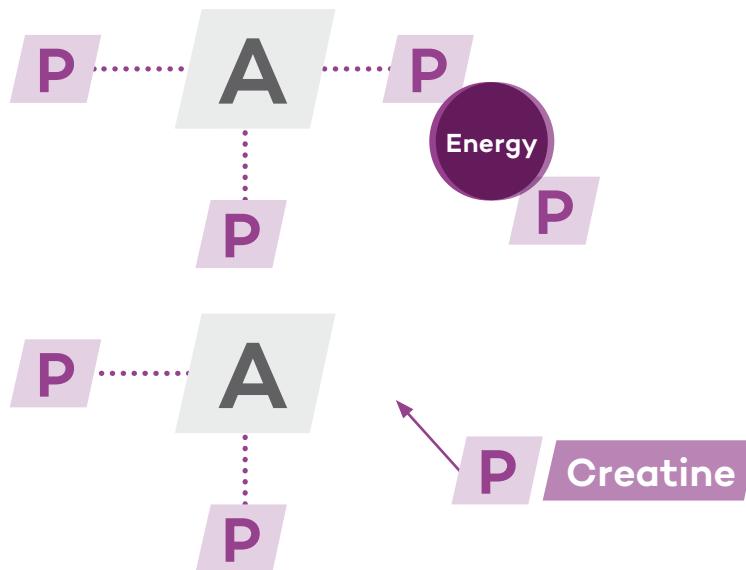


Figure 5.4 ATP resynthesis using the creatine phosphate energy system

## The relative contribution of energy systems

There is considerable overlap in the operation of the three energy systems. All three systems can, and do, provide the body with energy simultaneously. Although they work together, the amount of energy that each system contributes depends on:

- Intensity – The higher the intensity, the higher the relative contribution of the anaerobic systems.
- Duration – Longer duration activities require increased input from the aerobic energy system because the anaerobic systems cannot function effectively for long periods.
- Type of exercise – Unfamiliar exercise requires a higher relative intensity, so the anaerobic contribution would increase.

Figure 5.5 shows a visual representation of how the relative contribution of each energy system changes based on intensity and duration.

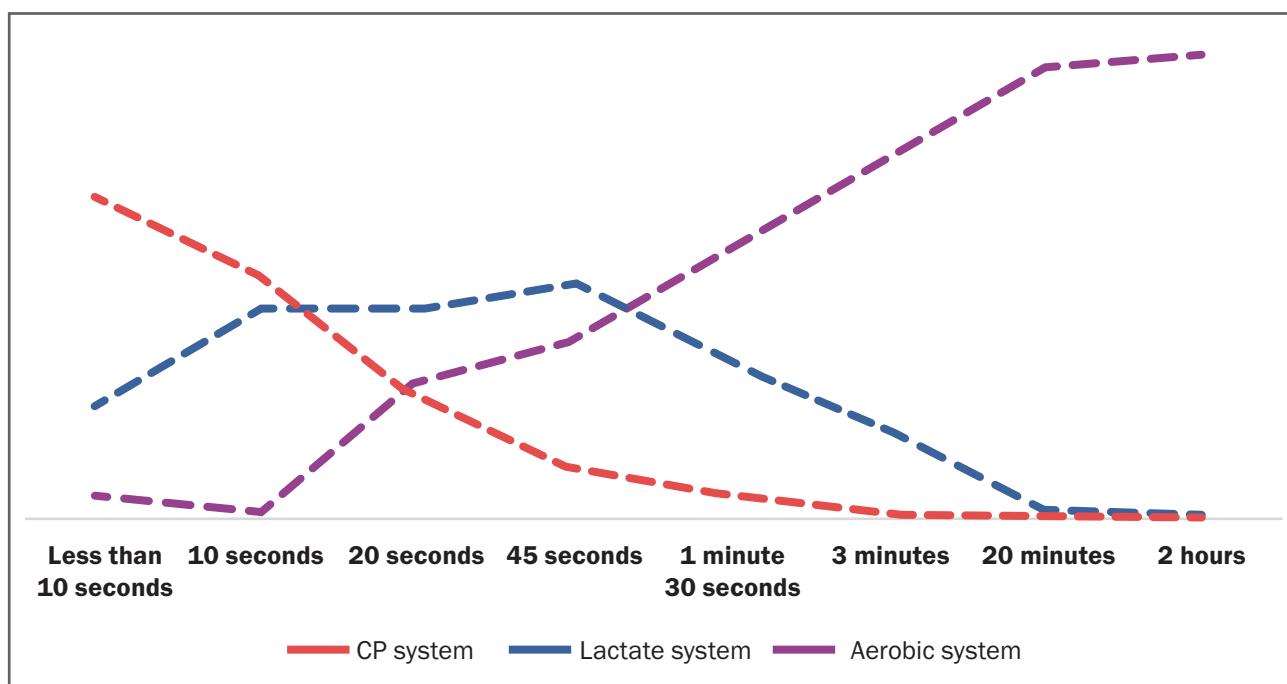


Figure 5.5 Energy system contributions over time

**For example**

- During a 100m track race, an athlete is likely to use approximately 95% anaerobic energy (55% CP system and 40% lactate system) and 5% aerobic energy.
- During an 800m track race, an athlete is likely to use approximately 50% aerobic energy whilst the anaerobic systems (predominantly the lactate system) will contribute the other 50%.
- During a 10,000m track race, an athlete is likely to use approximately 97% aerobic energy and 3% anaerobic.
- A marathon runner will utilise the aerobic system almost exclusively, with 80% of their energy coming from aerobic energy resynthesised by glucose, and 20% resynthesised by fatty acids.

(Bompa, 2015)

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- Identify the three energy systems, including their substrates and by-products.
- In your own words, explain the process of ATP resynthesis for each energy system.
- Plan an exercise session which focusses on the development of aerobic fitness.
  - Define the structure of the session using the FITT principles.
  - Identify ways to adapt the session to increase the utilisation of the other two energy systems.
  - For the session and each proposed adaptation, identify the approximate relative contribution of each energy system.
  - Perform the exercise session and adaptations, noting the key feelings, characteristics and recovery times.
- Repeat the above activity for the other two energy systems (lactate and CP).

# Section 6: The digestive system

The digestive system is the name given to the tissues and organs that are responsible for taking in food, preparing food for absorption, facilitating absorption and finally expelling waste once the nutrients have been removed.

## The structure of the digestive system

The main part of the digestive system is called the **gastrointestinal tract** (also known as the GI tract, the gut, the digestive tract and the alimentary canal). It's a continuous, hollow, muscular tube (including the stomach) which is approximately nine metres long, begins at the mouth and travels through the body to the anus. The GI tract consists of:

- Mouth.
- Pharynx.
- Oesophagus.
- Stomach.
- Small intestine (including the duodenum, jejunum and ileum).
- Large intestine.
- Rectum and anus.

There are a number of other organs and structures that assist the digestive process. These include:

- Teeth.
- Tongue.
- Three pairs of salivary glands (parotid, submandibular and sublingual).
- Liver.
- Pancreas.
- Gall bladder and bile ducts.

The digestive system provides two critical functions: digestion and absorption of nutrients, and it possesses a unique architecture to allow these processes to occur efficiently.

The **mouth** is the first part of the digestive system – the place where food is received. The roof of the mouth is formed by hard and soft palates and the anterior two-thirds of the tongue fill the floor of the mouth. The tongue is a muscular organ which is attached to the hyoid bone and the mandible.

The **pharynx** is the part of the throat situated immediately below the nasal cavity, posterior to the mouth and superior to the oesophagus and larynx.

The **oesophagus** is sometimes called the gullet. It is the tube that carries food from the mouth to the stomach. It is about 26cm long in adults. As it passes through the chest on its way to the stomach, it lies between the windpipe (trachea) and the spinal cord.

The **stomach** is located just under the diaphragm (the sheet of muscle under the lungs). The top of the stomach is connected to the oesophagus. The other end of the stomach is connected to the first part of the small bowel (the duodenum).

The average length of the **small intestine** in an adult is approximately 7m. It is approximately 2.5-3cm in diameter and is divided into three parts: the duodenum, the jejunum and the ileum.

The **pancreas** is quite high up in the abdomen. It lies across the body where the ribs meet at the bottom of the breastbone, just behind the stomach. It is about 15cm long and shaped like a leaf.

The **gallbladder** is a small, hollow, pear-shaped pouch about 8cm long and 2.5cm wide. It is situated underneath the right side of the liver in the upper abdomen.

The **liver** is the second largest organ in the body after the skin. It can be found below the right lung, and it is protected by the lower ribs on that side. The liver is divided into two main lobes: the larger right lobe and smaller left lobe. At the back of the right lobe are two smaller lobes.

The **large intestine (or colon)** extends from the end of the ileum to the anus, and it is about 1.5m long. It forms an arch.

The **anus** is the opening where the gastrointestinal tract ends and exits the body.

## Digestion and absorption

The body is unable to absorb or use large particles of food, so it uses the process of digestion to break these down into smaller components which can be more easily absorbed and transported. The key macronutrients are digested and absorbed in the following manner:



The digestive process is a combination of the mechanical breakdown of food via the chewing action of the mouth and contraction of the digestive tract, and the chemical breakdown caused by digestive enzymes. Digestive enzymes are protein-based chemicals that help speed up chemical reactions by enabling larger molecules to be broken down into smaller ones. Each food group requires a unique enzyme to break it down, and a single food group requires a different enzyme for each stage of its digestion.

Most of the absorption of nutrients takes place in the small intestine. The internal walls are arranged in a series of folds lined with microscopic hairs (microvilli). This provides a large surface area through which nutrients can be absorbed into the bloodstream. Water and some vitamins are absorbed in the large intestine.

Some substances (e.g. water) can be absorbed without digestion and others (e.g. dietary fibre) can't be digested by humans and therefore can't be absorbed. These unabsorbed substances pass through the digestive tract and are excreted in the faeces.

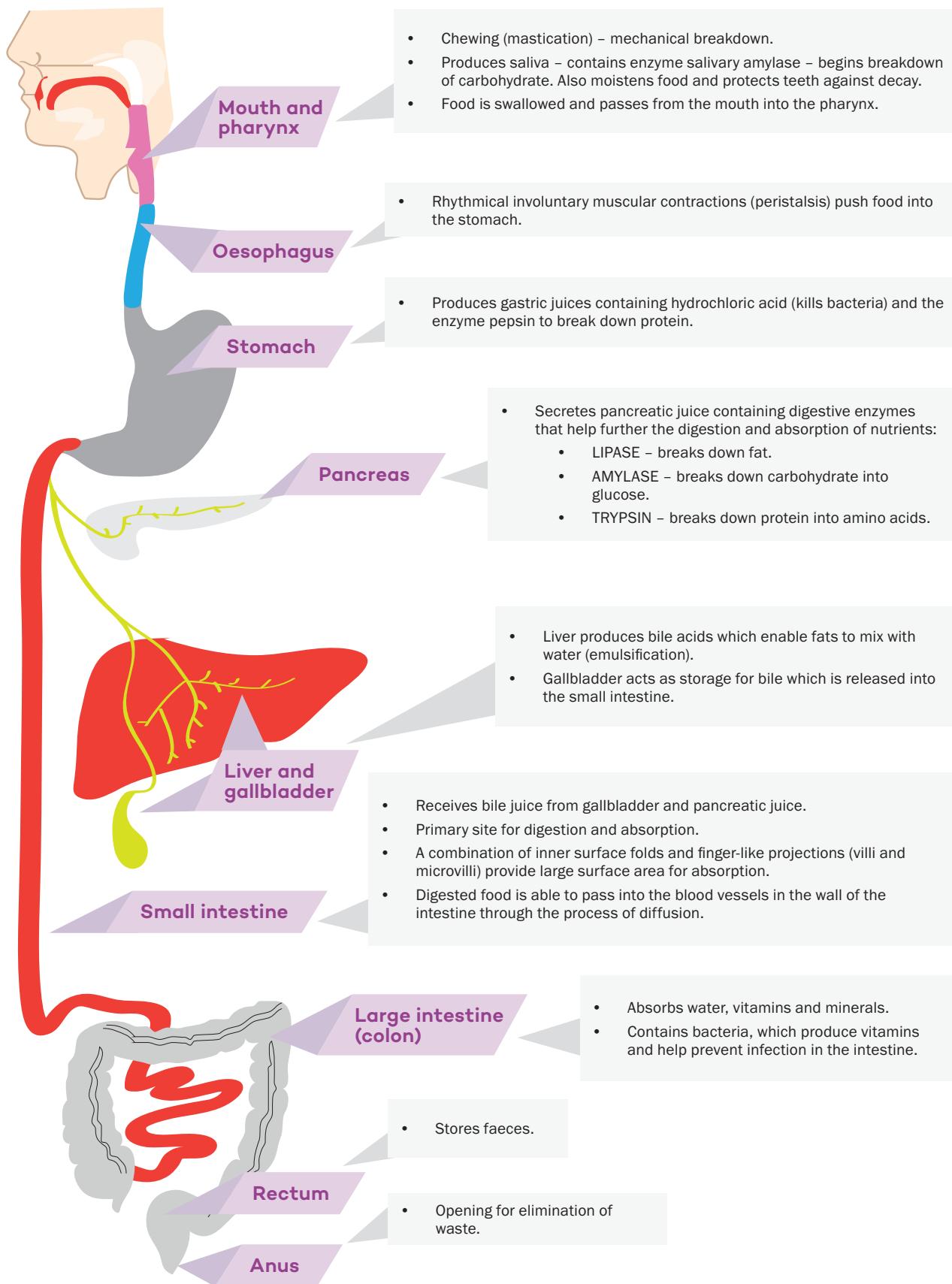


Figure 6.1 The digestive process

## The relationship between the digestive system, physical activity and health

The digestive system is important for the maintenance of health because it is responsible for the breakdown of food so that the body can absorb sufficient nutrients. Nutritional quality and quantity of food intake are central to optimal health and wellbeing, however a functioning digestive system is also key because failure of part or parts of this system will compromise the amount of nutrition that can be absorbed into the body for effective utilisation. For example, if the production of enzymes or bacteria essential for the breakdown of nutrients is negatively affected, the body won't be able to absorb the required nutrients to maintain health.

The liver helps the body to produce continuous energy that can be used for physical activity and bodily functions by converting lactate into glucose. It is also an important location for the storage of glycogen (the stored form of glucose) and a range of vitamins (including vitamins A, B12, D, E and K) and minerals (iron and copper). Deficiencies in any of these nutrients will significantly impact health in a wide variety of ways, including:

- Anaemia and night blindness (vitamin A deficiency).
- Progressive damage of the myelin sheath of neurons, which can affect memory and movement (following long-term vitamin B12 deficiency).
- Weakened bones (vitamin D deficiency).
- Swelling, loss of coordination, reduced eyesight and verbal capacity (vitamin E deficiency).

The digestive system also contributes to health by producing vitamin K in the large intestine. Vitamin K is used by the body to synthesise clotting factors in the liver. Vitamin K is plentiful in a healthy, balanced diet (via the intake of green, leafy vegetables, animal products and vegetable oils), therefore the large intestine only needs to produce a small proportion of the required amount. Vitamin K deficiency, although rare (due to the abundant dietary supply), can result in reduced or delayed clotting which causes excessive bleeding.

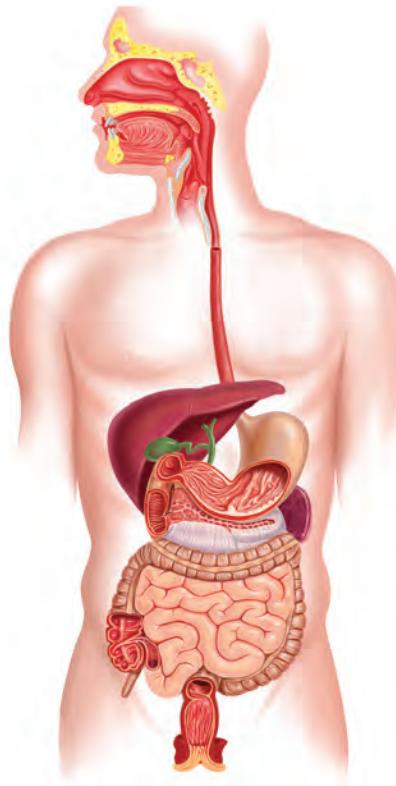
Digestive issues caused by poor dietary practices can also create debilitating symptoms such as constipation, cramps, nausea and vomiting. For example, diets excessively low or high in fibre will affect GI motility which can result in constipation or diarrhoea. Diets which are high in sugar and fats can increase the risk of developing type 2 diabetes. Diets which contain a lot of processed foods can result in nutrient deficiencies.

It is not just good dietary practices that are required to support the health of the digestive system; physical activity also plays an important role. Physical activity has been shown to help prevent gastrointestinal cancers (e.g. colon cancer), as well as support digestive peristalsis, motility of the GI tract, insulin sensitivity and blood sugar management.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- Label each of the structures of the digestive system and describe the function(s) of each structure.
- In your own words, describe each of the following terms:
  - Mastication.
  - Peristalsis.
  - Absorption.
  - Diffusion.
  - Emulsification.
- Identify four ways the digestive system helps to maintain health.
- Identify the digestive implications of each of the following:
  - High-fibre diet.
  - Low-fibre diet.
  - Diet high in processed foods.
  - Diet high in sugar and fat.
- In your own words, explain why physical activity is important for the health of the digestive system.



# References

- ACSM. (2004). Exercise and hypertension. *Medicine and Science in Sports and Exercise*, 36(3), pp.533-553.
- ACSM. (2011). 'Delayed Onset Muscle Soreness (DOMS)' [online]. Available at: [https://www.acsm.org/docs/brochures/delayed-onset-muscle-soreness-\(doms\).pdf](https://www.acsm.org/docs/brochures/delayed-onset-muscle-soreness-(doms).pdf) [Accessed 27 June 2016].
- ACSM. (2014). *Guidelines for Exercise Testing and Prescription*. 9th edition. Philadelphia, PA: Wolters Kluwer/Lippincott Williams and Wilkins.
- American Academy of Orthopaedic Surgeons. (1983). *Joint Motion: Method of Measuring and Recording*. Chicago: AAOS.
- Bartlett, R., Gratton, C. and Rolf, C.G. (2009). *Encyclopedia of International Sports Studies*. London: Routledge.
- Basari, M.E. (2003). *Human Nutrition: A Health Perspective*. 2nd edition. London: Hodder Arnold.
- Behnke, R.S. (2012). *Kinetic Anatomy with web resource*. 3rd edition. Champaign, IL: Human Kinetics.
- Berryman Reese, N. and Bandy, W.D. (2016). *Joint Range of Motion and Muscle Length Testing*. 3rd edition. Missouri: Elsevier.
- Beynnon, B.D. (2003). Keynote address I – Risk factors for Knee Ligament Trauma. *Journal of Orthopaedic Sports Physical Therapy*, 33(8), pp. A10-A13.
- Bleakley, C. et al. (2012). Cold-water immersion (cryotherapy) for preventing and treating muscle soreness after exercise. *Cochrane Database of Systematic Reviews* 2012, Issue 2. Art. No.: CD008262. DOI: 10.1002/14651858.CD008262.pub2.
- Bompa, T. (2015). *Periodization Training for Sports*. 3rd edition. Champaign, IL: Human Kinetics.
- Cheung, K. et al. (2003). Delayed onset muscle soreness: Treatment strategies and performance factors. *Sports Medicine*, 33(2), pp.145-164.
- Corrigan, B. and Maitland, G.D. (1994). *Musculoskeletal and Sports Injuries*. Philadelphia, PA: Elsevier Health Sciences.
- Costanzo, L.S. (2010). *Physiology*. 4th edition. Philadelphia, PA: Saunders Elsevier.
- Durstine, J.L. and Moore, G.E. (2003). *ACSM's Exercise Management for Persons with Chronic Diseases*. 2nd edition. Champaign, IL: Human Kinetics.
- Earle, R.W. and Baechle, T.R. (2004). *NSCA's Essentials of Personal Training*. Champaign, IL: Human Kinetics.
- Fleck, S.J. and Kraemer, W.J. (2014). *Designing Resistance Training Programs*. 4th edition. Champaign, IL: Human Kinetics.
- Gross, J.M., Fetto, J. and Rosen, E. (2015). *Musculoskeletal examination*. 4th edition. Chichester: Wiley-Blackwell.
- Hall, M.M., Rajasekaran, S., Thomsen, T.W. and Peterson, A.R. (2016). 'Lactate Friend or Foe'. *American Academy of Physical Medicine and Rehabilitation*, 8(3), pp.S8-15.
- Herbert, R.D. et al. (2011). Stretching to prevent or reduce muscle soreness after exercise. *Cochrane Database of Systematic Reviews* 2011, Issue 7. Art. No.: CD004577. DOI: 10.1002/14651858.CD004577.pub3.
- Hormones and Health Network. (ND). 'Hormones and Health' [online]. Available at: <http://www.hormone.org/hormones-and-health> [Accessed 29 June 2016].
- Kenney, W.L. et al. (2012). *Physiology of Sport and Exercise*. 5th edition. Champaign, IL: Human Kinetics.
- Lindinger, M.I. (2007). Combating muscle fatigue: extracellular lactic acidosis and catecholamines. *The Journal of Physiology*, 581(part 2), p.419.
- Mayo Clinic. (ND). 'Diseases and Conditions' [online]. Available at: <http://www.mayoclinic.org/diseases-conditions> [Accessed 29 June 2016].

- McArdle, W.D., Katch, F.L. and Katch, V.L. (2001). *Exercise Physiology: Energy, Nutrition and Human Performance*. 5th edition. Philadelphia, PA: Lippincott, Williams and Wilkins.
- McArdle, W.D., Katch, F.L. and Katch, V.L. (2010). *Exercise Physiology: Nutrition, Energy and Human Performance*. 7th edition. Philadelphia, PA: Lippincott, Williams and Wilkins.
- McGill, S. (2004). *Ultimate Back Fitness and Performance*. 3rd edition. Waterloo, Canada: Backfitpro Inc.
- McGinnis, P.M. (2013). *Biomechanics of Sport and Exercise*. 3rd edition. Champaign, IL: Human Kinetics.
- McKinley, M.P. et al. (2012). *Human Anatomy*. 4th edition. New York: McGraw Hill Education.
- NHS Choices. (ND). 'Health A-Z Conditions and Treatments' [online]. Available at: <http://www.nhs.uk/Conditions/Pages/hub.aspx> [Accessed 29 June 2016].
- NHS Choices. (ND). 'Digestive health' [online]. Available at: <http://www.nhs.uk/Livewell/digestive-health/Pages/digestive-health.aspx> [Accessed 6 July 2016].
- NICE. (2011). 'Hypertension in Adults: diagnosis and management' [online]. Available at: <https://www.nice.org.uk/guidance/cg127/chapter/1-Guidance> [Accessed 17 June 2016].
- Norkin, C.C. and White, D.J. (2009). *Measurement of Joint Motion: A Guide to Goniometry*. 4th edition. Philadelphia, PA: F.A. Davis Company.
- Palastanga, N., Field, D. and Soames, R.W. (2006). *Anatomy and Human Movement: Structure and Function*. 5th edition. London: Elsevier.
- Pescatello, L.S., MacDonald, H.V., Lamberti, L. and Johnson, B.T. (2015). Exercise for Hypertension: A Prescription Update Integrating Existing Recommendations with Emerging Research. *Current Hypertension Reports*, 17(11), p.87.
- Richardson, C., Hodges, P.W. and Hides, J. (2004). *Therapeutic Exercise for Lumbopelvic Stabilization: A Motor Control Approach for the Treatment and Prevention of Low Back Pain*. 2nd edition. Sydney: Churchill Livingstone.
- Richardson, C., Jull, G., Hodges, P.W. and Hides, J. (1998). *Therapeutic Exercises for Spinal Segmental Stabilization in Low Back Pain: Scientific Basis and Clinical Approach*. Sydney: Churchill Livingstone.
- Robergs, R.A., Ghiasvand, F. and Parke, D. (2004). Biochemistry of exercise-induced metabolic acidosis. *American Journal of Physiology*, 287(3), pp.R502-516.
- Schmidt, R.A. and Wrisberg, C.A. (2000). *Motor Learning and Performance*. 2nd edition. Champaign, IL: Human Kinetics.
- Solomon, E.P., Schmidt, R.R. and Adragna, P.J. (1990). *Human Anatomy and Physiology*. 2nd edition. Florida, USA: Saunders College Publishing.
- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*. 12th edition. New Jersey: John Wiley & Sons.
- Waugh, A. and Grant, A. (2014). *Anatomy and physiology in Health and Illness*. 11th edition. London: Churchill Livingstone, Elsevier.
- Wilmore, J. and Costill, D. (1999). *Physiology of Sport and Exercise*. Champaign, IL: Human Kinetics.

# The principles of nutrition and their application to exercise and health

## Aim

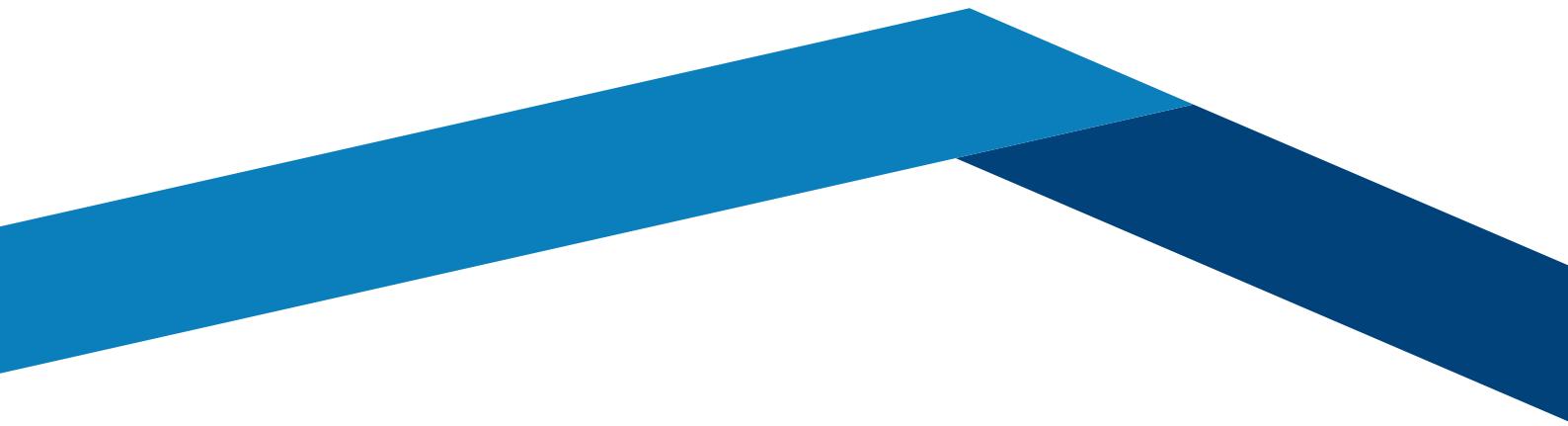
To understand and apply the underpinning principles of nutrition, the current guidelines for eating a healthy, balanced diet and the additional nutrient requirements for active individuals.

## Learning outcomes

At the end of this unit, you will:

- Understand how to access credible information about nutrition for exercise and health.
- Know common nutritional terms related to exercise and health.
- Know the nutrients required to maintain health.
- Understand evidence-based nutritional guidelines.
- Know how nutrients from food are used to fuel and recover from physical activity.
- Know how to estimate daily energy and nutrient requirements for clients with different goals.
- Know the risks of poor nutritional and lifestyle practices.
- Know the nutritional considerations for specific client groups.
- Be able to analyse clients' dietary habits and identify areas for improvement.
- Be able to apply nutritional principles when developing exercise and lifestyle programmes for clients.

# Introduction



We are constantly bombarded with conflicting information about what to eat and drink and when and how to do so. For anyone who wants to be healthy and active, it is difficult to keep up to date with the latest research and to decide what makes sense and what works.

This unit provides practical nutrition knowledge in a straightforward structure and approach. The content is in line with the latest research and recommendations, and the knowledge can be utilised to help guide, advise and plan healthy eating for active clients.

This unit aims to give current factual information but encourages the skilled professional to seek out the latest research and gain insight into the world of nutrition through their own investigative eyes.

# Section 1: Accessing credible nutrition information

## Evidence-based nutritional guidelines

Nutrition is a wide and varied subject that constitutes a substantial area of scientific study. Many experts and professional bodies provide a high standard of nutritional information and advice. It is vital to retrieve nutritional information from reliable, evidence-based sources.

The media and food marketing companies often make claims regarding certain foods or nutrients and their effects on health, and this will influence clients' beliefs and opinions regarding nutrition. Whenever you see nutritional information, whether it's online or in a newspaper or magazine, the source of the information should be considered. Has it come from a reputable scientific journal or body that specialises in publishing guidelines or position statements that are peer-reviewed? Does the information come from more than one source or a large number of studies confirming the findings with little contradictory research? This would provide reassurance about the certainty of the evidence.

Advertisorials or case studies with 'before' and 'after' images are often used to present some scientific information linked to a particular product or diet. Sometimes small, poorly constructed research trials are used to demonstrate a benefit of a product against a placebo and are reported in a way that implies a superiority to other similar products, which were not compared in the trial.

As professionals, we need to use reliable sources of information to determine the truth and debunk any myths. The world of nutrition is full of diverse opinions and theories, so it is important that skilled professionals use a grounded and evidence-based approach, so that the knowledge they base their advice upon is drawn from the best information available.

Table 1.1 lists some of the trusted organisations where information can be sourced.

Credible nutrition organisations	
<b>The American College of Sports Medicine (ACSM)</b>	Representing 70 occupations within the sports medicine field – <a href="http://www.acsm.org">http://www.acsm.org</a>
<b>The British Association for Applied Nutrition and Nutritional Therapy (BANT)</b>	A professional body for Nutritional Therapists – <a href="http://bant.org.uk">http://bant.org.uk</a>
<b>The British Association of Sports and Exercise Sciences (BASES)</b>	The professional body for sport and exercise sciences in the UK – <a href="http://www.bases.org.uk">http://www.bases.org.uk</a>
<b>The British Dietetic Association (BDA)</b>	The professional body and trade union for dietitians – <a href="http://www.bda.uk.com">http://www.bda.uk.com</a>
<b>The Nutrition Society</b>	Highly regarded by the scientific community and is the largest society for nutrition in Europe – <a href="http://www.nutritionsociety.org/">http://www.nutritionsociety.org/</a>
<b>Nutrition Society journals</b>	<i>British Journal of Nutrition, Journal of Nutritional Science, Proceedings of the Nutrition Society, Nutrition Research Reviews, Public Health Nutrition.</i>
<b>The Department of Health (DH)</b>	A ministerial department, supported by 28 agencies and public bodies – <a href="http://www.gov.uk/government/organisations/department-of-health">http://www.gov.uk/government/organisations/department-of-health</a>
<b>The Food Standards Agency</b>	An independent government department which uses expertise and influence so that people can trust that the food they buy and eat is safe and honest – <a href="http://www.food.gov.uk">http://www.food.gov.uk</a>
<b>Institute of Optimal Nutrition (ION)</b>	An independent, not-for-profit educational charity aiming to further the knowledge and practice of optimum nutrition. Its objectives are to advance education of the public and health professionals in all matters relating to nutrition and preserve and protect the health of the general public by giving advice and assistance where necessary through nutritional therapy – <a href="http://www.ion.ac.uk/">http://www.ion.ac.uk/</a>

<b>International Olympic Committee (IOC)</b>
Provides sports nutrition advice – <a href="http://www.olympic.org/ioc">http://www.olympic.org/ioc</a>
<b>NHS Choices</b>
The official website of the National Health Service in England and the UK's biggest health website – <a href="http://www.nhs.uk">http://www.nhs.uk</a> N.B. there are also links to more specific detail for NHS Wales, Northern Ireland and Scotland.
<b>Public Health England</b>
An executive agency, sponsored by the Department of Health – <a href="http://www.gov.uk/government/organisations/public-health-england">http://www.gov.uk/government/organisations/public-health-england</a>
<b>The Scientific Advisory Committee on Nutrition (SACN)</b>
A UK-wide advisory committee. It provides advice to UK government Health Departments – <a href="http://www.gov.uk/government/groups/scientific-advisory-committee-on-nutrition">http://www.gov.uk/government/groups/scientific-advisory-committee-on-nutrition</a>

Table 1.1 Credible nutrition organisations

## Professional boundaries

### Dietitian

Registered Dietitians (RDs) are the only qualified health professionals that assess, diagnose and treat dietary and nutritional problems at an individual and wider public health level. Dietitians use the most up-to-date public health and scientific research on food, health and disease to enable people to make appropriate lifestyle and food choices.

Dietitians are regulated by law and are governed by an ethical code to ensure that they always work to the highest standard. Only those registered with the Health and Care Professions Council (HCPC) can use the title of Dietitian/ Registered Dietitian. All dietitians need to hold the minimum of a BSc Hons in Dietetics, or a related science degree with a postgraduate diploma or higher degree in Dietetics.

### Nutritionist

Nutritionists are qualified to provide information about food and healthy eating. Many employers of nutritionists in all sectors would only consider recruiting Registered Nutritionists. Anyone can call themselves a nutritionist, however only registrants with the UK Voluntary Register of Nutritionists can call themselves a Registered Nutritionist.

There are many degree courses available in nutrition. A Registered Nutritionist can recommend NHS-approved supplements, such as folic acid.

### Nutritional therapist

Nutritional therapists make recommendations for diet and lifestyle in order to alleviate or prevent ailments; these are often based on complementary 'medicine' (although this is not recognised as valid treatment in conventional medicine). These recommendations can include guidance on detoxification, colonic irrigation, the avoidance of ingestion or inhalation of 'toxins' or 'allergens' and the use of supplementary nutrients.

Anyone can call themselves a nutritionist, a nutritional therapist, a clinical nutritionist or a diet expert. They are not permitted by law to call themselves dietitians. Nutritional therapists are not eligible to register with either the UK Voluntary Register of Nutritionists or the Health and Care Professions Council. Voluntary regulation is possible through the Complementary and Natural Healthcare Council.

## POINT OF INTEREST

Completing this unit will allow you to use the term 'nutritional advisor'. This does not authorise you to direct individuals regarding ill health or in the use of dietary supplements to promote health or manage disease, but it does allow you to guide individuals on current healthy eating advice and its application to exercise and activity.



## UK national food guidelines

The UK's national food guide has been updated in light of recent recommendations made by the Scientific Advisory Committee on Nutrition (SACN) in their report on 'Carbohydrates and Health' published in July 2015. The Eatwell Guide has replaced the eatwell plate and acts as a visual representation of the government's advice on achieving a healthy, balanced diet. The Eatwell Guide is based on the five food groups and shows how much of what you eat should come from each food group.

Public Health England encourages organisations and individuals to use the Eatwell Guide to make sure everyone receives consistent messages about the balance of foods in a healthy diet.

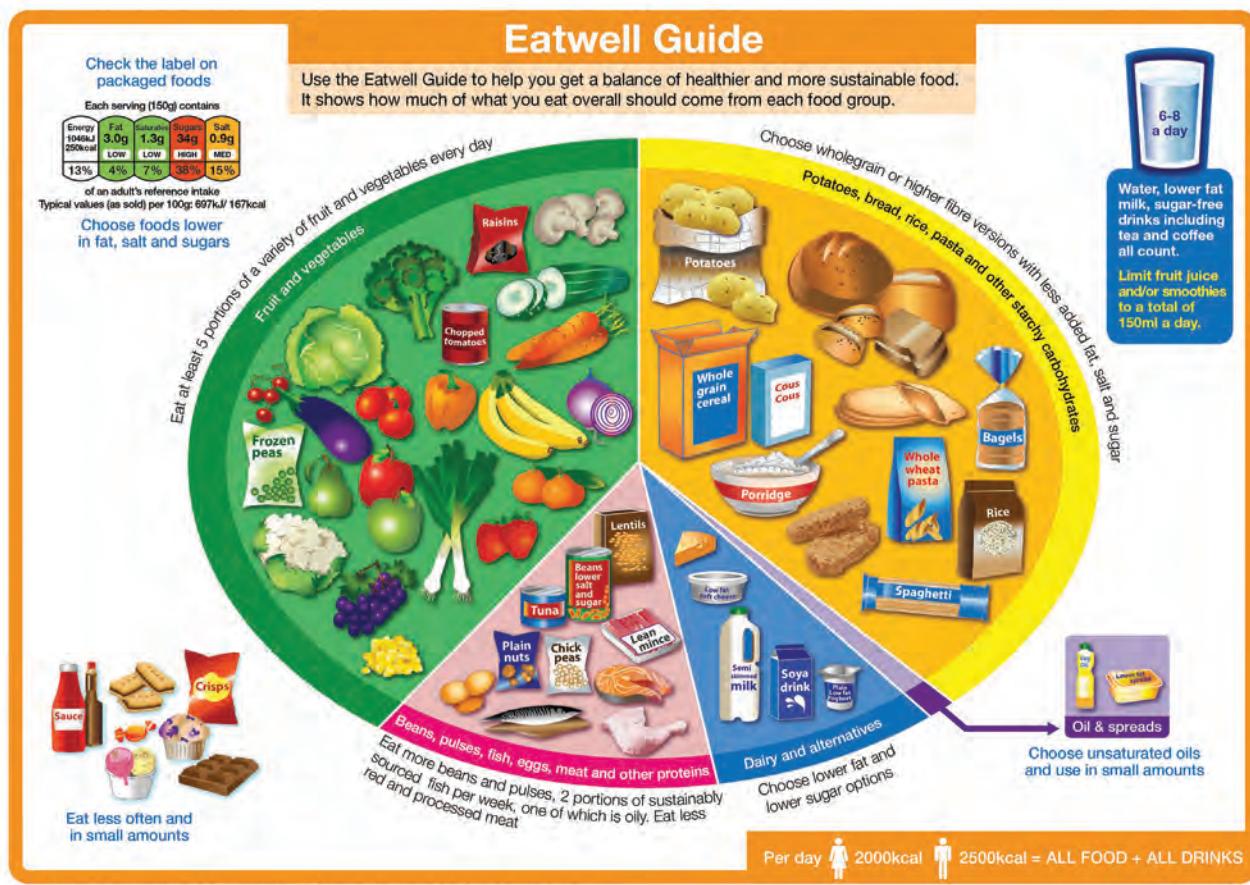


Figure 1.1 The Eatwell Guide

## How does the Eatwell Guide work?

The Eatwell Guide divides foods and drinks into five main groups. A variety of different foods from each of the groups should be chosen to enable an individual to get the wide range of nutrients their body needs to stay healthy and working properly.

Many foods include a combination of the food groups, for example, for a cottage pie: the potato fits into the yellow segment; the milk in the mashed potato fits into the blue segment; the spread in the mashed potato fits into the purple segment; the meat, meat substitute or beans fits into the pink segment; and the onion, carrots and peas fit into the green segment.

The Eatwell Guide aims to communicate the following advice:

### Fruit and vegetables

Fruit and veg should make up just over a third of the food eaten each day. These should form at least five varied portions, including foods that are fresh, frozen, canned, dried or juiced.



#### POINT OF INTEREST

A portion of fruit is 80g or any of the following:

- 1 apple, banana or other similar-size fruit.
- 3 heaped tablespoons of vegetables.
- 1 dessert bowl of salad.
- 30g dried fruit\*.
- 150ml glass of fruit juice/smoothie\*.

\*counts as a maximum of one portion a day irrespective of how much is consumed.

### Potatoes, bread, rice, pasta and other starchy carbohydrates

Starchy foods should make up just over a third of the daily diet. Higher fibre, wholegrain varieties are the ideal choices.



#### POINT OF INTEREST

### WHY CHOOSE WHOLEGRAIN?

Wholegrain food contains more fibre and more nutrients than white or refined starchy food. Wholegrain food includes wholemeal/wholegrain bread, pitta, chapati, wholewheat pasta, brown rice, wholegrain breakfast cereals and oats.

### Dairy and alternatives

Some lower fat and lower sugar dairy or dairy alternatives should be eaten.

### Beans, pulses, fish, eggs, meat and other proteins

These foods are important sources of protein, vitamins and minerals. Lean cuts of meat should be chosen and visible fat and skin should be removed. Meat and fish should be grilled instead of fried and eggs boiled or poached. Red or processed meat (e.g. sausages and bacon) should be limited to no more than 70g per day. Meat alternatives include beans, peas and lentils (pulses/legumes), tofu, bean curd and Quorn. At least two portions (2 x 140g) of fish should be eaten per week, including a portion of oily fish.

### Oils and spreads

It is important to get some fat in the diet, but foods high in fat, salt and sugar are placed outside of the main image as these types of foods are not essential and most individuals need to cut down. Unsaturated fats from plant sources, e.g. vegetable oil or olive oil, are healthier types of fat.

## Foods high in fat, salt and sugar

Foods and drinks high in fat, salt or sugar should be consumed less often and in small amounts. This includes products such as chocolate, cakes, biscuits, full-sugar soft drinks, butter and ice cream. These foods are not needed in the diet.

### Cutting down on saturated fat

Cutting down on saturated fat can lower blood cholesterol and reduce the risk of heart disease. Most people in the UK eat too much; the average man should have no more than 30g saturated fat a day and the average woman no more than 20g a day. Children should have less saturated fat than adults but a low-fat diet isn't suitable for children under five.

### Cutting down on sugar

Regularly consuming foods and drinks that are high in sugar increases the risk of obesity and tooth decay. Ideally, no more than 5% of energy consumed should come from free sugars (no more than 30g per day/7 sugar cubes). Currently, children and adults across the UK are consuming 2-3 times that amount. Almost a third of the free sugars consumed by 11-18-year-olds comes from soft drinks. Sugary drinks should be swapped for water, lower fat milk or sugar-free drinks. Many packaged foods and drinks contain surprisingly high amounts of free sugars, including some breakfast cereals, yogurts, cereal bars and fruit juice drinks. Swap sugary breakfast cereals for plain cereals (e.g. plain porridge, wholewheat biscuit cereals, shredded wholegrain or no-added-sugar muesli). Flavoured yogurts should be swapped for low-fat, lower sugar yogurts, adding fresh fruit for variety.



### POINT OF INTEREST

Free sugars are sugars added to food or drink products by the manufacturer, cook or consumer, including those naturally found in honey, syrups and unsweetened fruit juice.

### Cutting down on salt

Eating too much salt can raise blood pressure, which increases the risk of developing heart disease or having a stroke. Adults should eat no more than 6g (approximately a teaspoon) of salt a day. Children should have even less. Most of the salt that individuals eat is not added but already in everyday foods such as bread, breakfast cereal, pasta sauce and soup. Salt can be replaced with pepper, herbs and spices.

### Hydration

It is recommended that individuals drink 6-8 glasses of fluid every day. Water, lower fat milk and sugar-free drinks (including tea and coffee) all count. Fruit juice and smoothies also count towards fluid consumption, although they are a source of free sugars and should be limited.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- What is the difference between a dietitian, a nutritionist and a nutritional advisor?
- What is the UK national food guide called?
- Explain the five main food groups of the UK national food guide.
- Describe how a client can cut down on the following in their diet:
  - Saturated fats.
  - Sugar.
  - Salt.
- Name three credible organisations where you can find information on nutrition.
- Create a leaflet/handout for a client that explains the term 'healthy eating'.

# Section 2: Common nutritional terms related to exercise and health

There are a considerable range of definitions related to nutrition, health and wellbeing and the following terms are commonly seen in nutritional information sources.

## Health and wellbeing

There are many definitions of health and wellbeing, and there is more to health than just life expectancy and the presence or absence of disease.

### Health

The current World Health Organisation (WHO) definition (formulated in 1948) describes health as: 'A state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity'. Although this definition has been criticised in the past, it has never been adapted.

The Department of Health uses a broad definition of health that encompasses both physical and mental health, as well as wellbeing. Consideration is given not only to whether or not people are ill or have a health condition, but also to how healthy and well they are.

Both physical and mental wellbeing are important, as well as the recognition that there is a huge range of societal, individual and environmental factors that affect wellbeing.

### Wellness

Wellness is the 'state of being healthy' (Cambridge English Dictionary, 2016) or 'the state of being in good physical and mental health' (Collins English Dictionary, 2016).

### Wellbeing

As a concept, wellbeing is applied in a wide range of contexts and with different meanings. A broad definition adopted by the Department for Environment, Food and Rural Affairs states:

'A positive physical, social and mental state; it is not just the absence of pain, discomfort and incapacity. It requires that basic needs are met, that individuals have a sense of purpose and that they feel able to achieve important personal goals and participate in society. It is enhanced by conditions that include supportive personal relationships, strong and inclusive communities, good health, financial and personal security, rewarding employment, and a healthy and attractive environment.'

Good health and wellbeing can bring many benefits. Healthier people tend to be happier, play an active role and contribute to society and the economy (through their families, local communities and workplaces).

Poor health and wellbeing can put a huge strain on individuals, the NHS, the economy and society.

The 'Five Ways to Wellbeing' are a set of evidence-based actions developed by the New Economics Foundation which promote people's wellbeing. The Five Ways are used by health organisations, schools and community projects across the UK and worldwide to help people take action to improve their wellbeing.

#### The Five Ways:

- Connect.
- Be active.
- Take notice.
- Keep learning.
- Give.

## Diet

In recent times, the word 'diet' has become synonymous with cutting back on certain foods and restricting calories in order to initiate physical change (usually weight loss). However, the word simply refers to 'an individual's current eating pattern', i.e. all of the food and drink consumed by a person over a given period of time.

## Healthy eating

Healthy eating involves eating food that promotes the optimal health of all body systems and prevents the development of disease.

## Balanced diet

A balanced diet involves regulating the quantities of the various food groups consumed, because overconsumption of one food group at the expense of another has the potential to upset the body's delicate balance.

## Nutrients

Food provides a range of different nutrients. Water and fibre, although not strictly nutrients, are also important for health.

- Carbohydrate, protein and fat are **macronutrients** that individuals need to eat in large quantities to provide energy and to maintain a healthy body.
- Vitamins and minerals are **micronutrients** which are only needed in small amounts but are essential to keep a body healthy.
- Phytochemicals** are compounds found in fruit, vegetables, wholegrains, nuts and beans. They are not essential for the body but they have been shown to prevent diseases which stop the body working effectively.  
The roles of phytochemicals:
  - Provide antioxidants.
  - Quicken immune responses to disease.
  - Increase cell to cell communication in the body.
  - Help the body to repair damage done by smoking or other carcinogens.
  - Activate enzyme systems, which are used in detoxifying the body of harmful bacteria.

Most people should be able to get all the nutrients they need by eating a healthy, varied diet, although there are a few exceptions. For example, it is recommended that women thinking about having a baby take a folic acid supplement to prevent the baby developing conditions such as spina bifida.

## Nutrition

Nutrition involves the delivery of essential materials (required to promote optimal health and growth) to cells and organisms.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

Define the following terms:

- Health.
- Diet.
- Wellness/wellbeing.
- Healthy eating.
- Balanced diet.
- Nutrition.
- Nutrient.
- Macronutrient.
- Micronutrient.
- Phytonutrient.

# Section 3: Nutrients required to maintain health

A balanced diet requires the consumption of food from five nutrient groups in varying amounts as well as adequate water intake. These groups can then be divided into macronutrients and micronutrients.

Macronutrients	Basic functions
Carbohydrate.	<ul style="list-style-type: none"> <li>Collectively needed in greater amounts.</li> </ul>
Protein.	<ul style="list-style-type: none"> <li>Used within the body for structure, function and fuel.</li> </ul>
Fat (lipids).	N.B. alcohol is not classed as a nutrient (although it does provide some fuel).
Micronutrients	Basic functions
Vitamins.	<ul style="list-style-type: none"> <li>Needed in smaller amounts.</li> </ul>
Minerals.	<ul style="list-style-type: none"> <li>Used for structure and function.</li> <li>Necessary to ‘unlock’ the energy contained within the macronutrients.</li> <li>Support and manage vital physiological processes within the body.</li> </ul>

Table 3.1 Macronutrients and micronutrients

## Macronutrients: Carbohydrate

### Functions of carbohydrate

- Providing energy – Carbohydrate or starchy foods can be converted into energy more easily than proteins or fats. Carbohydrates are converted into glucose, which is the form of sugar that is transported and used by the body.
- Providing nutrients – Carbohydrates contain:
  - Fibre.
  - Calcium.
  - Iron.
  - B vitamins.

### Structure of carbohydrate

All carbohydrates are made up of molecules or units called **saccharides**. These form three basic carbohydrate types:

- Simple** (sugars).
- Complex** (starches).
- Non-starch polysaccharides** (fibre).

These terms refer to the size or complexity of the carbohydrate molecule.



## Simple carbohydrates

**Simple carbohydrates** are very small molecules with one or two sugar units; these include glucose, fructose (fruit sugar), sucrose (table sugar – one molecule of glucose joined with one of fructose) and lactose (milk sugar – one glucose and one galactose molecule joined together).

The energy contained in these foods can't be released without specific vitamins and minerals. The B vitamins are particularly important because the body cannot utilise carbohydrates without them.

In general, these foods tend to be poorer, less nutritious sources of vitamins and minerals but not totally devoid of nutrients, e.g. milk and ice cream provide calcium, chocolate provides iron and fruit provides vitamins and minerals.



## Complex carbohydrates



**Complex carbohydrates** include starches and are made up of much larger molecules, which consist of hundreds of sugar units (mostly glucose) joined together.

They are high in other nutrients, such as vitamins, minerals, protein and dietary fibre.

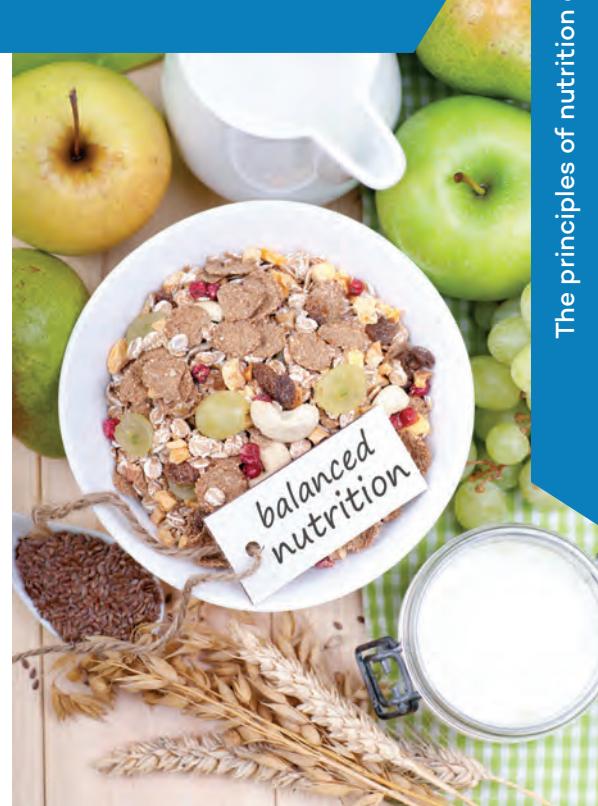
Wholegrain varieties are seen as preferable to 'white', 'beige' or refined foods as far as nutritional value is concerned.

## Fibre

**Fibre** is the name given to the diverse range of compounds found in the cell walls of vegetables, fruit, pulses and cereal grains. Fibre can help keep the bowels healthy and can help with the feeling of fullness after eating. Fibre doesn't provide any energy.

**Indigestible fibre** helps other food and waste products move through the gut more easily.

Some types of fibre present in fruit and vegetables can be **partly digested** and may help reduce the amount of cholesterol in the blood.



### POINT OF INTEREST

The Department of Health recommends an intake of 30g of fibre per day.

On average, individuals in the UK consume much less than this (about 18g per day).

## Storage of carbohydrate in the body

Dietary carbohydrate is digested and utilised in the body in a variety of ways. It is stored as glycogen in the muscles and liver, along with about three times its weight in water. Some glucose may also enter the adipose tissue (fat tissue) where it is used to help store fat.

There is about three times more glycogen stored in the muscles than in the liver. The body can only store a limited amount of glycogen at any one time and this is enough to last one day without eating. Small amounts of glucose are present in the blood and brain to allow for normal functioning, and the liver glycogen stores are used to top up the glycogen in these areas. Regular fitness training rapidly depletes these reserves and ample carbohydrates are needed each day to top up the levels.

## Dietary sources of carbohydrate

Starchy foods are the main source of carbohydrate so they play an important role in a healthy diet. Foods such as potatoes, bread, rice, pasta and cereals should make up just over a third of an individual's diet (as shown by the Eatwell Guide).

Wholegrain bread and breakfast cereals, brown rice, wholewheat pasta and the skin on potatoes are good sources of indigestible fibre. Apples, turnips, sweet potatoes, oats and pulses are good sources of partly digestible fibre.

Table 3.2 shows examples of simple and complex carbohydrate foods. Although, in practice, most foods contain a mixture of both types of carbohydrate, e.g. cakes (flour and sugar).

Simple carbohydrate	Complex carbohydrate
White sugar, brown sugar, honey.	Bread, cereals.
Jam and other preserves.	Rice.
Sweets, chocolates, cakes, biscuits.	Pasta, noodles.
Puddings, jelly, sweet pastries and pies.	Flour.
Milk, yogurt, ice cream, custard.	Potatoes, sweet potatoes.
Fruit.	Plantains, parsnips, sweetcorn.
Sweet pickles, sauces.	Pulses (dried beans, peas, lentils).
Soft drinks.	Oats, corn, barley, millet and other grains.

Table 3.2 Simple and complex carbohydrates

If a baked potato is compared with a small chocolate bar, both contain the same amount of calories, but the potato contains more carbohydrate, vitamins B and C, fibre, iron and other minerals; the chocolate contains more fat, minimal fibre and few vitamins. As a general rule, it is better to eat more nutritious sources of carbohydrate, such as fruit and wholemeal bread and pasta.

## Refined and unrefined carbohydrate

All carbohydrates provide energy, but their real dietary value centres on whether they are refined or unrefined.

### Refined carbohydrates:

- Contain excessive sugar (over 15g per 100g).
- Contain processed, low-quality fats.
- Have high energy density.
- Contain no vitamins or minerals.
- Adversely affect insulin response.

### Unrefined carbohydrates:

- Contain fructose and glucose in varying amounts.
- Contain antioxidants and phytochemicals.
- Have high levels of dietary fibre.
- Have high levels of vitamins and minerals.
- Contain a trace of amino acids.



### POINT OF INTEREST

Refined carbohydrates include:

- White bread.
- White pasta.
- Cakes.
- Biscuits.
- Pastries.
- White rice.
- Rice cakes.

Unrefined carbohydrates include:

- Wholemeal/wholegrain bread.
- Wholegrain rice.
- Frozen/fresh vegetables.
- Pulses.

## Blood sugar levels

A diet too high in carbohydrates can upset the delicate balance of the body's blood sugar (glucose) levels, resulting in fluctuations in energy and mood and feelings of irritability and tiredness.

In the past it was thought that simple carbohydrates caused a rise in blood sugar levels and therefore a rise in insulin levels followed by a 'rebound' low drop in blood sugar. It is now known that this area is complicated by other factors that affect blood sugar levels, including the presence of other food components, such as fibre, protein and fat, which slow this process.

The many types of carbohydrate behave differently in the body. This is because starchy foods are digested at different rates, which in turn have an effect on blood glucose levels.

The glycaemic index (GI) is used to take account of these different influential factors. This index shows the rise in blood sugar levels from ingesting a particular carbohydrate in comparison to pure glucose (GI of 100). The number is calculated by giving volunteers 50g of a carbohydrate food and then checking their blood glucose levels regularly over a two-hour period. The maximum amount that a food increases blood glucose levels by is then divided by the amount that pure glucose increases the level by, and the result is multiplied by 100. This is repeated with ten people and an average (mean) is calculated. Table 3.3 shows some approximate GI values.

- A food with a high GI (70 or more) produces a rapid rise in blood sugar levels.
- A food with a moderate GI (between 56 and 69) produces a moderate rise.
- A food with a low GI (under 55) causes a slow rise.

Each time a sugary or starchy food or drink is consumed, the blood glucose level in the body rises. Some of these foods are quickly digested and cause quick and sharp rises in the blood glucose levels – they are called high-GI foods and drinks. Low-GI foods and drinks, which are more slowly digested, make the blood glucose rise more slowly. These are sometimes called 'slow-release' carbohydrates.

Foods with a high GI are not necessarily bad foods. For example, crisps have a medium GI but a baked potato has a high GI. Despite this, a baked potato is better for health than crisps, which are higher in fat and salt. Also, all lower GI foods are not necessarily healthy – chocolate and ice cream have a low-to-medium GI rating.



### POINT OF INTEREST

Complex carbohydrates do not necessarily have a low GI.

Other components in foods (i.e. soluble fibre, water, fat, protein) interact with the carbohydrate in the digestive system, slowing down digestion and entry of glucose into the bloodstream.

Soluble fibres (e.g. fruit, oats and pulses) can make the walls of the muscle cells more sensitive to insulin, enabling glucose to enter them more easily and be converted to glycogen.



The GI value of a food is tested on the food when eaten on its own, and there are published lists of high-, medium- and low-GI foods. However, it is not helpful to use the GI values in isolation, as we generally eat a combination of foods.

Low GI foods (55 or less)		Medium GI foods (56 to 69)		High GI foods (70 or more)	
Food	GI	Food	GI	Food	GI
Peanuts.	14	Muesli, boiled potatoes, sultanas.	56	Mashed potato, white bread.	70
Cherries.	22	Pitta bread.	57	Watermelon, swede, bagel.	72
Red lentils.	26	Basmati rice, honey.	58	Bran Flakes, Cheerios.	74
Whole milk.	27	Digestive biscuit.	59	Chips.	75
Dried apricots.	31	Cheese and tomato pizza.	60	Coco Pops.	77
Skimmed milk.	32	Ice cream.	61	Jelly beans.	80
Low-fat fruit yogurt.	33	New potatoes.	62	Rice cakes, Rice Krispies.	82
Wholemeal spaghetti.	37	Coca-Cola.	63	Cornflakes.	84
Pure apple juice.	40	Apricots (canned in syrup), raisins.	64	Jacket potato.	85
Porridge with water.	42	Couscous, rye bread.	65	Puffed wheat.	89
Lentil soup.	44	Pineapple (fresh).	66	Baguette.	95
Peas.	48	Cantaloupe melon, croissant, Shredded Wheat.	67	Parsnips (boiled).	97
Crisps.	54	Mars bar.	68	White rice (steamed).	98
Bananas.	55	Wholemeal bread.	69	Dates.	100

Table 3.3 Example GI values for carbohydrate foods

### GI and weight management

GI is a well-known weight management tool, however it can be restricting as it measures foods per 50g of carbohydrate provided and not by portion size, so foods like carrots are included in the high-GI list along with other important fruit and vegetables.

Some research suggests that slow, steady rises and falls in glucose may help control appetite. Although many low-GI foods are also filling, there is not enough evidence to suggest that all low-GI foods can help people to feel full.

- Lower GI foods can help weight management if they are eaten as part of a carefully planned diet in conjunction with regular physical activity.
- Lower GI foods like wholegrain, fruit, beans, lentils and vegetables are generally low in calories too but some lower GI foods (such as chocolate cake) may be high in fat or calories and so they are not a healthy choice.

Glycaemic load (GL) is a sum which takes into account the GI of a food and the available carbohydrate content in a serving of that food. Like GI, the higher the GL, the faster the expected rise in blood sugar. For example, carrots have a high GI but a low GL. This is because GI is based on the rise caused by consuming 50g of carbohydrate from any food. To get 50g of carbohydrate from carrots, around 700g of carrots (about five) whole carrots would need to be eaten. As the portion of carrots eaten is typically much smaller – at 60g rather than 700g – carrots have a low GL.

### Carbohydrate requirements

As glycogen is made from carbohydrate, it is key for an active individual to eat a diet that contains enough carbohydrate for their needs.

Experts advise that carbohydrate intake should be fine-tuned with individual consideration of total energy needs, specific training needs, other dietary goals and feedback from clients.

The recommended starting point is between 50% and 60% of energy from carbohydrate per day.

Table 3.4 provides some suggested intakes of grams of carbohydrate per day depending on an individual's activity levels.

#### Example

If a diet contains 3,000kcals per day, 1,800kcals should come from carbohydrate (which is about 450g).

$3,000 \times 0.6 (60\%) \text{ divided by } 4 (4\text{kcal per g})$ .

<b>Physical activity levels per week</b>	<b>Recommended intake (per kg body weight each day)</b>
For no physical activity.	Reduce carbohydrate further.
Minimal physical activity.	2-3g
3-5 hours per week	4-5g
5-7 hours per week.	5-6g
10 hours per week.	6-7g
<b>Physical activity levels per day</b>	<b>Recommended intake (per kg body weight each day)</b>
Less than 1 hour a day.	5g
1-2 hours per day.	5-8g
2+ hours per day.	7-10g
Professional/elite athletes (20+ hours a week).	>7g
Extremely intense or prolonged exercise within an 8-10-hour period.	May need up to 8-10g/kg
Extreme sports, such as the Tour de France.	May need up to 12g/kg
Carbohydrate loading for endurance and ultra-endurance events.	7-12g
Weight loss.	Reduce to 3-4g/kg

Table 3.4 Calculating carbohydrate needs based on activity levels

## Macronutrients: Protein

### Functions of protein

- Repair and maintenance** – Every cell in the human body contains protein. It is a main component of the skin, muscles, tendons, organs and glands. It is also found in all body fluids, except bile and urine, and is needed in the diet to help the body repair cells and damaged tissues. The body naturally loses protein and therefore a supply needs to be provided in the diet to compensate for this loss. Proteins are constantly being broken down and built up again in every cell of the body.
- Growth** – Important for development in childhood, adolescence and pregnancy.
- Digestion** – When proteins are digested, amino acids are left. The human body needs a number of amino acids to break down food. Amino acids need to be eaten in large enough amounts for optimal health.
- Making enzymes and hormones** (e.g. insulin and adrenalin).
- Energy** – Protein helps to provide energy when glycogen stores are low (e.g. after prolonged intense exercise or during a low-carbohydrate diet). If an individual does not have enough carbohydrate available for energy, the body breaks down protein, most of which comes from muscles, but possibly organs too.

### Structure of protein

Protein makes up approximately 18-20% of the body's weight. About three quarters of human muscle is protein. Water is the only other substance which is more plentiful in the body.

#### POINT OF INTEREST ROOT WORD - PEPTIDES

- Dipeptide – 2 amino acids (di = 2)
- Tripeptide – 3 amino acids (tri = 3)
- Oligopeptide – 4-9 amino acids (oligo = few)
- Polypeptide – 10+ amino acids (poly = many)

#### POINT OF INTEREST

Proteins are often called 'the building blocks of life'.

Proteins are made from building blocks called amino acids, and there are 20 of these in total which combine to make hundreds of different proteins. Most proteins are relatively large molecules comprised of at least 100 amino acids. Smaller clusters of amino acids are referred to as peptides. Amino acids can be thought of as forming a 'protein alphabet'. They build proteins in a similar way to how the 26 letters of the alphabet are used in various combinations to create individual words – one protein will differ from another according to the number and sequence of its constituent amino acids.

In the digestive system protein foods are broken down into amino acids and then reassembled according to the body's needs. Of the 20 amino acids, 8 are considered to be essential to the daily diet because the body is unable to produce or synthesise them itself. Only when sufficient quantities of these amino acids have been ingested are we able to synthesise the remaining non-essential amino acids.

The essential amino acids		The non-essential amino acids	
Isoleucine.	Phenylalanine.	Alanine.	Glutamic acid.
Leucine.	Threonine.	Arginine.	Glutamine.
Lysine.	Tryptophan.	Asparagine.	Glycine.
Methionine.	Valine.	Aspartic acid.	Proline.
Histidine (essential for babies, not adults).		Cysteine.	Serine.
		Tyrosine.	

Table 3.5 Amino acids

## Storage of protein in the body

Protein is not stored like carbohydrate or fat; it forms muscle and organ tissue, so it is mainly used as a building material rather than an energy source. However, as previously mentioned, proteins can be broken down for energy if needed.

## Dietary sources of protein

Protein is found in many foods (see Table 3.6). Even foods not classed as 'protein foods' contain small amounts of protein, e.g. bread and pasta. Sources of protein can be subdivided into two categories: **complete proteins** and **incomplete proteins**.

A complete protein must contain sufficient amounts of all essential amino acids. Animal sources of protein, such as beef, pork, chicken, turkey, eggs and fish, and most protein supplements are considered complete proteins.

Incomplete protein sources are generally all plant sources (apart from soy – this makes soy protein an excellent complete source of protein for vegetarians). Incomplete protein sources are low in or lacking one or more of the essential amino acids. Plant-based sources such as beans (e.g. kidney beans), chickpeas, legumes and vegetables are considered incomplete, but they can be mixed to create complete proteins.

**Biological value (BV)** is a measurement of the ability of the body to make use of amino acids in foods. The higher the BV of a protein source, the greater the capacity for the body to make use of the amino acids.

**Protein complementation** occurs when two or more plant-based protein foods are eaten in one meal, with the shortfall in one protein food supplemented by an excess in another. The resulting mixture may be as good as a high-biological-value protein. For example, cereals are short of lysine but have plenty of methionine, whereas pulses are short of methionine but have plenty of lysine; mix the two together by combining beans with wholemeal toast or lentils with rice and a balanced protein is achieved.

### POINT OF INTEREST

Protein deficiency is rare in developed countries.

Even a vegetarian diet typically provides all the protein the body needs if it includes a wide variety of plant-based sources.

### POINT OF INTEREST

Proteins from the following groups complement each other:

- Meat and dairy produce.
- Pulses.
- Cereals.
- Nuts.

Protein-rich foods	
Poultry (turkey and chicken with skin removed).	Beans (pinto beans, black beans, kidney beans).
Meat (lean cuts of beef or pork with visible fat trimmed).	Lentils, split peas.
Fish (white fish, oily fish, shellfish).	Nuts (almonds, hazelnuts, mixed nuts, peanuts, peanut butter, walnuts).
Milk (full-fat, semi-skimmed, skimmed), yogurt.	Seeds (sunflower, sesame, pumpkin).
Hard cheese, soft cheese, cottage cheese.	Soy foods (tofu, tempeh).
Eggs.	Buckwheat, wheatgerm, quinoa.

Table 3.6 Protein-rich foods

## Protein requirements

The amount of protein needed by an individual depends on the training programme and other dietary goals, but the recommended starting point is between 15% and 20% of protein per day. Two to three servings of protein-rich food (complete, incomplete and complementary proteins) will meet the daily needs of most adults. Protein should be a major part of every meal consumed. A basic starting point to work out how much protein an individual needs is to consider body weight and physical activity levels.

Table 3.7 provides some suggested intakes of grams of protein per day depending on an individual's activity levels.

Activity or timing	Recommended intake (per kg body weight each day)
Sedentary adult.	0.8-1g/kg
Recreational adult exerciser – general training.	0.8-1.5g/kg
Adult endurance athlete – heavy training.	1.2-1.7g/kg
Adult strength athlete – heavy training.	1.2-1.7g/kg
Adult endurance athlete – extreme training.	2g/kg
Growing teenage athlete.	1.5-2g/kg
Adult building muscle mass.	1.5-1.7g/kg
Estimated upper limits (adults).	2.2g/kg

Table 3.7 Daily protein requirements

Protein breakdown increases during and immediately after exercise and protein manufacture slows down. The longer the exercise and the higher the intensity, the more protein is broken down. This is why reduced muscle size and strength is a symptom of over-training.

If an individual is training to increase muscle mass, protein needs are greater still for the natural breakdown replacement and for new growth. Too small an intake may cause smaller muscle growth or lack of progress in spite of hard training. However, the body can adapt to insufficient or excessive intakes of protein and progress may still be seen.

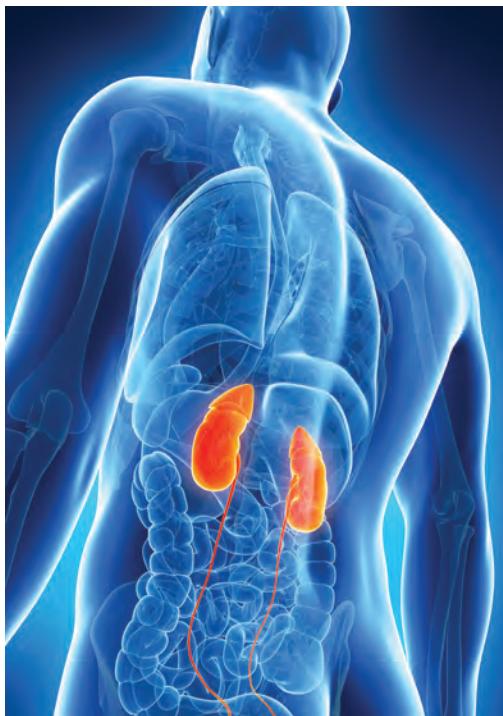
The protein needs of beginners are actually higher than those of experienced athletes due to the sudden increases in protein turnover. After a few weeks the body becomes accustomed to training and more efficient at recycling and conserving protein. Ultimately, however, the experienced athlete needs more protein than those who do not exercise regularly.

If inadequate amounts of carbohydrate are eaten for individual energy needs, protein may be broken down for energy rather than being used for growth and repair. This has implications if an individual is dieting to be a certain weight for a competition. Cutting energy intake means that protein needs are higher, so protein consumption should not be reduced.

Active individuals with a positive energy balance (eating more energy than they need) have smaller losses of protein and lower protein needs. Individuals wanting to increase their muscle mass must ensure they are obtaining enough energy through carbohydrate foods, as well as sufficient protein in their diet. Individuals with low glycogen stores risk breaking down proteins so it is important to have full glycogen stores.

Large amounts of protein are not needed to build muscle as muscles can only use a limited amount of protein for growth, provided there is enough carbohydrate to fuel the training. Any excess protein would not be converted into muscle, nor would it increase strength or stamina.

Surplus protein is a burden to the body, as it has to be broken down and converted to other substances. The amino group containing nitrogen is passed to the liver to be converted to urea and then passed to the kidneys to be excreted in urine. What is left of the protein is converted by the body into glucose. This can be utilised as energy or stored as fat if energy requirements are being met by carbohydrates.



### POINT OF INTEREST

Other theories surrounding excess protein state that:

- The kidneys and liver are placed under undue strain.
- Excessive calcium is excreted and can lead to dehydration due to the amount of water needed by the body to help dilute and excrete urea.
- It can contribute to kidney disease, gout and arthritis.
- It may increase calorie intake and therefore the risk of weight gain.

## Macronutrients: Fat

### Functions of fat

- Providing energy – Fat is a major source of energy during lower intensity workloads.
- Transportation, storage and utilisation of the fat-soluble vitamins A, D, E and K.
- Formation of cell membranes.
- Important component of the central nervous system and spinal cord and is vital in the formation of the myelin sheath.
- Synthesis of steroid hormones.
- Regulation of enzymes.
- Insulation through subcutaneous adipose tissue.
- Protection of internal organs.
- Essential fats help transport oxygen and keep red blood cells (the oxygen carriers) healthy. They are vital for the immune system, which is often challenged in people who do a lot of exercise.

### Structure of fats

Fats and oils are often referred to as **lipids**. Most dietary lipids consist of chains or rings of carbon atoms joined together with other atoms, most commonly hydrogen and oxygen.

Lipids that are liquid at room temperature are called oils, and those which are solid are called fats.

## Fatty acids

Fatty acids are the acids produced when fats are broken down during digestion. They are considered to be 'good fats'. Fatty acids are not highly soluble in water and can be used for energy by most cell types.

Fatty acids naturally occur as **triglycerides**, where three fatty acids attach to a carbohydrate 'backbone' called glycerol. During digestion, the fatty acids are broken off and then used in the body as required.

The function and behaviour of a fat is determined by the structure of fatty acid chains, which can be of different lengths and shapes. Fatty acid chains contain a backbone of carbon atoms, each paired with one or two hydrogen atoms. The shape and function of the chain is determined by the number of hydrogen atoms.

Fatty acids can be saturated, monounsaturated or polyunsaturated.

### POINT OF INTEREST

Fatty acids can:

- Help keep skin healthy.
- Help prevent early ageing.
- Help the body to process cholesterol.
- Help the arteries remove cholesterol build-up.
- Assist the adrenal and thyroid glands, which may also help regulate weight.

Fatty acid type	Structure	Appearance	Notes
<b>Saturated</b>	Chains are 'saturated' (filled) with hydrogen.	Straight. Tend to arrange themselves more uniformly.	<ul style="list-style-type: none"> <li>• Typically solid at room temperature.</li> <li>• More chemically stable.</li> <li>• Less likely to change when heated or exposed to oxygen.</li> </ul>
<b>Unsaturated</b>	Hydrogen atoms are absent from portions of the carbon chains. Unstable double bonds form between adjacent carbons where the hydrogen is missing.	Often a bending or kinking of the fatty acid chains at the point of the missing carbons. Less uniform and more fluid arrangement.	<ul style="list-style-type: none"> <li>• Typically liquid at room temperature (oils).</li> <li>• More unstable and reactive.</li> <li>• More likely to change when heated or exposed to oxygen.</li> </ul>
<b>Monounsaturated</b>	These oils contain fatty acids with only one double bond ('mono' means 'one').	The molecule has a single bend in it.	<ul style="list-style-type: none"> <li>• The body is able to recognise the distinct shape and length of the various monounsaturated fatty acids and utilise them accordingly.</li> <li>• Diets high in monounsaturated fats have been shown to lower levels of low-density lipoproteins (bad cholesterol) and plasma triglycerides (fat in the blood), and are thought to reduce the risk of coronary heart disease.</li> </ul>
<b>Polyunsaturated</b>	Long chains of carbon atoms; they are typically missing hydrogen at more than one point so they have more than one double bond ('poly' means 'many').	Each double bond is characterised by a bend or kink in the chain.	<ul style="list-style-type: none"> <li>• The varying positions of the double bonds give rise to distinct forms of polyunsaturated fats, two of which are considered fundamental to health: omega-3 and omega-6. These are commonly referred to as <b>essential fatty acids</b> (EFAs) because the body isn't able to synthesise them itself.</li> </ul>

Table 3.8 Fats

## **Omega-3 and omega-6 fatty acids**

These fatty acids play a fundamental role in numerous metabolic processes and are very specific to the functioning of the cell. They must be eaten in the required amounts to promote good health. The omega-3 fatty acids found in oily fish are particularly beneficial. They have been shown to reduce the blood's tendency to clot, lower blood triglyceride levels, lower total cholesterol levels and, in some individuals, to raise HDL (high-density lipoproteins) cholesterol, all of which are thought to lower the risk of CHD (coronary heart disease).

## **Storage of fat in the body**

Dietary fat is easily stored as adipose fat throughout the body, around the organs and beneath the skin. A small amount is stored in muscle. The amount stored depends on genetic make-up and individual hormone balance.

## **Dietary sources of fat**

<b>Saturated</b>	<b>Monounsaturated</b>	<b>Polyunsaturated</b>	
		<b>Omega-3</b>	<b>Omega-6</b>
Meat (beef, pork, lamb, venison), poultry (chicken, duck).	Lard, beef dripping.	Oily and fatty fish, cod liver oil.	Oils (soybean, sunflower, corn).
Dairy (milk, cheese, yogurt, cream, butter), eggs.	Nuts, seeds, olives, avocado.	Pasture-related eggs.	Evening primrose oil, safflower oil, grapeseed oil.
Oils (coconut, palm, palm kernel), cocoa butter.	Oils (olive, rapeseed).	Nut and seed oils (flax, hemp, walnut).	Seeds (pumpkin seeds, sesame seeds).

Table 3.9 Common sources of fat

## **Fat requirements**

Dietary recommendations for fats and their effect on human health are the subject of much debate.

Most fat-containing foods include a mixture of saturated, monounsaturated and polyunsaturated fats. All of these fats are equally rich in calories and are easily converted and stored as body fat.

Polyunsaturated fats are the most easily converted into energy so these fats should be chosen when planning a healthy diet, along with monounsaturated fats.

There are also specific reasons why some saturated fat should be included within the daily diet:

- Enhancement of the immune system.
- Provision of energy and structural integrity to the cells.
- Enhancement of liver function.
- The ability of coconut oil to act as an antimicrobial and an antiviral agent.

The amount of daily fat needed in grams varies according to body composition, goals and activity levels. On average, 20-30% of energy should come from fat. This equates to about 1-1.5g/kg of body weight. For sedentary individuals, fat intake should be reduced to the low end of the recommended range.

Some of this fat would be naturally provided by:

- Protein foods (cheese, chicken, fish and dairy foods).
- Added fats (butter, margarine, avocado and peanut butter).
- Hidden fats (high-fat cheeses, processed meats, chocolate, crisps and nuts).

## The relationship between fat intake and disease

Evidence indicates a significant link between disease and the consumption of heavily processed fats, in particular vegetable oils. A common processing method is **hydrogenation**, during which cheap vegetable oils are converted into solid, spreadable fats (such as margarine and shortening). Through a combination of heating and chemical manipulation, liquid unsaturated fats are essentially converted to a solid, saturated form. Potential by-products of this form of processing include **trans fats**; whilst these are structurally similar to 'normal' unsaturated fats, their fatty acid chains have been distorted by the hydrogenation process. Trans fatty acids may have adverse effects on blood lipid levels, promoting an increase in bad cholesterol and a decrease in healthier cholesterol, so where possible, these types of fat should be avoided.



### POINT OF INTEREST

Trans fats can be found in:

- Margarine products.
- Pre-made biscuits.
- Pre-made cakes.
- Pre-made cracker products.
- Takeaway foods.
- Pre-made pies.
- Pastry products.
- Pre-prepared meals.
- Many processed food products.

## Cholesterol

Cholesterol is a large lipid molecule produced by the liver, and it can't be used by the body as energy. As a lipid, cholesterol doesn't mix with the watery medium of blood, therefore the body has developed protein-based carriers called lipoproteins that completely encase lipids for transportation in the blood. Cholesterol is a vital component of cell membranes. Its functions include production of steroid hormones, synthesis of bile acids and synthesis of vitamin D. Cholesterol is so essential to life that the liver is able to synthesise about 75-80% of the body's own supply. When dietary cholesterol intake is low, the body increases the synthesis of its own supply, and when dietary intake increases, cholesterol production falls.

Cholesterol type	Formation	Function
Very low-density lipoproteins (VLDL).	Synthesised by the liver and contain cholesterol and triglycerides.	Transport triglycerides into adipose tissue.
Low-density lipoproteins (LDL). 'Bad cholesterol'.	Formed from VLDLs once they have unloaded most of their triglycerides.	Transport the remaining cholesterol to cells throughout the body that are in need.  Associated with increased availability of cholesterol to the tissues and therefore higher levels of blood cholesterol.
High-density lipoproteins (HDL). 'Good cholesterol'.	Synthesised by the liver.	Transport excess cholesterol from the tissues and blood back to the liver, potentially lowering blood cholesterol levels.

Table 3.10 Different types of cholesterol

Elevated levels of total triglycerides, elevated LDL cholesterol and lower than 25% HDL cholesterol have been identified as increasing the risk of heart and circulatory problems.

In the UK, the desirable upper limit of total cholesterol level is accepted to be 5.2mmol/dL. If members of the medical profession find levels above this, they will suggest lifestyle changes and will often prescribe medications (such as statins) to lower plasma cholesterol.

# Micronutrients: Vitamins and minerals

## Function of vitamins and minerals

Vitamins and minerals do not provide any energy but they are needed for good health and optimal physical performance. The body cannot make vitamins and minerals so they must come from food. Many vitamins and minerals form the essential parts of enzyme systems involved in energy production and exercise performance. Others are involved in the functioning of immune, hormonal and nervous systems. Vitamins and minerals are also components in cell structures.

Vitamins are classed as:

- **Fat-soluble** – Vitamins A, D, E and K can only be absorbed, transported and utilised in the presence of fat. A diet that is low in fat will lead to a severe deficiency in the fat-soluble vitamins, which will lead to ill health. Any excess leaves the body via the urine.
- **Water-soluble** – The B vitamins and vitamin C are absorbed, transported and utilised within water. They are absorbed along the length of the digestive tract and tend to have an effect within the cells themselves. These vitamins cannot be stored within the body in any great quantity, so they need to be included in the diet on a daily basis. A diet high in refined simple carbohydrates and sucrose will eventually lead to deficiency.

Minerals have many regulatory and structural functions in the body, such as controlling fluid balance in tissues, muscle contractions, nerve functions, enzyme secretions, hormone manufacture and formation of red blood cells. The body requires minerals in varying amounts. Calcium, chloride, magnesium, phosphorus, potassium, sodium and sulphur are required in larger amounts and some minerals are required in smaller amounts (trace minerals). A lack of minerals such as sulphur would impair muscle growth and strength increases after training, as muscle fibres cannot repair without them. Minerals such as zinc and magnesium are necessary for manufacturing testosterone essential for muscle growth and repair after exercise.

### POINT OF INTEREST

Only a qualified dietitian (or doctor) is able to prescribe vitamin or mineral supplements.

A registered nutritionist is only able to prescribe NHS-approved supplements, such as folic acid.

Both are able to diagnose deficiencies.



Many vitamins and minerals interact and work together:

- Healthy bones need vitamin D, calcium, phosphorus, magnesium, zinc, fluoride, chloride, manganese, copper and sulphur.
- The body's defence systems need vitamins C and E, zinc, manganese, selenium and copper.
- Vitamin C helps with the absorption of iron – eat a vitamin C-rich food with an iron-rich food. Avoid drinking tea/coffee with meals, as tannin and caffeine inhibit iron absorption.
- Zinc, calcium and iron interact with each other. An excess of iron can cause deficiency in zinc.

## Dietary sources of fat-soluble vitamins

Vitamin	Function	Source
A	<ul style="list-style-type: none"> <li>Maintains retinal health (vision).</li> <li>Essential for vision in dim light.</li> <li>Essential for the maintenance of healthy skin/surface tissues, especially those that excrete mucus.</li> <li>Stimulates gastric juices for protein digestion.</li> <li>Plays vital role in bone building.</li> <li>Protects against pollution and degenerative damage.</li> </ul>	<ul style="list-style-type: none"> <li>Animal origin foods.</li> <li>Dairy produce.</li> <li>Eggs.</li> <li>Liver and kidneys.</li> <li>Seafood and fish liver oils.</li> <li>Orange and green fruits and vegetables contain carotenes which can be converted in the body to retinol, therefore they are considered sources of vitamin A.</li> </ul>
D	<ul style="list-style-type: none"> <li>Needed for calcium and phosphorus absorption.</li> <li>Helps form strong bones and teeth.</li> <li>Helps regulate bone formation.</li> <li>Protects tissues against damage.</li> <li>Promotes normal growth and development.</li> <li>Helps in normal red blood cell formation.</li> </ul>	<ul style="list-style-type: none"> <li>The action of sunlight (UV light) on the skin.</li> <li>Fish oils and oily fish.</li> <li>Eggs.</li> <li>Butter.</li> <li>Vitamin D-fortified cereals, margarine and some yogurts.</li> </ul>
E	<ul style="list-style-type: none"> <li>Protects tissues against damage.</li> <li>Promotes normal growth and development.</li> <li>Helps in normal red blood cell formation.</li> <li>Aids blood circulation.</li> <li>Helps with tissue repair and healing.</li> <li>Maintains structural integrity of cells (e.g. healthy skin, nails and hair).</li> <li>Slows ageing process.</li> <li>Acts as a powerful antioxidant.</li> </ul>	<ul style="list-style-type: none"> <li>Pure vegetable oils.</li> <li>Wheatgerm.</li> <li>Wholemeal bread and cereals.</li> <li>Egg yolk.</li> <li>Nuts and seeds.</li> <li>Unrefined vegetable oils.</li> <li>Butter.</li> <li>Organ meats.</li> <li>Dark green, leafy vegetables.</li> </ul>
K	<ul style="list-style-type: none"> <li>Important role in blood clotting.</li> <li>Aids bone formation.</li> </ul>	<ul style="list-style-type: none"> <li>Spinach, peas, cauliflower and cabbage.</li> <li>Cereals.</li> <li>Liver.</li> <li>Eggs.</li> <li>Butter.</li> <li>Wholegrains.</li> <li>Dark green, leafy vegetables.</li> </ul>

Table 3.11 Fat-soluble vitamin food sources



## Dietary sources of water-soluble vitamins

Vitamin	Function	Source
<b>B1 Thiamin</b>	<ul style="list-style-type: none"> <li>Forms a coenzyme essential for the conversion of carbohydrates into energy.</li> <li>Used for normal function of the brain, nerves and muscles.</li> </ul>	<ul style="list-style-type: none"> <li>Wholemeal bread and cereals.</li> <li>Liver, kidneys and red meat.</li> <li>Pulses.</li> <li>Yeast extract.</li> <li>Fortified breakfast cereals.</li> </ul>
<b>B2 Riboflavin</b>	<ul style="list-style-type: none"> <li>Essential for the conversion of carbohydrates into energy.</li> <li>Promotes healthy skin and eyes and normal nerve functions.</li> </ul>	<ul style="list-style-type: none"> <li>Liver, kidneys, red meat, chicken.</li> <li>Fish.</li> <li>Milk, yogurt, cheese, eggs.</li> <li>Fortified breakfast cereals.</li> </ul>
<b>B3 Niacin</b>	<ul style="list-style-type: none"> <li>Essential for the conversion of carbohydrates into energy.</li> <li>Promotes healthy skin and normal nerve functions and digestion.</li> </ul>	<ul style="list-style-type: none"> <li>Liver, kidneys, red meat, chicken, turkey, fish.</li> <li>Milk, yogurt, cheese, eggs.</li> <li>Fortified bread and cereals.</li> <li>Legumes, nuts.</li> </ul>
<b>B6 Pyridoxine</b>	<ul style="list-style-type: none"> <li>Involved in the metabolism of fats, proteins and carbohydrates.</li> <li>Promotes normal red blood cell formation.</li> <li>Active in chemical reactions of amino acids and proteins.</li> </ul>	<ul style="list-style-type: none"> <li>Liver, lean meat, poultry, fish.</li> <li>Nuts.</li> <li>Pulses, soya beans.</li> <li>Eggs.</li> <li>Wholewheat bread, cereals.</li> <li>Bananas.</li> <li>Yeast extract.</li> </ul>
<b>B5 Pantothenic acid</b>	<ul style="list-style-type: none"> <li>Involved in the metabolism of fats, proteins and carbohydrates.</li> <li>Promotes healthy skin, hair and normal growth.</li> <li>Helps in the manufacture of hormones and antibodies.</li> <li>Required to make glucocorticoids.</li> <li>Aids energy release from food.</li> </ul>	<ul style="list-style-type: none"> <li>Liver, red meat.</li> <li>Wholemeal bread, yeast.</li> <li>Brown rice.</li> <li>Nuts.</li> <li>Pulses.</li> <li>Eggs.</li> <li>Vegetables, dried fruit.</li> </ul>
<b>B12</b>	<ul style="list-style-type: none"> <li>Needed for red blood cell manufacture.</li> <li>Used in fat, protein and carbohydrate metabolism.</li> <li>Promotes growth and cell development.</li> <li>Needed for nerve function.</li> <li>Required to make adrenalin.</li> </ul>	<ul style="list-style-type: none"> <li>Meat, fish and offal.</li> <li>Milk, cheese and yogurt.</li> </ul>
<b>Biotin</b>	<ul style="list-style-type: none"> <li>Involved in the manufacture of fatty acids and glycogen.</li> <li>Needed for normal growth and development.</li> </ul>	<ul style="list-style-type: none"> <li>Egg yolk.</li> <li>Liver, red meat.</li> <li>Nuts, peanut butter.</li> <li>Wholegrains and oats.</li> </ul>
<b>Folic acid</b>	<ul style="list-style-type: none"> <li>Essential in the formation of DNA and red blood cell manufacture.</li> </ul>	<ul style="list-style-type: none"> <li>Liver and offal.</li> <li>Green vegetables.</li> <li>Wheatgerm, yeast extract.</li> <li>Pulses.</li> </ul>

Vitamin	Function	Source
<b>C</b>	<ul style="list-style-type: none"> <li>Helps haemoglobin and red blood cell production.</li> <li>Aids body cell growth and repair.</li> <li>Promotes healthy blood vessels, gums and teeth.</li> <li>Used in the manufacture of adrenalin.</li> <li>Aids formation of collagen.</li> <li>Important for immune system function.</li> <li>Strengthens capillary walls.</li> <li>Vital for formation of collagen and connective tissue health.</li> <li>Helps in healing of wounds.</li> <li>Powerful antioxidant.</li> </ul>	<ul style="list-style-type: none"> <li>Fresh fruit, especially citrus fruit, berries and currants.</li> <li>Vegetables, especially dark green, leafy vegetables.</li> <li>Tomatoes and peppers.</li> </ul>

Table 3.12 Water-soluble vitamin food sources

## Dietary sources of minerals

Name	Function	Source
<b>Calcium</b>	<ul style="list-style-type: none"> <li>Important for bone and tooth structure.</li> <li>Helps with blood clotting.</li> <li>Helps with muscle contraction.</li> <li>Acts to transmit nerve impulses.</li> </ul>	<ul style="list-style-type: none"> <li>Dairy products.</li> <li>Fish with soft bones (e.g. salmon), seafood.</li> <li>Green, leafy vegetables.</li> <li>Fortified white flour and bread.</li> <li>Pulses.</li> </ul>
<b>Chloride</b>	<ul style="list-style-type: none"> <li>Regulates acid-alkali balance.</li> <li>Regulates fluid balance.</li> <li>Aids protein and carbohydrate digestion.</li> </ul>	<ul style="list-style-type: none"> <li>Natural unprocessed sea salt.</li> <li>Coconut flesh.</li> </ul>
<b>Magnesium</b>	<ul style="list-style-type: none"> <li>Involved in the formation of new cells, in muscle contraction and nerve functions.</li> <li>Assists with energy production.</li> <li>Helps to regulate calcium metabolism.</li> <li>Forms part of the mineral structure of bones.</li> </ul>	<ul style="list-style-type: none"> <li>Wholegrain cereals.</li> <li>Green vegetables, potatoes.</li> <li>Fruit.</li> <li>Nuts, sesame seeds, dried figs.</li> <li>Milk.</li> <li>Natural unprocessed sea salt.</li> </ul>
<b>Phosphorus</b>	<ul style="list-style-type: none"> <li>Assists in bone and tooth formation.</li> <li>Involved in energy metabolism as a component of ATP.</li> <li>Involved in kidney function.</li> </ul>	<ul style="list-style-type: none"> <li>Cereals.</li> <li>Meat and fish.</li> <li>Milk and dairy products.</li> <li>Green vegetables.</li> <li>Nuts and legumes.</li> </ul>
<b>Potassium</b>	<ul style="list-style-type: none"> <li>Works with sodium to control body fluid balance and muscle and nerve functions.</li> </ul>	<ul style="list-style-type: none"> <li>Vegetables.</li> <li>Fruit and fruit juices.</li> <li>Unprocessed cereals.</li> </ul>
<b>Sodium</b>	<ul style="list-style-type: none"> <li>Helps to control body fluid balance.</li> <li>Involved in muscle and nerve function.</li> </ul>	<ul style="list-style-type: none"> <li>Natural unprocessed sea salt.</li> <li>Tinned vegetables.</li> <li>Fish and meat.</li> <li>Ready-made sauces and condiments.</li> <li>Processed meats.</li> <li>Bread.</li> <li>Cheese.</li> </ul>

Name	Function	Source
<b>Sulphur</b>	<ul style="list-style-type: none"> <li>• Protection from infection.</li> <li>• Component in muscle cell structure.</li> <li>• Forms cartilage and skin.</li> <li>• Protects against radiation and pollution.</li> </ul>	<ul style="list-style-type: none"> <li>• Cruciferous vegetables.</li> <li>• Eggs.</li> <li>• Dairy products.</li> </ul>
<b>Iron</b>	<ul style="list-style-type: none"> <li>• Involved in red blood cell formulation and oxygen transport and utilisation.</li> </ul>	<ul style="list-style-type: none"> <li>• Red meat, liver and offal.</li> <li>• Egg yolk.</li> <li>• Fortified breakfast cereals.</li> <li>• Shellfish.</li> <li>• Wholegrain bread.</li> <li>• Pasta and pulses.</li> <li>• Dark green, leafy vegetables.</li> <li>• Dried fruit.</li> </ul>
<b>Zinc</b>	<ul style="list-style-type: none"> <li>• A component of many enzymes involved in the metabolism of proteins, carbohydrates and fats.</li> <li>• Helps to heal wounds and assists the immune system.</li> <li>• Needed for building cells.</li> </ul>	<ul style="list-style-type: none"> <li>• Red meat, dark meat of chicken.</li> <li>• Oysters.</li> <li>• Eggs.</li> <li>• Wholegrain cereals.</li> <li>• Legumes.</li> <li>• Milk and dairy products.</li> <li>• Peanuts, sunflower seeds.</li> </ul>
<b>Copper</b>	<ul style="list-style-type: none"> <li>• Turns glucose within cells into energy.</li> </ul>	<ul style="list-style-type: none"> <li>• Organ meats, shellfish.</li> <li>• Nuts and seeds.</li> <li>• Mushrooms.</li> <li>• Cocoa.</li> </ul>

Other trace minerals include manganese, iodine, boron, nickel, selenium, cobalt, chromium, molybdenum and silicon.

Table 3.13 Mineral food sources

## Vitamin and mineral requirements

Every individual needs a different amount of vitamins and minerals. Scientists have studied groups of people to come up with recommended values. Highly active individuals probably need to consume the upper limits, especially those vitamins and minerals that are involved in energy production and the breaking down of carbohydrate and fat. Regular exercise also causes an increase in red blood cell production, muscle cell growth and tissue breakdown and renewal: all of these processes involve vitamins and minerals.

Highly active individuals who do regular endurance exercise, such as running or cycling, may require increased antioxidant nutrients such as vitamins A, C and E to help the body use oxygen and detoxify the by-products of making energy. A higher intake of these vitamins would reduce the stress of endurance sports.

Guidance to help individuals consume sufficient vitamins and minerals includes:

- Eat a wide variety of fruit and vegetables (5-9 portions per day) of differing colours.
- Choose fresh, in-season produce where possible or frozen as a good alternative.
- Limit the storage time of vegetables; when cooking vegetables keep the lids on pans at all times and avoid overcooking.

## Antioxidants and phytochemicals

### Antioxidants

The term ‘antioxidant’ means to combat oxidation. Antioxidants are substances that help fight unstable molecules (called ‘free radicals’) in the body which may help trigger a number of serious ailments, such as rheumatoid arthritis, cancer, heart disease, Parkinson’s and Alzheimer’s disease. People who eat a diet high in antioxidant foods appear to have a lower risk of the development of chronic diseases, but this is difficult to prove because other factors may account for these effects.

Some antioxidants are produced in the body and others are obtained from foods such as fruit, vegetables, cereal grains, nuts and legumes.

**Oxidation** – the natural process that occurs when the body is exposed to environmental factors such as radiation and tobacco smoke. Oxidation produces free radicals.



### POINT OF INTEREST

Antioxidants include:

- Vitamin C.
- Vitamin E.
- Lutein.
- Lycopene.
- Beta-carotene.
- Coenzyme Q10.
- Flavonoids.
- Lipoic acid.

### POINT OF INTEREST

Phytochemicals include:

- Vitamin C.
- Vitamin E.
- Folic acid.
- Polyphenols.
- Carotenoids.
- Lignans.
- Isoflavones.

### Phytochemicals

Phytochemicals are plant-sourced substances that have health benefits and in some cases act as antioxidants. Phytochemicals act in a similar way to hormones and can be found in fruit, vegetables, grains and beans. Isoflavones and lignans (in soybeans, liquorice, wholegrains and flaxseed) may have an effect on the body similar to that of the hormone oestrogen. Some phytochemicals belonging to the flavonoid group (in cauliflower, Brussels sprouts and grapes) have antioxidant properties. Carotenoid phytochemicals (in squash and carrots) may have cancer-fighting properties.

## Hydration

### Water

Water is essential for the optimal functioning of:

- Cells – biochemical reactions, moving nutrients in and waste out.
- Electrolytes.
- Blood.
- Organs.
- Body tissues.
- Nerves.
- Muscles.
- Body temperature regulation.

Regular fluid intake also has immunity benefits. Saliva contains several proteins with antimicrobial properties, so maintaining saliva flow ensures levels are kept up.

Water plays a significant part in the performance of active individuals. Individuals who do not drink anything during exercise perform less well than they would if they drank adequate fluids.

When an individual exercises, they lose fluid from sweating and from breathing out (water vapour). The harder and longer the exercise and the hotter the environment, the more fluid is lost. If the fluid is not replaced quickly, dehydration occurs, which has an adverse effect on exercise performance.

In general, women lose less sweat than men performing the same workload. This is due to lower average body weight and higher percentage of adipose tissue (which is 10% water). Men tend to carry more muscle (which is 75% water) so they have a greater water reservoir and are less affected by dehydration.

Exercising muscles produce extra heat. This is why exercise increases body temperature. Extra heat has to be disposed of to keep the inner temperature around 37-38°C. If the temperature rise is too high, heat stroke can occur. To cool down, the body produces sweat. Water from the body is carried to the skin, and as it evaporates, heat is lost. For every litre of sweat that evaporates, 600 calories of heat energy is lost from the body. During an hour's exercise, an average person loses about one litre of fluid.

Thirst sensors are inhibited during prolonged exercise so individuals can easily become dehydrated, leading to an increase in body temperature causing energy to be diverted away from the muscles in order to cool the body down.

When hydrating prior to exercise, individuals should slowly drink beverages (for example, 5-7ml per kg body weight) at least four hours before the exercise task. If the individual does not produce urine, or the urine is dark or highly concentrated, more beverages should be consumed (for example, another 3-5ml per kg) about two hours before the event or activity.

Pre-hydrating should be initiated several hours before the exercise task to enable fluid absorption and allow urine output to return toward normal levels. Consuming beverages containing sodium or eating salted snacks or small meals can help to stimulate thirst and help retain the required fluids.

Eating plenty of carbohydrate also helps to store water because each unit of carbohydrate, stored as glycogen, is bound with nine units of water. As the glycogen is liberated to provide energy for muscles, so too is the water.

Individuals should develop customised fluid replacement programmes that prevent excessive dehydration (aim for less than 2% weight reduction from baseline body weight). Consumption of beverages containing electrolytes and carbohydrates can help to sustain fluid-electrolyte balance and exercise performance (American College of Sports Medicine (ACSM), 2007).

Another issue that can affect hydration levels is restrictive clothing, strapping and protective gear.

Consumption of normal meals and beverages after the activity or event will restore normal hydration levels. Individuals needing rapid and complete recovery from excessive dehydration should aim to drink 1.5l of fluid for each kilogram of body weight lost. Consuming beverages and snacks with sodium will help recovery by stimulating thirst and fluid retention.

## **Dehydration**

Risks of dehydration include:

- Increased core temperature as the body begins to overheat.
- Strain on the heart as the heart rate increases for a given workload due to the increased viscosity of blood.
- Increase of perceived effort and diminished concentration skills and mental functioning.
- Gastrointestinal discomfort and upset; this also makes rehydration more difficult to achieve.



## POINT OF INTEREST

Muscles are 75% water.

A loss of only 3% of this water causes a 10% drop in strength and an 8% loss of speed.



## POINT OF INTEREST

One way to estimate the amount of fluid lost during exercise is for the individual to weigh themselves before and after exercise.

For every 1kg decrease, replace with 1 litre of water.



Early signs of dehydration	Advanced signs of dehydration requiring urgent attention
<ul style="list-style-type: none"> <li>• Headache.</li> <li>• Fatigue.</li> <li>• Loss of appetite.</li> <li>• Flushed skin.</li> <li>• Heat intolerance.</li> <li>• Light-headedness.</li> <li>• Dry mouth.</li> <li>• Dry eyes.</li> <li>• Dark-coloured and strong-smelling urine.</li> </ul>	<ul style="list-style-type: none"> <li>• Difficulty swallowing.</li> <li>• Clumsiness.</li> <li>• Shrivelled skin.</li> <li>• Sunken eyes.</li> <li>• Dim vision.</li> <li>• Painful urination.</li> <li>• Numb skin.</li> <li>• Muscle spasms.</li> <li>• Delirium.</li> </ul>

Table 3.14 Signs of dehydration

Loss of water from the body has no direct link to fat loss, as was once believed (e.g. the use of sweatsuits/sweatpants). Deliberate dehydration techniques are often carried out for weight-category sports and physique competitions. These regimes are extreme and are not something to be encouraged, although it continues to happen in practice.



### What type of fluid is best?

Water is the best fluid replacer, as this is what the body has lost and what it needs. A number of studies have shown that it may be advantageous to have a drink with added carbohydrates or minerals (electrolytes) during prolonged exercise. This can serve three purposes: to replace water lost through sweating, to provide carbohydrate to boost dwindling reserves and to replace the electrolytes lost in sweat. Electrolytes are mineral salts dissolved in the body's fluid. They include sodium, chloride, potassium and magnesium. Electrolytes help to regulate the fluid balance between different body compartments, such as the amount of fluid inside and outside a muscle cell and the volume of fluid in circulation.

If exercise is high intensity and lasts for two hours or more, glycogen depletion and early fatigue as well as dehydration are likely to limit performance. A high-carbohydrate drink (up to 10-20g of carbohydrate per 100ml) would help to maintain blood sugar levels, spare liver glycogen (not muscle glycogen) and reduce fatigue. If sweating is profuse, a drink with a lower carbohydrate level would be more suitable.

If exercise lasts for less than two hours, extra carbohydrate is not necessary. Either water or a low-sugar drink (up to 2-3g per 100ml) with a fairly high electrolyte concentration (up to 60mmol) is best.

In hot conditions, the body's priority is to replace water rather than carbohydrate, so water or a low-carbohydrate electrolyte drink is best. If exercise is carried out in cold weather and there is little sweat, a carbohydrate drink may be beneficial.

## Overhydration

Hyponatraemia (low blood sodium levels) can occur during ultra-endurance events lasting longer than four hours as a result of drinking too much water, which dilutes the body's sodium levels. Overhydration can be avoided by being sensitive to thirst as a signal to drink, consuming salt in drinks beforehand, and monitoring weight before and after a race/event to check how much fluid is lost.

## Alcohol

Alcohol provides fuel (7kcal per gram) but is not classed as a nutrient. Alcohol is devoid of proteins, minerals and vitamins, and inhibits the absorption and usage of vital nutrients such as thiamin (vitamin B1), vitamin B12, folic acid and zinc. Alcohol calories cannot be converted to glycogen and therefore are not a good source of energy during exercise. The body treats alcohol as fat, converting alcohol sugars into fatty acids.

The latest guidance states there is no 'safe' drinking level, but less than 14 units a week is considered low-risk. The recommended levels are now the same for men and women.

High-risk drinkers who regularly drink more than the recommended amounts over long periods are more likely to suffer from serious conditions linked to excessive alcohol intake.



### POINT OF INTEREST

### UNITS OF ALCOHOL

Single measure of spirits (25ml) = 1 unit.

Pint of normal-strength beer = 2 units.

Medium glass of wine (175ml) = 2 units.

Large glass of wine (250ml) = 3 units.

Pint of strong beer = 4 units.

Physical effects	Psychological effects
Weight gain.	Alcohol dependence and addiction.
Liver damage.	Depression.
High blood pressure, cardiovascular disease, stroke.	Anxiety.
Pancreatitis, stomach ulcers.	Sleep disorders.
Various cancers.	Alcoholic psychosis.
Brain and nervous system damage.	Dementia.
Osteoporosis, risk of falls.	Suicide.
Reduced fertility.	

Table 3.15 Risks of heavy alcohol consumption



## Caffeine

Caffeine is a naturally-occurring substance found in 60 different plants. It is mildly addictive and the most commonly used drug in the world. Caffeine is currently permitted for professional sportspeople (but is being monitored by the World Anti-Doping Agency, and it has been prohibited in the past).

Caffeine can have positive short-term effects. It increases adenosine uptake in the brain, boosting mood and increasing alertness. Performance-enhancing effects can be found at levels as low as 1-3mg/kg of body weight (50-100mg caffeine). Caffeine increases fat mobilisation and utilisation during aerobic exercise, thereby 'sparing' glycogen.

Caffeine can also cause the following short-term negative effects, especially for those not used to it:

- Rapid heartbeat.
- Dizziness and light-headedness.
- Nausea.
- Shakiness and palpitations.
- Headaches.
- Anxiety and nervousness.

It is recommended not to drink more than four caffeine drinks per day and not to drink caffeine after 1pm (it takes about 10 hours for caffeine to leave the system, so it can affect sleep).

Caffeine can cause a number of health problems:

- It is a powerful diuretic, so high doses can lead to dehydration.
- It can interfere with iron absorption (avoid at mealtimes due to risk of iron deficiency).
- It stimulates the central nervous system, increasing heart rate and blood pressure.
- It can irritate the stomach and cause headaches and insomnia.
- Excess caffeine in pregnancy has been linked to babies with low birth weights. The current advice for expectant mothers is to consume no more than 200mg a day (in food and drink).

### POINT OF INTEREST

Caffeine is found in:

- Coffee.
- Tea.
- Cola-based drinks.
- Energy drinks.
- Chocolate.
- Diet pills.
- Sports gels.
- Sports drinks.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- What is a macronutrient?
- What is a micronutrient?
- What are the functions of carbohydrates?
- What percentage of a healthy diet should be made up of carbohydrate foods?
- What is glycogen?
- What is a complex carbohydrate? Give three examples of complex carbohydrate foods.
- What is a simple carbohydrate? Give three examples of simple carbohydrate foods.
- What is the difference between refined and unrefined carbohydrates?
- Research the carbohydrate content of various common foods.
- Compare the nutrition data of different carbohydrate foods.
- How much fibre should an individual eat per day?
- Research what foods could be eaten to meet an individual's daily fibre allowance.
- Source and research different glycaemic tables.
- Source a variety of foods and classify them as high-, moderate- or low-GI.
- Investigate good sources of protein for meat eaters and non-meat eaters.
- What are the functions of protein?
- What percentage of a healthy diet should be made up of protein foods?
- What are amino acids?
- What is the difference between essential and non-essential amino acids?
- What is a complete protein?
- What is an incomplete protein?
- What would be good food/meal combinations of the following groups of proteins?
  - Meat and dairy.
  - Pulses.
  - Cereals.
  - Nuts.
- What are the functions of fat?
- What percentage of a healthy diet should be made up of fats?
- What are trans fats?
- What is cholesterol?
- What are VLDL, LDL and HDL? Explain the differences between them.
- Name the fat-soluble vitamins and the water-soluble vitamins. Research the recommended intakes for each of the vitamins you identified.
- What is the difference between the fat-soluble vitamins and the water-soluble vitamins?
- Name four important minerals and their functions.
- Name two risks of dehydration.
- Name three risks of exceeding the recommended alcohol limits over a long period of time.
- Name four sources of caffeine.

# Section 4: Using nutrients to fuel activity

## A healthy, balanced diet for an active client

Active, health-conscious individuals need to choose a diet that optimises their health. An optimal diet should contain just the right amount of each nutrient to prevent a deficiency, to maintain a certain nutrient level in the blood or to minimise the risk of disease. The optimum level will be different for each individual, for example, men have different needs from women, growing children have different needs from adults, and athletes/sportspeople have different needs from sedentary individuals.

Research and information about nutrition for activity and sport is constantly changing and with the advancements of technology, more detailed analysis can be performed on active individuals, athletes and sportspeople to inform the correct methods of nutritional intervention to improve performance. An already-healthy diet can be manipulated to improve endurance, aid recovery, alter body composition, reduce fatigue and develop mental performance and skills.

Maximising physical performance depends on giving the body the right 'fuel' for energy, as well as consuming the right balance of essential nutrients and fluids for maintaining health.

When an individual starts to exercise, their body must start producing energy faster than it does when at rest. The muscles contract more strenuously; the heart beats more quickly, pumping blood around the body more rapidly and the lungs work harder. All of these processes require extra energy.

Energy is produced by the splitting of a chemical bond in a substance called ATP (adenosine triphosphate). This is often referred to as the body's energy currency. It is produced in every cell in the body from the breakdown of carbohydrates, proteins and fats. These three fuels are transported and transformed by various biochemical processes into the same end product: ATP.

The body stores only small amounts of ATP at any one time; there is just enough to keep up basic energy requirements while at rest. When an individual starts exercising, energy demand suddenly increases and the supply of ATP is used up within seconds. As more ATP needs to be produced to continue exercising, more fuel must be broken down.

### Where does the energy come from?

There are four components in food and drink that can be used to generate energy. Each one provides a different amount of energy when broken down in the body.

Food component	Energy
Carbohydrate.	4kcal per gram.
Protein.	4kcal per gram.
Fat.	9kcal per gram.
Alcohol.	7kcal per gram.

Table 4.1 Energy yield of food and drink components

### The most important fuels for exercise and activity

Carbohydrate, fat and protein are the fuel sources for the body, but before they can be used to fuel activity, their energy must be converted into the high-energy compound adenosine triphosphate (ATP). ATP is the immediate source of energy for all the body's functions. In a resting muscle, there is enough stored ATP to sustain activity for a few seconds. As the ATP in the muscle is used, enzymes break down another high-energy compound called creatine phosphate (CP) to replenish the ATP supply. As with ATP, the amount of CP stored in the muscle at any time is small. During the first 10-12 seconds of exercise, the muscles use the energy from the stored ATP and CP, but activity of longer duration requires the body to replenish ATP from the metabolism of energy-yielding nutrients.

Carbohydrates, fats and proteins are all capable of providing energy for exercise, although the production of ATP during most forms of exercise comes mainly from broken-down carbohydrates and fats. During a period of semi-starvation or following a low-carbohydrate diet, proteins can have a more important function for energy fuel, as glycogen would be in short supply.

The amount of each fuel that muscles use during exercise depends on:

- The type, intensity and duration of exercise.
- Fitness levels and training programme.
- Diet and nutritional status.

### Type

The blend of carbohydrate/fat/protein fuel would be different for a long, slow jog compared to a short sprint. The fuel blend also changes as the person continues to exercise. The combination used at the start is different from the combination used at the end. A fit, highly-trained individual would have a different fuel blend from a beginner.

### Intensity

Generally speaking, the harder a person exercises, the greater the proportion of carbohydrate and the smaller the proportion of fat used. During light or low-intensity exercise, an individual uses carbohydrate and fat. If the pace becomes slower, a greater proportion of fat is used. If the pace becomes faster, more carbohydrate is used. During moderate-to-high-intensity exercise, such as fast running, most of the fuel would be provided by carbohydrate. Proteins play a more important role in strenuous and prolonged exercise, e.g. the last stages of a marathon or long-distance cycle race when glycogen stores are exhausted. Even then, they only make up about 10% of the body's fuel mixture.

### Duration

As a person continues to exercise aerobically, more and more fat and less carbohydrate are used as the body makes every effort to conserve its glycogen stores. Fat is never burned completely on its own as it needs certain substances produced by the breakdown of carbohydrate. Glycogen stores in the muscles are unable to provide energy that lasts indefinitely. During the later stages of endurance events, the glycogen stores in muscles are extremely depleted and the stored glycogen in the liver becomes more important. Muscle proteins also start to break down into amino acids to help meet energy demands. After three or four hours of exercise (e.g. the last stages of a marathon) 75-90% of energy could be coming from glucose released by the liver.

All these energy-producing systems keep glucose levels surprisingly steady, but after exercise lasting over three hours, when liver and muscle glycogen stores are depleted, glucose levels can drop below normal ranges. This is known as **hypoglycaemia** and causes fatigue, nausea and dizziness.

### Fitness levels

As a result of aerobic training, muscles become better at using fat and sparing glycogen, so the body can exercise for longer before glycogen stores run down. As a person becomes fitter, they'll use a larger proportion of fat along with a smaller proportion of glycogen when exercising at any intensity. A beginner would predominantly use glycogen and a little fat in the first 15-20 minutes of exercise. After this time, glycogen stores would be low and fat would start to be used. An experienced athlete would start using fat after 5-10 minutes. He or she would be able to keep going for longer before their glycogen levels became depleted.

### Training programme

#### Anaerobic activities

During anaerobic activities (high-intensity, short-duration) the body must produce energy very rapidly without the help of oxygen. In order to generate sufficient ATP, a lot of glucose from carbohydrate food needs to be broken down and the glycogen stores are rapidly diminished. This cannot be kept up for long (1-3 minutes at most).



Anaerobic activities include:

- Sprinting.
- Throwing.
- Jumping.
- Kicking.
- Weight training.



## POINT OF INTEREST

Aerobic activities include:

- Jogging.
- Distance running.
- Distance cycling.
- Distance swimming.
- Exercise to music.
- Distance rowing.
- Brisk walking.
- Skiing.

### Aerobic activities

During aerobic activities (low-intensity, longer-duration) the demand for energy is slower. ATP is produced using oxygen, so this type of exercise can be kept up for longer. Fats can also be used to produce energy for aerobic activities as they can only be broken down with oxygen present. The body has a larger store of fat than carbohydrate.

Most sports and activities involve a mixture of both anaerobic and aerobic exercise, e.g. football, hockey and rugby contain short bursts of strenuous activity (sprints, kicks, throws) interspersed with longer periods of less strenuous activity (jogging, walking).

Fuel	Intensity of exercise					
	Maximal short bursts	High intensity intermittent	High intensity <40 min	High intensity 40-150 min	High intensity >150 min	Low intensity
<b>Creatine phosphate</b>	Great.	Very great.	Moderate.	Moderate.	Moderate.	Negligible.
<b>Muscle glycogen</b>	Slight.	Moderate.	Moderate.	Very great.	Very great.	Negligible.
<b>Liver glycogen + blood glucose</b>	Negligible.	Slight.	Slight.	Moderate-great.	Great-very great.	Slight.
<b>Fat</b>	Negligible.	Slight.	Negligible.	Negligible.	Slight.	Slight.

Table 4.2 Depletion of fuel for different types of exercise

## Energy to start exercise

At the start of exercise, energy is produced without oxygen. As the heart and lungs work harder, carbohydrates and fats can be broken down. If the exercise becomes aerobic in nature, more oxygen is delivered around the body and fats start to be broken down into fatty acids, taken to muscle cells and used as energy. For the first 5-15 minutes (depending on fitness level) carbohydrate (glycogen) is used for fuel. As time goes on, the use of carbohydrate lessens and more fat is utilised for energy.

## Fatigue

The fitter the individual is, the longer it takes to fatigue or run out of glycogen. After three or more hours of exercise, fatigue is caused by the depletion of glycogen in the muscles and liver, as well as low blood glucose levels.

No matter what type of exercise is completed, or how fit the individual is, the body will always need glycogen. The amount of glycogen in the muscles (and liver) before exercise is crucial, as the size of a person's store dictates how long they will be able to exercise for before fatiguing. The message is 'always start with a full glycogen store'.

A diet rich in carbohydrates ensures high glycogen stores. The amount of glycogen in the muscles dictates how hard and for how long an athlete can exercise. If the individual eats a high-carbohydrate diet prior to training and competitions, their stores will be full.

- Low glycogen levels would only allow for low-intensity exercise and cause early fatigue.
- High glycogen levels mean an athlete can train harder and longer.



## Fat and exercise

The speed at which the body uses fat for exercise depends on the following:

- How fast fat is broken down into fatty acids; this requires oxygen so the exercise needs to be aerobic.
- How fatty acids are delivered into muscle cells.
- The speed at which the fatty acids are transported into the mitochondria in muscle cells.
- How many mitochondria are in the cells.
- How many fat-burning enzymes are in the body.
- The distribution of muscle fibre types in the body and the way type IIa intermediate fibres are trained to respond; some fibres are better-suited to producing ATP aerobically and some anaerobically.

All of these factors can be improved by regular aerobic training and this helps to keep the body's fat levels within normal range.

## Eating before and during exercise

There has been a lot of research around what to eat before training and events, as well as what to eat during endurance events.

It has been shown that consuming a modest amount of carbohydrate (liquid or solid) before or during exercise is a good idea, particularly for endurance exercise. Some people are more susceptible to the lowering of blood sugar during exercise so the exact amount needed varies from person to person. Most experts recommend about 50g of carbohydrate, but more or less may be suitable.

It is important for an individual to experiment during training rather than an event. The carbohydrate can be taken before exercise or during the warm-up and then at regular intervals, depending on the duration of the training.

If an individual is training for more than an hour, taking extra carbohydrate in the form of food or drink helps to boost blood sugar levels, delay fatigue and maintain exercise intensity. It is important to take this at regular intervals before fatigue sets in. If an individual is performing in a continuous event, such as a marathon, fuel should be carried or picked up from drinks/energy stations. If an individual is performing in a tournament/match they should ensure carbohydrate is consumed in the breaks between bouts/matches.

Carbohydrate should be consumed about 30 minutes into the activity. For most extended activities/events, an intake of 30-60g per hour is sufficient (1g per minute) as the maximum that the body can oxidise is 60g per hour. A carbohydrate with a high GI would be suitable for consumption during competition, and liquids are easier to consume than solids. This is where carbohydrate drinks are useful.

<b>Suitable carbohydrate snacks between competition bouts</b>	
Rice cakes or crackers with fruit spread.	Toast with fruit spread or honey.
Cereal bars.	Muffins.
Fruit or dried fruit.	Real fruit cake.
Oatmeal biscuits or oatcakes.	Fig rolls.
Maltodextrin drinks.	Carbohydrate gels.
<b>Suitable carbohydrate meals when there are more than two hours between bouts</b>	
Baked potato and beans, sweetcorn or cottage cheese.	Breakfast cereal and skimmed milk.
Boiled pasta and tomato sauce.	Baked beans on toast.
Rice with white fish and peas.	Couscous with beans and raisins.

Table 4.3 Carbohydrate snacks and light meals to eat between competition bouts

## Recovery after exercise

Glycogen stores need refilling after exercise just as petrol needs refilling in a car after a long journey. Without refuelling before the next exercise session, early tiredness and poor technique may be experienced. If an individual does not eat enough carbohydrate it will take longer to refuel (more than two days if they are eating a low-carbohydrate diet).

Intensity, duration and training experience all affect overall depletion of glycogen. An individual might deplete their stores after 15-20 minutes of intense exercise or they might deplete them after 2-3 hours of low-intensity exercise. Many team sports involve a mixture of high- and low-intensity exercise and it is not uncommon to be depleted in

glycogen at half-time. The more experienced a person is at a particular sport or activity, the more fat is utilised as fuel. Muscles learn to economise glycogen to keep them going for longer. A beginner's glycogen would get depleted a lot earlier on than that of an experienced athlete. Also, an experienced athlete's body would have an increased glycogen-storing capacity. The more trained an individual is, the more quickly the body can refuel; this is one of the adaptations of training. Elite athletes are able to train every day, while a beginner would not be able to train that frequently (and should not).

To perform well, the body needs ample glycogen stores, which means leaving enough time between training sessions to refuel and consume enough carbohydrate.

Individuals need to allow sufficient time for muscles to recover between training sessions. For this, they can alternate between heavy and light sessions, different muscle groups or work and rest.

Recovery meals should:

- Replenish liver and muscle glycogen stores.
- Replace fluid and electrolytes lost in sweat.
- Regenerate and repair damaged tissues.

The best time to start refuelling is as soon as possible after training, and then the individual should continue to eat a high-carbohydrate snack every two hours. This is more effective than eating a large meal, as glucose from the bloodstream can only pass into muscle cells at a fixed rate determined partly by insulin levels. The rate of glycogen synthesis is optimal when high- or moderate-GI carbohydrate foods are eaten.

Within 60 minutes after exercise, 1-1.5g of high-GI carbohydrate should be consumed, and then at frequent intervals until the next meal. Adding a small amount of protein would stimulate carbohydrate storage and result in faster repair and recovery of muscles.

The best type of carbohydrate to eat later on would be low- or moderate-GI foods because glycogen manufacture would be slower, enzymes would be able to cope with the speed of supply and all of the carbohydrate would be converted to glycogen rather than fat. A larger amount of glucose is not necessarily taken into cells more quickly than a smaller amount, and the remainder would be converted into fat. The enzymes that convert glucose into glycogen can only work at a set speed. A small meal containing 50g of carbohydrate is absorbed into the bloodstream and virtually all of that carbohydrate would be converted into glycogen within about two hours. If there were a delay in eating carbohydrate after exercise, glycogen manufacture would be slower and it would take longer to refuel.

Examples of suitable meals to consume 1-3 hours after exercise:

- Lasagne with vegetables and potatoes, followed by fruit.
- Stir-fried chicken and vegetables with noodles, followed by yogurt.
- Baked beans on toast, followed by fruit.
- Macaroni cheese with salad, followed by oat apple crumble.
- Hummus with pitta bread and salad, followed by fruit.
- Chilli, red kidney beans and rice with salad, followed by fruit.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- What is an optimal diet?
- How do type, intensity and duration of exercise affect the amount of fuel that muscles use during exercise?
- How do fitness levels affect the amount of fuel that muscles use during exercise?
- What is hypoglycaemia?
- List four anaerobic activities/sports.
- List four aerobic activities/sports.
- Explain how fat is used as a fuel during exercise.
- Explain how carbohydrate is used as a fuel during exercise.
- What are the guidelines for eating before, during and after training?

# Section 5: Tailoring nutrition to client goals

It is essential for a skilled professional to know how to estimate daily energy and nutrient requirements for clients with different goals. These goals can vary but the most common are those involving weight management, fat loss or performance.

## Weight management

The following terms are useful to know when tailoring nutrition goals for weight management.

### **Calories**

Calories are a measure of the amount of energy in food. The calorie content of many foods is stated on the nutrition label under the heading 'Energy'. The calorie content is often given in kcals, which is short for 'kilocalories', and also in kJ, which is short for 'kilojoules'. A 'kilocalorie' is another word for what is commonly called a 'calorie', so 1,000 calories will be written as 1,000kcals.

### **Energy balance**

Energy balance occurs when total energy intake from food matches energy expenditure from daily activity. Energy is provided by the carbohydrate, protein, fat and alcohol in food and fluids. An individual's energy requirements are influenced by factors such as body size, body composition goals and the energy cost of training.

If the calories consumed are greater than those expended then the extra calories will be stored, most likely as excess body fat. Consequently, a common approach to reducing body fat is to establish a **negative energy balance** (an energy deficit) by consuming fewer calories than the amount expended.

An athlete would need to be in **positive energy balance** before an event to ensure there is enough energy to fuel the activity to follow.

### **The basal metabolic rate (BMR)**

BMR is the rate at which the body uses energy for vital functions during rest, e.g. breathing and staying warm. BMR is calculated using the variables: height, weight, age and gender.

### **Thermic effect of food (TEF)**

TEF refers to the amount of energy expended by the body through the ingestion, digestion, absorption, utilisation and storage of food. TEF accounts for 6-10% of daily energy expenditure for men and 6-7% for women.

### **Thermic effect of physical activity (TEPA)**

TEPA includes the amount of energy required for planned and unplanned levels of physical activity. TEPA is the most variable component of energy expenditure, and it accounts for approximately 20-40% of total energy expenditure.

### **Total daily energy expenditure (TDEE)**

TDEE is the amount of calories the body needs on a daily basis to fuel all its functions and any exercise undertaken.

### **Non-exercise activity thermogenesis (NEAT)**

NEAT is the energy expended that is not from sleeping, eating or physical activity. It includes the energy expended from everyday movement such as typing and fidgeting. NEAT can be measured by subtracting BMR and the thermic effect of food from total daily energy expenditure.

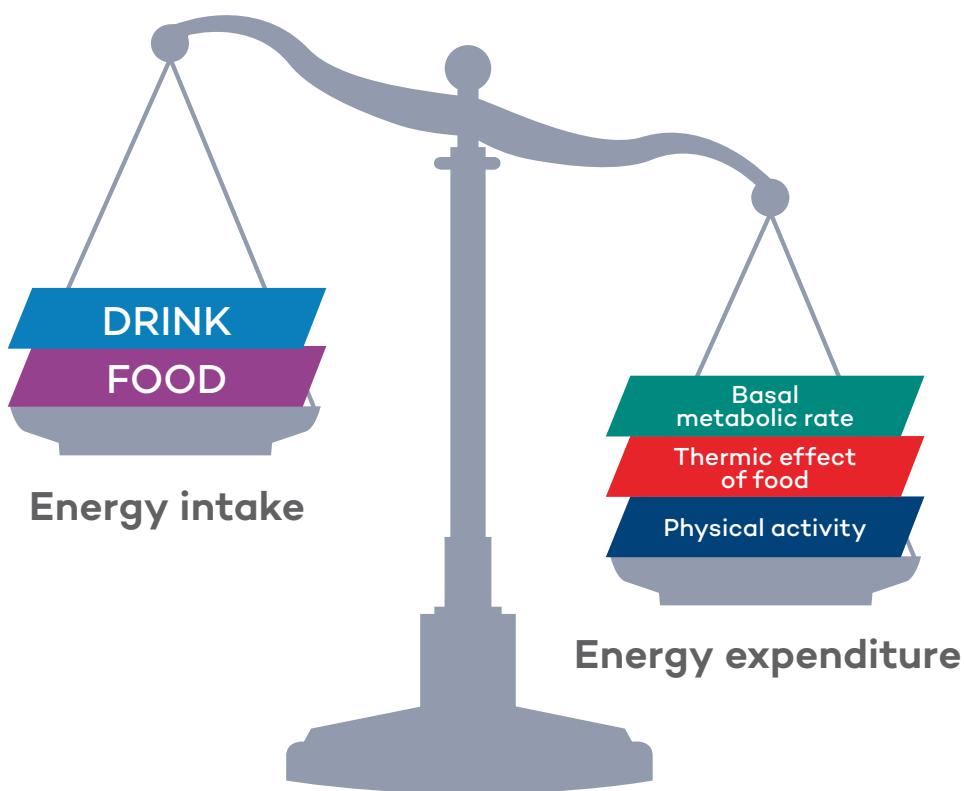


Figure 5.1 Energy balance equation

## Handy energy equations

To convert kilocalories into kilojoules, multiply the amount by 4.2.

$$1\text{kcal} = 4.2\text{kJ}$$

$$10\text{kcal} = 42\text{kJ}$$

To convert kilojoules into kilocalories, divide by 4.2.

### Example:

If 100g of food provides 400kJ and you need to know the kilocalories:

Divide 400 by 4.2 (=95kcal).

### Example

1 slice (25g) of wholemeal bread contains:	
10.4g carbohydrate	= 166kJ (42kcal)
0.6g fat	= 22kJ (5kcal)
2.3g protein	= 39kJ (9kcal)
<b>Total</b>	<b>= 227kJ (56kcal)</b>

### To find the percentage of energy from carbohydrate

$$\frac{42}{56} \times 100 = 75\%$$

$$\frac{\text{kcal or kJ from carbohydrate}}{\text{total kcal or kJ}} \text{ or } \frac{166}{227} \times 100\% = 75\%$$

### To find the percentage of energy from fat

$$\frac{5}{56} \times 100 = 9\%$$

$$\frac{\text{kcal or kJ from fat}}{\text{total kcal or kJ}} \text{ or } \frac{22}{227} \times 100\% = 9\%$$

### To find the percentage of energy from protein

$$\frac{9}{56} \times 100 = 16\%$$

$$\frac{\text{kcal or kJ from protein}}{\text{total kcal or kJ}} \text{ or } \frac{39}{227} \times 100\% = 16\%$$

## The Harris-Benedict equation

Energy intake is estimated at 2,000 calories per day for women and 2,500 calories per day for men. These are very basic and general guidelines that do not take any specific individual requirements into account.

The Harris-Benedict equation provides a better estimate of individual daily energy needs, taking gender, age, height, weight and activity levels into consideration.

The result does not account for the amount of lean body mass, so it would not be accurate for the extremely muscular (under-estimate caloric needs) and the extremely overweight (over-estimate caloric needs).

**Conversion formulae:** 1 inch = 2.54 cm 1 kg = 2.2 lbs 1 stone = 14 lbs

### Men

Basal metabolic rate =  $66 + (13.7 \times \text{weight in kg}) + (5 \times \text{height in cm}) - (6.8 \times \text{age})$

### Women

Basal metabolic rate =  $655 + (9.6 \times \text{weight in kg}) + (1.8 \times \text{height in cm}) - (4.7 \times \text{age})$

#### Example

Female, 30 years old, 5' 6" tall (167.6cm) and weighing 8 stone 8lbs (54.5kg).

Basal metabolic rate =  $655 + 523 + 302 - 141 = 1339$  calories/day

Once the basal metabolic rate is known, the total daily energy expenditure (TDEE) can be calculated by multiplying basal metabolic rate by the activity multiplier.

Activity multiplier		
Sedentary.	BMR x 1.2	Little or no exercise, desk job.
Lightly active.	BMR x 1.375	Light exercise/sports 1-3 days/week.
Moderately active.	BMR x 1.55	Moderate exercise/sports 3-5 days/week.
Very active.	BMR x 1.725	Hard exercise/sports 6-7 days/week.
Extra active.	BMR x 1.9	Hard daily exercise/sports and physical job.

Table 5.1 Activity multiplier for calculating TDEE

## Reducing body fat levels

A certain amount of body fat is essential for:

- Providing protection, cushioning and insulation around organs.
- Forming an essential part of the membranes in every cell in the body and in the brain, nerve tissue and bone marrow.



Women need 5-9% more body fat than men to ensure normal hormonal and menstrual functions occur.

The minimum amount of body fat essential for life is around 3-5% for men and 8-14% for women. These ranges are classed as very low.

Very low body fat levels are not sustainable and can be detrimental to health. Keeping body fat low is often associated with poor nutritional status. Performance suffers (early fatigue, increased risk of infection and intolerance to cold) and women's periods may stop, putting them at risk of additional problems, such as increased bone loss and osteoporosis.

It is difficult to come up with an exact figure of how much body fat is healthy, but it's estimated at 8-25% for men and 21-36% for women – the upper levels of these ranges are aimed at older adults. For competitive sportspeople, these figures tend to be lower.

There is no secret formula for losing body fat. The best way is through a combination of healthy eating and exercise. Food intake needs to be nutritious and the diet balanced, while eating fewer calories than normal. Experts in the field of nutrition recommend beginning by cutting out high-fat and high-sugar foods that are low in protein, vitamins and minerals. It is important that carbohydrate intake is sufficient to meet energy demands with enough protein to ensure satiety and prevent loss of lean muscle tissue.

Reasons for cutting out high-fat foods:

- Fat contains more energy (calories) than starchy carbohydrate foods or protein. It is therefore easy to ingest excess energy from fat through small portion sizes.
- Fat in the diet is easily converted into body fat.
- The body can store almost unlimited quantities of dietary fat. Only small amounts of starch foods and sugars can be stored in muscle and the liver.
- Fats have a weak effect on long-term control of appetite and little impact on feeling full, which can lead to over-eating.

### POINT OF INTEREST

Eating a diet that's too low in fat carries the risk of preventing the fat-soluble vitamins from being absorbed.

It is difficult to estimate how many calories need to be reduced in the diet to encourage fat loss as everyone is different. Current NHS recommendations suggest that individuals should aim to lose about 0.5-1kg (1-2lb) a week. This should be achievable by eating 500-600 fewer calories than needed per day. This rate will ensure muscle is retained while body fat is lost. Faster weight loss is usually due to loss of water and muscle, which would affect performance.

One of the problems with 'dieting' is that metabolism tends to slow as the body adapts to a lower intake of food. There is also a greater tendency to break down muscle (protein) for energy. Exercise can prevent this from happening. It is recommended that individuals increase their levels of low-intensity exercise to ensure fat is being used, rather than high-intensity exercise where more glycogen is burned.

## **Following popular diets**

Many different dietary approaches are used today in an effort to achieve a desirable body weight and size. It's vital that clients who are planning to embark on one of these diets understand the reasons behind the approach and the potential health risks associated with these weight-loss methods. Empathetic, accurate and clear communication will help the client make an informed decision about their nutrition and avoid falling into a trap of yo-yo dieting and harming their health.

### **Low-carbohydrate diets**

Extensive research supports the benefits of a high-carbohydrate diet in improving the performance of endurance exercise, 'stop and go' high-intensity sports (such as team and racquet games) and high-intensity bursts of activity. However, popular diets proclaim that a reduction of carbohydrate intake is the key to successful weight loss. In some cases, followers restrict carbohydrate intake to very low levels while continuing to eat generous amounts of foods that are high in fat and/or protein. The rationale is that low-carbohydrate diets cause a shift in fuel use to increase fat-burning, but this is not the case. Decreasing glycogen stores can cause the body to start breaking down muscle protein for much-needed glucose, causing loss of lean muscle and therefore strength. These diets lead to a lack of energy during exercise, early fatigue, loss of concentration and delayed recovery.

### **Very low-calorie diets**

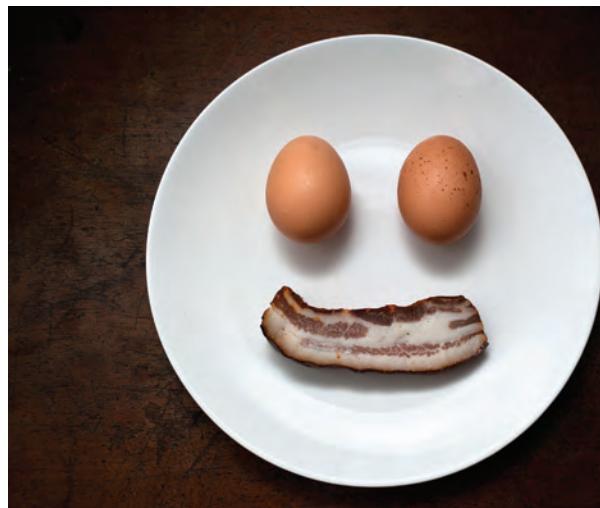
Very low-calorie diets often recommend consuming less than 800kcal/day. These diets are designed for the obese to achieve rapid weight loss. They often include meal replacements such as shakes and bars fortified with daily requirements of vitamins and minerals. The risks of very low-calorie diets include:

- Fatigue.
- Constipation or diarrhoea.
- Nausea.
- Possible gallstone formation.
- Lack of essential nutrients.

### Meal replacement diets

Many set 'diet plans' include foods that are processed and of poor quality. This is often true of meal replacement diets and slimming groups that allow 'cheats' or 'treats'. Any diet that contains processed foods and lacks real food cooked from scratch from real ingredients may lead to nutritional deficiencies. Individuals following these diets may find it difficult to go back to healthy eating and can experience unhealthy eating patterns as they go from one quick-fix to another.

The key is to advise clients to eat a healthy diet in line with current health recommendations and to be able to make sense of all the 'diet industry' information that is thrown around in the media.



### Recognising fad diets

Ask the following questions when presented with a diet that strays from the current recommended healthy eating guidelines; the answers may help you decide whether the diet is just a 'fad'.

Does the diet:

- Recommend large quantities of a specific food/rely on a 'miracle' food?
- Recommend a particular supplement or food replacement?
- Enforce food combinations?
- Require a very limited energy intake?
- Excessively restrict carbohydrate-rich foods?
- Include highly processed foods?
- Promise a quick fix?
- Challenge current thinking?
- Address the cause of the problem, such as lack of exercise or overeating due to boredom, loneliness or depression?
- Show that it has been scientifically tested?

### POINT OF INTEREST

Hypertrophy is the increase in size of skeletal muscle resulting from the increased size of individual muscle fibres.

## Gaining muscle

Increased muscle mass can be achieved by combining the right sort of training (strength/resistance) to provide the stimulus for muscle growth with a balanced diet containing the nutrients to enable muscles to grow.

To gain lean weight, an individual would need to eat enough calories, carbohydrates, proteins, vitamins and minerals. If any of these were in short supply, gains would be slower.

It is estimated that to gain 1 pound (0.45kg) of muscle, an individual would need to eat an extra 2,500 calories. This means to gain 1 pound of muscle each week, an individual would need an extra 300-400 calories per day. In practice, this figure varies depending on individual metabolism, and there is a fine balance between eating enough to gain muscle and eating too much and gaining fat.

It is advisable that food intake provides a steady supply of nutrients through the day, e.g. splitting meals into five or six daily parts. Do not leave more than two to three hours between meals.

### Muscle protein synthesis

Recent research (Macnaughton and Witard, 2014) suggests that one primary driver of muscle hypertrophy is the stimulation of muscle protein synthesis (MPS) during exercise recovery. Several factors are important for MPS, including the type of protein eaten and the pattern and timing of protein intake. Recent guidelines regarding how much dietary protein individuals should consume are given on a meal-by-meal basis rather than a total daily amount. Ingesting 20g of high-quality protein is sufficient for the maximal stimulation of MPS during exercise recovery. If

the protein is plant-based, increase levels to 25-30g. After resistance exercise, 25g of protein is sufficient for the maximal stimulation of MPS.

Recent research has shown that a dietary pattern that distributed 90g of protein evenly between breakfast (30g), lunch (30g) and dinner (30g) stimulated a greater response of MPS compared with a meal pattern that contained a larger proportion of daily protein intake (64g) in the evening meal, with a breakfast of 10g and lunch at 16g. Protein at bedtime has also been shown to increase the overnight stimulation of MPS.

## Competition nutrition

A lot of research has been done in this area and it is clear that certain dietary approaches can enhance competition performance. These approaches depend on the event and should be tailored to the individual.

Each of the following events would require a different nutrition strategy:

- Team-based events.
- Multi-day events.
- Ultra-endurance races.
- Weight-category sports.
- Track and field events.

### Pre-competition nutrition – one week before

Optimal nutritional intake one week before an event requires the fine-tuning of an already well-planned training and eating regime and should involve no surprises – all of the eating strategies should have been practised beforehand.

It is important to ensure glycogen stores are full, and this is especially important when taking part in an event lasting longer than 90 minutes, an endurance event or a number of heats spread over a short period. The best way to increase glycogen stores is to taper training the final week before a competition (with a complete rest day before the competition so that glycogen stores have a chance to recover and refill) and to increase carbohydrate intake by eating complex carbohydrate foods with a low GI. For the last three to four days, it is important to eat a small snack every two to three hours.

Total energy intake should remain about the same as usual – eating smaller portions of high-protein foods, keeping fat to a minimum and eating larger portions of carbohydrate. Ideally, 60-70% of energy should come from carbohydrates in the last few days.

### Pre-competition meal

The pre-competition meal should be eaten about three to four hours before the event to allow for digestion and for blood sugar and insulin levels to return to normal. If the event is started with high insulin levels, the athlete may develop low blood sugar and risk hypoglycaemia during the event. Pre-competition nerves also tend to slow down the rate at which the stomach empties. It is essential that the athlete has a trial run to see what works best for them.

Eating a meal with 200-300g of carbohydrate 3-4 hours before competition improves performance. This may be due to boosts in glycogen levels, delayed fatigue and improvement of glucose uptake from the bloodstream during latter parts of the competition.

Pre-competition meals should be:

- High in carbohydrate.
- Low in fat.
- Low in protein.
- Low in fibre.
- Enjoyable and familiar.
- Light and easy to digest.
- Partly consisting of fluid.



Suitable foods for the pre-competition meal include:

- Breakfast cereals or porridge.
- Bread, rolls or toast.
- Fruit juice.
- Rice cakes or plain crackers.
- Boiled rice.
- Potatoes, sweet potatoes or yams.
- Boiled pasta.
- Dried fruit.
- Oatmeal/wholemeal biscuits or homemade muffins.
- Carbohydrate drinks.

Just before the competition, a small amount (50g) of fast-absorbing (high-GI) carbohydrate can be eaten. This can help to delay fatigue and improve endurance. If exercise were to begin within five minutes of consuming the snack, the carbohydrate would be quickly absorbed but the usual rise in insulin would be prevented, therefore blood sugar levels would be slightly raised for longer which can help 'spare' glycogen stores and keep the athlete going for longer.

### POINT OF INTEREST

Suitable 50g carbohydrate foods include:

- 300ml carbohydrate drink (20% maltodextrin).
- 75g raisins.
- 8 rice cakes.
- 1 bar of confectionery.
- 500ml fruit juice or ready-made soft drink.



## Endurance events

### *Carbohydrate loading*

The aim of carbohydrate loading is to raise the muscles' glycogen stores above normal levels. This is advantageous in endurance events that last for two hours or more, such as long-distance running and cycling, or if the individual has a number of competitions in a short period of time (e.g. tennis matches or a rugby tournament). It is not advantageous in anaerobic sports or short events. It is also unwise to do this more than four times per year.

High levels of pre-competition glycogen help to delay fatigue and improve performance in the latter stages of the event. By eating moderate levels of carbohydrate for the 3 days before carbohydrate loading (when training begins to taper) and then increasing carbohydrate intake for the 3 days before an event, muscle glycogen stores can be increased to 20-40% above normal. On the last day, aim to reduce the bulk and fibre content of the diet.

Meltzer and Fuller 2005 suggest an intake of 7-12g carbohydrate/kg body weight for the 3 days leading up to the event.

Sample carbohydrate loading menu	
Meal 1	100g oats, half pint of skimmed milk, banana, 2 slices of toast, 1tsp low-fat spread, 1tbsp honey.
Meal 2	1 large baked potato, 1 small tin of baked beans, 1 orange.
Meal 3	85g pasta, 100g sweetcorn, 2 apples.
Meal 4	2 rolls, 1tsp low-fat spread, 1tbsp honey.
Meal 5	85g noodles (dry weight) with vegetables, 250ml maltodextrin (20%) drink, 100g rice pudding (low-fat milk).
Meal 6	2 slices of bread, 100g fruit.
3,000 calories/650g carbohydrate (80% of calories).	

Table 5.2 Carbohydrate loading menu example

### **During the event**

If an individual is competing for more than an hour, taking extra carbohydrate in the form of food or drink helps to boost blood sugar levels, delaying fatigue and maintaining exercise intensity, especially during the later stages of the event when glycogen is considerably depleted. It is important to take in carbohydrate at regular intervals before fatigue sets in. If performing in a continuous event, such as a marathon, ensure fuel is carried or available at drinks/energy stations. If performing in a tournament, ensure carbohydrate is consumed in the breaks or between bouts/matches.

An individual should start to consume carbohydrate about 30 minutes into the activity. For most events or sports an intake of 30-60g per hour is enough – think of it as 1g per minute (the maximum that the body can oxidise is 60g per hour).

Any carbohydrate with a high GI would be suitable to consume during competition, but liquids are easier to consume than solids. This is where carbohydrate drinks are useful. Maltodextrin drinks are a way of obtaining a lot of carbohydrate fairly quickly. There are many gels on the market that also serve this purpose. Dried fruit, cereal bars, rice cakes and bananas are also useful foods. Any individual taking part in an event must ensure they try out different foods during training sessions as some gels and drinks can cause upset stomachs and nausea.

### Fat loading

Many strategies have been trialled to try and increase fat oxidation, including intravenous fat infusion, high-fat diets and even the use of some drugs. Studies have shown performance benefits for endurance athletes consuming medium-chain triglyceride (MCT) oils in combination with carbohydrates. MCTs provide about 8kcal per gram but are more rapidly absorbed than longer-chain fats, thereby providing an additional and more efficient source of fuel. However, the side effects can include diarrhoea which can adversely affect performance.

For fat loading, the diet should increase to 60-70% fat for 5 days. This can include foods such as chocolate, cream, full-fat milk, high-fat crackers and cheese. This can be followed with 1-3 days of carbohydrate loading with the fat foods substituted by carbohydrate foods, such as pasta, potatoes, bread, sugar and carbohydrate bars and drinks. On the day of the event, pre-competition meal recommendations should be followed along with race guidelines for carbohydrate intake. After the event the athlete would need to plan for recovery and consume plenty of high-GI carbohydrates.

Fluid replacement guidelines also need to be followed along with replacement of electrolytes. Sodium and potassium would be lost in sweat and urine. Depending on the environment, an athlete may need to consume 400-800mg sodium per hour which can be taken in powder or tablet form, or real foods such as soups and pretzels along with bananas for potassium.

### Strength and power events

The priority for these sports is to ensure good nutrition throughout day-to-day training and to prepare well for competition. Individuals involved in these sports are often required to compete in several events throughout the day. It is important for individuals to plan their food and fluid intake in order to maintain adequate fuel and fluid stores, while avoiding any gastrointestinal discomfort.

Matching carbohydrate intake to training remains a priority. Eating too little carbohydrate would deplete energy stores, which prevents optimal performance, training capacity and recovery. Fluids are also important and should not be neglected.



- Glycogen stores should be topped up to usual resting level stores for competition day.
- With a high-carbohydrate diet already in place for training needs, glycogen levels can be restored before competition with 24-36 hours of rest or light training.
- Blood glucose and hydration levels need to be maintained.
- Snacks and drinks should be accessible and planned ahead of any competition, especially when competing in multiple events.
- Liquid snacks between matches/intervals may be useful.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- Define the following terms:
  - Calorie.
  - Energy balance.
  - Negative energy balance.
  - Positive energy balance.
  - Basal metabolic rate (BMR).
  - Thermic effect of food (TEF).
  - Thermic effect of physical activity (TEPA).
  - Non-exercise activity thermogenesis (NEAT).
- Using the Harris-Benedict equation, practise calculating the daily calorie intake needed for different clients with different goals.
- What are the minimum body fat levels for men and women?
- What are the recommended guidelines for safe and effective fat loss?
- What are the recommended guidelines for safe and effective muscle gain?
- Explain the term ‘carbohydrate loading’ and outline when it is beneficial.
- What is fat loading and when is this beneficial?
- What are the nutrition priorities for strength and power activities?
- Research the nutrition guidance and recommendations for a sport or activity of your choice.

# Section 6: Nutritional considerations for specific client groups and medical conditions

## Pre and postnatal clients

### The importance of a balanced diet

A healthy diet is an important part of a healthy lifestyle at any time, but it's especially vital during pregnancy. Eating healthily during pregnancy will help the baby to develop and grow. Avoiding dramatic weight loss during pregnancy and ensuring sufficient calorie intake to support breastfeeding are two important concerns.

The Royal College of Obstetricians and Gynaecologists Scientific Advisory Committee can provide helpful up-to-date information on the latest guidelines for nutrition and other issues related to pregnancy.

It is important for the pregnant woman to eat a variety of different foods every day to get the right balance of nutrients that she and the baby need. It's best to get vitamins and minerals from foods, but a pregnant woman may also need to take supplements to ensure they are getting everything they need. Pregnant women may feel hungrier than usual but they do not need to 'eat for two' as previously thought – even if they are expecting twins or triplets. Calorie intake will need to increase by up to 500 calories per day during breastfeeding.

### Helpful tips for eating well in pregnancy

- Eat at least five portions of fruit and vegetables per day to provide vitamins, minerals and fibre (to help digestion and can help prevent constipation).
- Starchy foods should make up just over a third of the food eaten (e.g. wholegrain and potatoes with their skins on).
- Protein foods should be eaten every day (two portions of fish should be eaten per week, one of which should be oily).
- Dairy foods are important in pregnancy because they contain calcium and other nutrients that the baby needs. Aim for two to three portions a day.
- Food and drink that are high in fat and sugar should be consumed less often and in small amounts.
- Snack on healthy food such as salad vegetables, plain yogurt with fruit, hummus with wholemeal pitta bread or vegetable sticks, porridge with milk, and fresh fruit.
- Eat food that contains folate (the natural form of folic acid), such as green, leafy vegetables and brown rice.
- Food rich in vitamin C and calcium should be eaten to support the baby's growth and development.

### Vitamin and mineral guidance

- Vitamin D – 10 micrograms recommended each day throughout pregnancy and beyond if breastfeeding. This is to provide the baby with enough vitamin D for the first few months of life.
- Folic acid – 400 micrograms recommended each day (this should be taken from before the pregnancy until 12 weeks pregnant). This can help to prevent birth defects known as neural tube defects.
- Iron – supplements should be taken if anaemia is a problem. There are special iron supplements that are suited to pregnancy. Iron levels will be monitored by medical professionals and supplements prescribed if needed.

The following table highlights the current recommendations for foods to avoid or take care with when pregnant.

Food	Examples	Reasons to avoid or take care with
Soft cheeses with white rinds (mould-ripened).	Brie, Camembert.	Tend to be unpasteurised. Less acidic than hard cheeses and contain more moisture, which means they can be an ideal environment for harmful bacteria, e.g. listeria.
Soft, blue-veined cheeses.	Danish blue, Gorgonzola, Roquefort.	
Pâté.	Meat pâtés, vegetable pâtés.	Can contain listeria. They may contain a lot of vitamin A – too much vitamin A can harm the baby.
Eggs.	Raw or partially cooked.	To prevent the risk of salmonella food poisoning.
Raw cow's milk.	Unpasteurised milk or any foods made from them.	Raw milk is not pasteurised, it can carry disease-causing microbes.
Goats' or sheep's milk.	Unpasteurised milk or any foods made from them.	Raw milk is not pasteurised, it can carry disease-causing microbes.
Foods with soil on them.	Vegetables, fruit, salad.	Increased risk of E. coli and toxoplasmosis.
Raw or undercooked meat.	Meat joints and steaks cooked rare.	Potential risk of toxoplasmosis.
Cured cold meats.	Salami, Parma ham, chorizo, pepperoni.	Not cooked but cured and fermented which means there is a risk of toxoplasmosis.
Liver or liver products.	Pâté, sausage, haggis.	They may contain a lot of vitamin A.
Game that has been shot with lead pellets.	Pheasant, duck, rabbit, hare.	They may contain high levels of lead.
Specified fish.	Shark, swordfish, marlin.	Slow growing and may contain more mercury than other types of fish, which can affect the baby's developing nervous system.
Oily fish (no more than two portions a week).	Salmon, trout, mackerel, herring.	Can contain pollutants and high levels of mercury.
Tuna (no more than two fresh portions or four medium tins a week).	Fresh tuna steaks, tinned tuna.	Contains more mercury than other types of fish.
Caffeine.	Coffee, tea, green tea, hot chocolate, chocolate.	No more than 200mg of caffeine a day. One mug of instant coffee is 100mg, one mug of tea is 75mg.
Herbal tea (no more than four cups a day).	Sage and parsley tea. Teas containing valerian.	Sage tea contains thujone which has been linked to miscarriage and high BP. Parsley tea may increase the risk of miscarriage and affect the baby's development. It's fine to use sage and parsley in cooking.
High-dose multivitamins.	Fish liver oils. Vitamin A.	Large amounts of vitamin A can harm the baby.
Peanuts or food containing peanuts (such as peanut butter) can be eaten during pregnancy, unless there is a known allergy or a health professional advises not to.		

Table 6.1 Foods to avoid or take care with during pregnancy (Nutrition Foundation 2016).

## Hydration

Good hydration is extremely important for a healthy pregnancy and recovery. Water flushes waste products from the cells and aids liver and kidney function for both mother and baby. During pregnancy, water is also needed for the expansion in blood volume, and insufficient intake may contribute to constipation and fatigue. Proper hydration is also important for adequate breast milk production and flow.

- Drink 8-12 glasses of water per day (more if the weather is warm or during exercise).
- Avoid caffeinated and high-sugar beverages, which are actually dehydrating.
- Drink smaller amounts of healthy liquids frequently, as opposed to large amounts only a couple of times per day.



## Older clients

### The importance of a balanced diet

In the UK, life expectancy has doubled over the last 200 years and now around 16% of the population is aged over 65 years. General nutrient requirements and healthy eating guidelines apply to older people.

Good nutrition and regular physical activity play a protective role in a number of age-related conditions, including cardiovascular disease and cognitive decline, and can help to protect oral and dental health, and bone and joint health in later life.

For healthy people, energy requirements decrease with advancing age. This is due to changes in body composition: a decrease in lean body tissue (muscle) and an increase in fat tissue. This means older people tend to have less muscle and more fat, leading to a fall in basal metabolic rate (BMR). Many people also become less active as they get older.

Adequate intakes of calcium and vitamin D are key to ensure that optimum peak bone mass is attained in early adulthood, to reduce post-menopausal bone loss and prevent osteoporotic fractures. Low vitamin K intake is associated with low bone mass and increased fracture risk. A diet that contains adequate protein and vitamin K, and is rich in fruit and vegetables and low in salt, may also help to delay bone ageing. A high intake of vitamin A (retinol) may be associated with low bone mineral density, so high doses should be avoided (e.g. liver and fish oil supplements containing retinol).

### Helpful tips for eating well when older

- Eat a varied diet containing plenty of fruit and vegetables.
- Include some fortified foods such as bread or fat spreads, which are often fortified with vitamins and minerals by manufacturers.
- Functional foods may be of benefit for particular health conditions. Examples include probiotic drinks and yogurts, foods with added fibre or prebiotics for gut health and cholesterol-lowering spreads.
- Consume two portions of fish each week, one of which should be oily. Oily fish contains long chain omega-3 fatty acids which can help protect against heart disease and have been shown to be particularly important for those who have had a heart attack. Omega-3 fatty acids may also help to alleviate some of the symptoms of rheumatoid arthritis, preserve eye health, prevent cognitive decline and improve immune function.
- Take a supplement containing 10g of vitamin D daily as well as regularly eating food sources of the vitamin (e.g. oily fish and fortified breakfast cereals). The skin's ability to synthesise vitamin D decreases with age.

A range of factors can influence the nutritional status of older people, including ill health and other medical conditions, drug-nutrient interactions, lack of mobility, low income, social isolation or bereavement, and poor oral health.

Sense of taste and smell can alter with age, and this can affect appetite and enjoyment of food. Older people tend to eat less and the body's ability to absorb some nutrients becomes less efficient with age, so it can be harder to get all the necessary nutrients for good health. It is important for older people to eat a varied diet to ensure an adequate supply of all the essential vitamins and minerals, and enough food to cover their energy requirements.

# Nutrition for disease prevention and medical conditions

## High blood pressure

Diet affects the health of the heart and blood pressure levels. The healthier the diet, the lower blood pressure will be. A healthy diet can reduce the need for medication or reduce the amount of medication required.

### *Helpful tips for lowering blood pressure*

- Eat less salt. Salt makes the body retain water and the extra water stored in the body raises blood pressure. An adult should eat no more than 6g of salt a day. Some food labels may say how much sodium the food contains, but not how much salt. Sodium is one of the chemicals in salt (1g of sodium is the same as 2.5g of salt).

	Low	Medium	High
<b>Salt levels</b>	0.3g salt or less per 100g of food.	0.3-1.5g salt per 100g of food.	1.5g salt or more per 100g of food.
<b>Sodium levels</b>	0.1g sodium or less per 100g of food.	0.1-0.6g sodium per 100g of food.	0.6g sodium or more per 100g of food.
<b>Guidance</b>	Eat plenty of these.	Eat small amounts occasionally.	Avoid completely.

Table 6.2 Salt intake guidance

- Eat more fruit and vegetables (at least five portions per day). As well as all the usual benefits, they contain potassium, which helps to balance out the negative effects of salt. This helps to lower blood pressure.
- Drink less alcohol. Keep to the recommended limits.
- Reduce the amount of saturated fat in the diet. Eat foods that are less than 3g total fat or 1g saturated fat per 100g of food. This will keep cholesterol levels down. Eat polyunsaturated fats and monounsaturated fats as these will help to reduce cholesterol levels.
- Maintain a healthy weight.
- Don't smoke.

## Cardiovascular disease

Cardiovascular disease (including coronary heart disease and stroke) risk factors include obesity, a high intake of saturated fats, hypertension, smoking, low levels of physical activity and diabetes. A diet that is energy-dense, high in saturated fatty acids and salt, and low in dietary fibre, wholegrains and fruit and vegetables is generally associated with an increased risk of developing cardiovascular disease and other chronic diseases.

### *Helpful tips for protection against cardiovascular disease*

Follow advice for high blood pressure plus:

- Choose wholegrains as the main form of carbohydrate.
- Eat adequate amounts of long chain omega-3 fatty acids (predominantly from oily fish).

## Obesity

Obesity can be defined as a chronic relapsing condition. Obesity is a condition in which abnormal or excessive fat accumulation in adipose tissue impairs health. In most cases, it is the result of energy intake exceeding energy expenditure over a period of years. Obesity is no longer a disease that only affects the more developed, affluent countries. It is now a worldwide public health problem, affecting all ages and socioeconomic groups.

An individual is classed as obese if their BMI is 30 or over.

There is a large emotional component underlying obesity and weight control, so emotional support needs to be part of weight loss interventions in order for them to be successful.

In England, most people are overweight or obese. This includes 61.9% of adults and 28% of children aged between 2 and 15. People who are overweight have a higher risk of type 2 diabetes, heart disease and certain cancers. Excess weight can also make it more difficult for people to find and keep work, and it can affect self-esteem and mental health. Health problems associated with being overweight or obese cost the NHS more than £5 billion every year (Department of Health 2016).

By 2020, the UK government wants to see:

- A downward trend in the level of excess weight in adults.
- A sustained downward trend in the level of excess weight in children.

The government has outlined its actions to help people choose to eat and drink more healthily and be more active. This will only be achievable through:

- Giving people advice on a healthy diet and physical activity.
- Improving labelling on food and drink to help people make healthy choices.
- Encouraging cafes and restaurants to include calorie information on their menus so that people can make healthy choices.
- Giving people guidance on how much physical activity they should be doing. The Department of Health 2016 recommends that in order to prevent obesity, many individuals need to participate in moderate-intensity physical activity for 45-60 minutes each day. Those who have been obese and have successfully lost weight may need to include 60-90 minutes of activity per day to avoid regaining weight (Nutrition Foundation 2016).

## Stress

There is a proven link between what an individual eats and how they feel. Healthy, wholesome food can increase energy levels and calm moods. Junk and processed foods, high in saturated fats and sugar, are unlikely to help mood (leading to higher levels of anxiety) and will lead to weight gain. It is not always possible to avoid the stressors of daily life but individuals can change how they react to them with healthy food choices.

Swap	Try
Refined white flours (bread, pasta, rice, potatoes).	Wholegrain flour, bread, pasta and sweet potatoes.
Caffeinated drinks (coffee, fizzy drinks) and alcohol.	Herbal teas such as camomile can be calming to drink. Green tea is an exception to the rule when it comes to no caffeine as it is rich in antioxidants.
Carbohydrate-heavy diet.	Add fish, chicken, turkey, beef or eggs to every meal. When snacking on fruit, include a small amount of nuts and seeds.
Gulping down food.	Mindful eating.

Table 6.3 Food swaps for stress

## Diabetes

Individuals living with diabetes need to learn which foods contain carbohydrates, how to estimate carbohydrate portions and how to monitor their effect on blood glucose levels. All carbohydrate is converted into glucose. In someone without diabetes, the body produces insulin automatically to deal with the glucose that enters the blood from the carbohydrate-containing food. Diabetics need to take insulin, either by injections or a pump, to lower the glucose in the blood. Individuals taking fixed amounts of insulin twice a day may find it beneficial to eat roughly the same amount of carbohydrate at similar times each day. More carbohydrate than usual can cause blood glucose levels to go too high, and less than usual can cause low blood glucose levels. Diabetes UK recommends that everyone with diabetes should see a registered dietitian at diagnosis, and then have regular reviews. Diabetics should ensure they eat healthy carbohydrates and avoid processed foods.



### *Helpful tips for type 1 diabetics*

Type 1 diabetes is not related to lifestyle factors like diet. It develops when the insulin-producing cells in the body have been destroyed and the body is unable to produce any insulin. Food choices play a key part in managing the condition, so eating a balanced diet – including fruit and vegetables, starchy foods, non-dairy sources of protein and dairy – can really help. Carbohydrate counting (which works by matching the insulin dose to the amount of carbohydrate an individual eats and drinks) is an important part of managing blood sugar levels. With any medical condition it is important to obtain medical guidance to help manage lifestyle changes and to ensure a balanced approach.

### *Helpful tips for type 2 diabetics*

Type 2 diabetes develops when the body cannot produce enough insulin or when the insulin that is produced does not work properly. Type 2 diabetes can be caused by lifestyle factors. If untreated, it can cause serious problems. Keeping active, managing weight and eating a healthy, balanced diet will help to control blood glucose levels and reduce the risk of future complications.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Why is good nutrition important during pregnancy?
- Name three foods that should be avoided during pregnancy and explain why.
- Name three factors that may affect the nutritional status of older adults.
- Name two important changes to diet that can help to decrease high blood pressure.
- What BMI is classed as obese?
- How can good nutrition support an individual with stress?
- What questions should a skilled professional ask a diabetic client?

# Section 7: Analysing dietary habits and identifying areas for improvement

## Informed consent

Personal information can only be collected, recorded and stored with permission. An informed consent form usually contains a statement to say that the client has been informed of the reasons, risks and benefits of their programme/plan and they sign to show that they agree to take part. This will ensure that the client is fully aware of the type or level of service on offer.

## Collecting nutritional information from clients

In order to provide nutritional advice and empower a client to make changes to their eating habits, it is imperative that a trusting and supportive professional relationship is established. This will help to open the channels of honesty and communication that are essential in facilitating dietary change. A skilled professional cannot watch over every meal and snack that someone eats, so the client must have a certain degree of motivation and self-discipline.

There are many methods that can be used to gather information from a client that will help the skilled professional offer advice on nutrition, including:

- Questionnaires (e.g. lifestyle, PAR-Q, medical, nutritional).
- Food diary (e.g. 24-hour recall, 3-day or 7-day).
- Interview/consultation.
- Short- and long-term observation (e.g. body language, behaviours, habits, reactions, emotions, health).
- Nutritional testing/assessing.

It is very important that a sufficient amount of accurate information is gathered prior to offering advice and direction. This will help the skilled professional fully understand the client's current situation in relation to where they really need to be. It will also serve as the foundation for determining the correct, individualised stages of change to ease the client through a series of adjustments to their current lifestyle and food habits.

Eating behaviours are personal, and clients may be concerned about what others think of them for eating a certain way. Other personal information (e.g. religion) could also be inferred from information about eating habits. Consulting with a client will always provide valuable information to assist the skilled professional with producing solutions. However, it is vital that the skilled professional is sensitive to the client and the confidential information they share. Information that is divulged during a consultation may cover areas such as personal health, dietary failures, personal beliefs, family stresses, abusive relationships, depressive eating habits, self-loathing and many other sensitive topics. Whilst these issues will help the skilled professional to understand the client, their behaviours and potential barriers, this information must be treated with privacy and respect. When information is gathered, in any context, the regulations of the Data Protection Act must be complied with.

## Questionnaires

The client's PAR-Q, lifestyle, medical and nutrition questionnaires can provide valuable information for the skilled professional. They can serve as a basis for further questioning, and will help with identifying potential barriers and solutions, such as:

- Time available to purchase food and prepare meals.
- Family commitments that may hinder efforts.
- Employment commitments and degree of priority.
- Potential support networks.
- Social habits and activities that support or hinder activity levels.
- Health problems that may require more specialist care.

A nutrition questionnaire can provide a valuable base of information for a consultation. However, clients often answer questionnaires in a way that emphasises what they perceive to be the positive elements of their dietary habits and minimises the areas that they perceive to be 'bad'. With this in mind, it is advisable that some form of food diary is utilised to obtain a more accurate base of information to work from.

## Food diaries

A food diary can provide a significant amount of information about a client's current eating patterns and habits. Time should be taken to ensure that the client fully understands what information should be recorded and when it should be done. A good level of trust and rapport with a client is essential prior to asking them to complete a food diary. A poorly established professional relationship is much more likely to lead to dishonesty and an intentionally adjusted food diary that will not provide a true record of the client's dietary habits.

After information has been gathered using a food diary, the data needs to be correctly analysed and interpreted. This is a skill that takes some practice. The more often a professional reviews food diaries, the easier it becomes to extract the relevant and important information.

Studies show that keeping a food diary is vital for weight loss. Researchers from Kaiser Permanente Center for Health Research (2008) followed more than 2,000 dieters who were encouraged to record meals and snacks; they found that whether a person kept a food diary was the single best predictor of them losing weight. Keeping a food diary was more significant than exercise habits, age and body mass index. In fact, the number of pounds a person lost was directly related to the number of days they completed their food diary.

## Food diary analysis

It is difficult to collate a list of all the possible information that can be drawn from an effectively recorded food diary, but the following will provide a starting point:

- Varied fruit and vegetable intake.
- Amount of carbohydrate in the daily diet.
- Level of refinement of carbohydrate foods.
- Energy, mood and mental response to carbohydrate intake.
- Amount of protein in the daily diet.
- Inclusion of protein at meal and snack times.
- Quality of the sources of protein.
- Energy, mood and mental response to protein intake.
- Amount of fat in the daily diet.
- Types of fat included.
- Quality of the sources of fat in the diet.
- Sources and the current ratio of omega-6 to omega-3.
- Energy, mood and mental response to fat intake.
- Timing of meals generally throughout the day.
- How food fits in around the working day and family commitments.
- Food intake around activity, exercise and other key stressors.
- Regularly eaten foods that may form part of subconscious addictive patterns.
- Fluid intake and how this measures up to guidelines and additional exercise needs.
- Alcohol habits and intake.
- Additives that are ingested regularly and the potential side effects.
- 'Go to' foods when time is limited or energy and/or mood is low.
- Any repetitive eating patterns without much variety.



Encourage a client to:

- Complete the diary after each meal, not at the end of the day.
- Record accurately what was eaten.
- Identify amounts eaten where possible.
- Identify food brands and quality of food.
- Note the time of intake.
- Specify any fluid intake.
- Note when activity or exercise was done.
- Assess energy, mood and mental clarity one to two hours after food was eaten.

## Providing feedback to clients

Following an in-depth analysis of a client's food diary, it is essential to provide accurate and valid feedback. This should include positive feedback as well as highlight areas for improvement. A client may have one or many different objectives in mind: they might want to lose body fat, lose weight or develop muscle. They might want to eat to achieve optimal health or to fuel exercise or a specific sport. The skilled professional should not determine the client's goals beforehand and arrive at the feedback session with a set of goals to impose upon them. Instead, the client should form and shape their goals with the support of the professional. The client is more likely to take ownership of goals they have set themselves and these goals are more likely to be achieved.

Some clients may have many areas that need to be worked on, so this may be too much for a client to get to grips with in one go. In this case, the areas of change should be prioritised by considering which are most nutritionally important, as well as the changes that are the easiest to make. The skilled professional should be careful with their language and manner when discussing negative feedback. It is important not to upset or offend a client, but it's still the professional's duty to honestly inform them of detrimental nutritional habits. The areas of concern should first be highlighted in a factual, non-judgemental manner. Next, through appropriate questioning, the client's willingness to change in this specific area should be ascertained. This may be done across each topic area where the professional feels the need for some adjustment in dietary habits. By listening to the client's verbal responses, the tone and pitch of their voice and observing their facial expressions and body language, the skilled professional will have a good idea which areas the client feels greater willingness (and greater resistance) to change.

## Translating nutritional goals into healthy eating advice

Not only must goals be SMART, they must also reflect current healthy eating advice. For example, a client who wishes to lose 10kg in weight, a realistic and healthy rate of loss should be specified. Losing at a rate of approximately 0.5kg per week, the client should be able to achieve their goal in 20 weeks.

The long-term SMART weight goal for this client would be:

- To achieve 10kg weight loss by week 20 of the programme.

To achieve this rate of loss, healthy eating advice stipulates that an energy deficit of approximately 500kcal per day should be maintained, and it is recommended that this is achieved through a combination of calorie reduction and exercise.

Consequently, this may give rise to the following short-term goals:

- Cut out all chocolate/sweets (approximately 250kcal per day).
- Take a brisk walk of at least 20 minutes each day.

## Integrating other health and fitness goals

It is important to remember that good health depends on nutrition, exercise and rest, so a client's nutritional goals need to be carefully considered in relation to the other two elements. Eating a sensible diet will be less effective if the client is inactive, has poor posture and doesn't get enough sleep. Alternatively, a client who trains hard six days per week is not going to be able to sustain themselves by following the generic nutritional guidance for the sedentary population, regardless of how much rest they get. The skilled professional needs to ensure that they take an integrated approach to achieving their client's goals.

## Monitoring progress

The time frames given to goals should vary in relation to the priorities that were originally discussed to help set long-, medium- and short-term goals. This can help the client to break things down into more manageable, bite-size chunks.

Once an action plan has been agreed, the client's progress needs to be regularly monitored through follow-up consultations, food diaries and assessments. As time progresses and the client begins to achieve their initial priorities, it is important to drip-feed the other objectives into the strategic formula. Goals should be written down and placed where the client will see them on a regular basis, but not in a place where all their work colleagues or housemates (for example) can see what they are doing, as this might add extra strain.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- Name two methods for obtaining nutritional information from clients.
- When asking a client to complete a food diary, name five key pieces of information you would need them to record.
- Practise calculating energy deficits for specific clients who would like to lose body fat.
- Practise calculating energy requirements for clients who would like to gain muscle.

# References

- American College of Sports Medicine. (2007). Exercise and Fluid Replacement. *Medicine & Science in Sports & Exercise*, [online]. Available at: [http://journals.lww.com/acsm-msse/Fulltext/2007/02000/Exercise\\_and\\_Fluid\\_Replacement.22.aspx#P8](http://journals.lww.com/acsm-msse/Fulltext/2007/02000/Exercise_and_Fluid_Replacement.22.aspx#P8) [Accessed: 20 July 2016].
- Australian Institute of Sport. (No date). 'Carbohydrate – the facts' [online]. Available at: <http://www.ausport.gov.au/ais/nutrition> [Accessed: 4 July 2016].
- Bean, A. (1993). *The Complete Guide to Sports Nutrition*. London: A&C Black.
- Blood Pressure UK. (2016). 'Healthy blood pressure diet'. [online]. Available at <http://www.bloodpressureuk.org/BloodPressureandyou>Yourlifestyle/Eatingwell> [Accessed: 5 July 2016].
- British Nutrition Foundation. (2016a). 'What are nutrients?' [online]. Available at <https://www.nutrition.org.uk/healthyliving/basics/what-are-nutrients.html> [Accessed: 24 June 2016].
- British Nutrition Foundation. (2016b). 'Dietary fibre' [online]. Available at <https://www.nutrition.org.uk/healthyliving/basics/fibre.html> [Accessed: 26 June 2016].
- British Nutrition Foundation. (2016c). 'Obesity and overweight' [online]. Available at <https://www.nutrition.org.uk/nutritiionscience/obesity-and-weight-management/obesity-and-overweight.html?limit=1&limitstart=0> [Accessed: 5 July 2016].
- British Nutrition Foundation. (2016d). 'Obesity and weight management behaviour change' [online]. Available at <https://www.nutrition.org.uk/nutritiionscience/obesity-and-weight-management/918-behaviour-change.html?limit=1&start=3> [Accessed: 22 July 2016].
- British Nutrition Foundation. (2016e). 'Nutrition through life – Older adults' [online]. Available at <https://www.nutrition.org.uk/nutritiionscience/life/older-adults.html?limit=1&limitstart=0> [Accessed: 5 July 2016].
- Cambridge English Dictionary. (2016). Definition of 'Wellness' [online]. Available at <http://dictionary.cambridge.org/dictionary/english/wellness#translations> [Accessed: 20 June 2016].
- Collins English Dictionary. (2016). Definition of 'Wellness' [online]. Available at <http://www.collinsdictionary.com/dictionary/english/wellness> [Accessed: 20 June 2016].
- Department of Environment, Food and Rural Affairs (DEFRA). (2006). Measuring Societal Wellbeing in the UK [online]. Available at [www.ons.gov.uk/.../well-being/.../working-paper--measuring-societal-we](http://www.ons.gov.uk/.../well-being/.../working-paper--measuring-societal-we) [Accessed: 12 August 2016].
- Department of Health. (2010). 'Our Health and Wellbeing Today' [online]. Available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/215911/dh\\_122238.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/215911/dh_122238.pdf) [Accessed: 24 June 2016].
- Department of Health. (2015). '2010 to 2015 government policy: obesity and healthy eating' [online]. Available at <https://www.gov.uk/government/publications/2010-to-2015-government-policy-obesity-and-healthy-eating/2010-to-2015-government-policy-obesity-and-healthy-eating> [Accessed: 22 July 2016].
- Diabetes UK. (2016). 'Diabetes and food' [online]. Available at <https://www.diabetes.org.uk/Guide-to-diabetes/Enjoy-food/Food-and-diabetes/I-have-Type-2-diabetes/> [Accessed: 6 July 2016].
- Holford, P. (1999). *The Optimum Nutrition Bible*. London: Piatkus.
- Huber M., et al. (2011). How should we define health? The British Medical Journal [online]. Available at <http://www.bmjjournals.org/content/343/bmj.d4163> [Accessed: 24 June 2016].
- Kaiser Permanente Centre for Health Research. (2008). 'Keeping a food diary research' [online]. Available at <https://share.kaiserpermanente.org/article/keeping-a-food-diary-doubles-diet-weight-loss-kaiser-permanente-study-finds/> [Accessed: 20 June 2016].
- Kris-Etherton et al. (1999). High-monounsaturated fatty acid diets lower both plasma cholesterol and triacylglycerol concentrations. *The American Journal of Clinical Nutrition* [online]. Available at <http://ajcn.nutrition.org/content/70/6/1009.full> [Accessed: 20 June 2016].

- Kris-Etherton et al. (2002). Fish Consumption, Fish Oil, Omega-3 Fatty Acids, and Cardiovascular Disease. *The New England Journal of Medicine* [online]. Available at <http://circ.ahajournals.org/content/106/21/2747.full> [Accessed: 20 June 2016].
- Levine, J.A. (2003). Non-exercise activity thermogenesis. *Proceedings of the Nutrition Society* [online]. Available at [http://journals.cambridge.org/download.php?file=%2FPNS%2FPNS62\\_03%2FS0029665103000909a.pdf&code=6f6646e466ac0cf7329e7a33e0a9df0e](http://journals.cambridge.org/download.php?file=%2FPNS%2FPNS62_03%2FS0029665103000909a.pdf&code=6f6646e466ac0cf7329e7a33e0a9df0e) [Accessed: 24 June 2016].
- Macnaughton, L. and Witard, O. (2014). New insights into protein recommendations for promoting muscle hypertrophy. *The Sport and Exercise Scientist*. Issue 41, autumn 2014 [online]. Available at [http://www.bases.org.uk/write/Images/TSES\\_ISSUE\\_41-P8-P10.pdf](http://www.bases.org.uk/write/Images/TSES_ISSUE_41-P8-P10.pdf) [Accessed: 4 July 2016].
- Meltzer, S. and Fuller, C. (2005). *The Complete Book of Sports Nutrition*. London: New Holland.
- NHS Choices. (2015a). 'The energy diet' [online]. Available at <http://www.nhs.uk/Livewell/tiredness-and-fatigue/Pages/energy-diet.aspx> [Accessed: 6 July 2016].
- NHS Choices. (2015b). 'How to diet' [online]. Available at <http://www.nhs.uk/Livewell/loseweight/Pages/how-to-diet.aspx> [Accessed: 20 July 2016].
- NHS Choices. (2015c). 'Starch foods and carbohydrates' [online]. Available at <http://www.nhs.uk/Livewell/Goodfood/Pages/starchy-foods.aspx#> [Accessed: 24 June 2016].
- NHS Choices. (2015d). 'Vitamins and nutrition in pregnancy' [online]. Available at <http://www.nhs.uk/Conditions/pregnancy-and-baby/pages/vitamins-minerals-supplements-pregnant.aspx> [Accessed: 5 July 2016].
- NHS Choices. (2016). 'Understanding calories' [online]. Available at <http://www.nhs.uk/Livewell/loseweight/Pages/understanding-calories.aspx> [Accessed: 20 July 2016].
- Poehlman, E.T. and Horton, E.S. (1989). The impact of food intake and exercise on energy expenditure. *Nutrition Review* [online]. Available at <http://www.ncbi.nlm.nih.gov/pubmed/2654774> [Accessed: 24 June 2016].
- Royal College of Nursing. (2016). 'Body fat percentage factsheet' [online]. Available at [https://www2.rcn.org.uk/\\_\\_data/assets/pdf\\_file/0011/519626/DIY\\_Information\\_Sheet\\_Body\\_Fat\\_Percentage.pdf](https://www2.rcn.org.uk/__data/assets/pdf_file/0011/519626/DIY_Information_Sheet_Body_Fat_Percentage.pdf) [Accessed: 20 July 2016].
- The British Dietetic Association. (2013). 'Glycaemic Index (GI) Factsheet' [online]. Available at <https://www.bda.uk.com/foodfacts/GIDiet.pdf> [Accessed: 24 June 2016].
- The British Dietetic Association. (2014). 'Factsheet – Dietitian, Nutritionist, Nutritional Therapist or Diet Expert? A comprehensive guide to roles and functions' [online]. Available at [https://www.bda.uk.com/publications/dietitian\\_nutritionist.pdf](https://www.bda.uk.com/publications/dietitian_nutritionist.pdf) [Accessed: 23 June 2016].
- The New Economics Foundation. (2016). 'The Five Ways to Wellbeing' [online]. Available at <http://www.fivewayswellbeing.org/> [Accessed: 24 June 2016].
- The Stress Management Society. (2016). 'Eat yourself calm' [online]. Available at <http://www.stress.org.uk/eat-yourself-calm/> [Accessed: 5 July 2016].
- Weight Loss Resources. (2016). 'GI Index Chart' [online]. Available at [http://www.weightlossresources.co.uk/diet/gi\\_diet/glycaemic\\_index\\_tables.htm](http://www.weightlossresources.co.uk/diet/gi_diet/glycaemic_index_tables.htm) [Accessed: 26 June 2016].
- Wilson, P. (2016). 'Your definitive guide to protein foods' [online]. Available at <http://www.theproteinworks.com/thelockerroom/article/peterwilson/your-definitive-guide-protein-foods> [Accessed: 5 July 2016].

# Lifestyle, health, wellbeing and common medical conditions

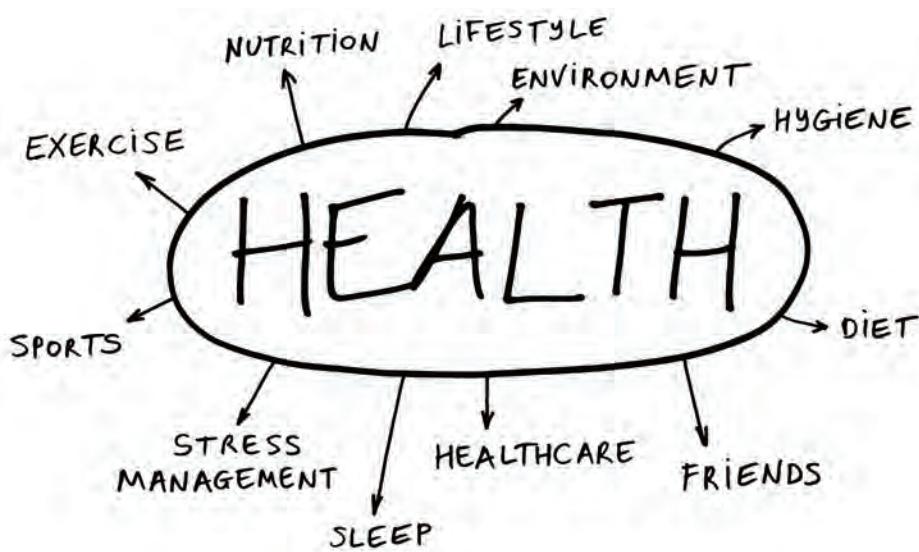
## Aim

To understand the different factors and common medical conditions that can affect a client's health and wellbeing and the impact these may have on the success of a behavioural change programme.

## Learning outcomes

At the end of this unit, you will:

- Understand how lifestyle factors affect a client's health and wellbeing.
- Understand commonly occurring medical conditions and how they may impact a client's lifestyle.
- Understand how to risk-stratify and when to refer clients with common medical conditions.



# Section 1: Lifestyle factors and health and wellbeing

## The biological, behavioural and social components of health and wellbeing

To understand how lifestyle factors affect a client's health and wellbeing, it is useful to understand and apply a range of psychological theories in relation to health behaviours. This will enable a skilled professional to support their client with their behavioural change goals. The theories covered in this section are not exhaustive and research in this area is constantly moving forward.

### The biopsychosocial model

According to the biopsychosocial model (BPS), biological, behavioural, psychological and social factors have equal potential to influence health.

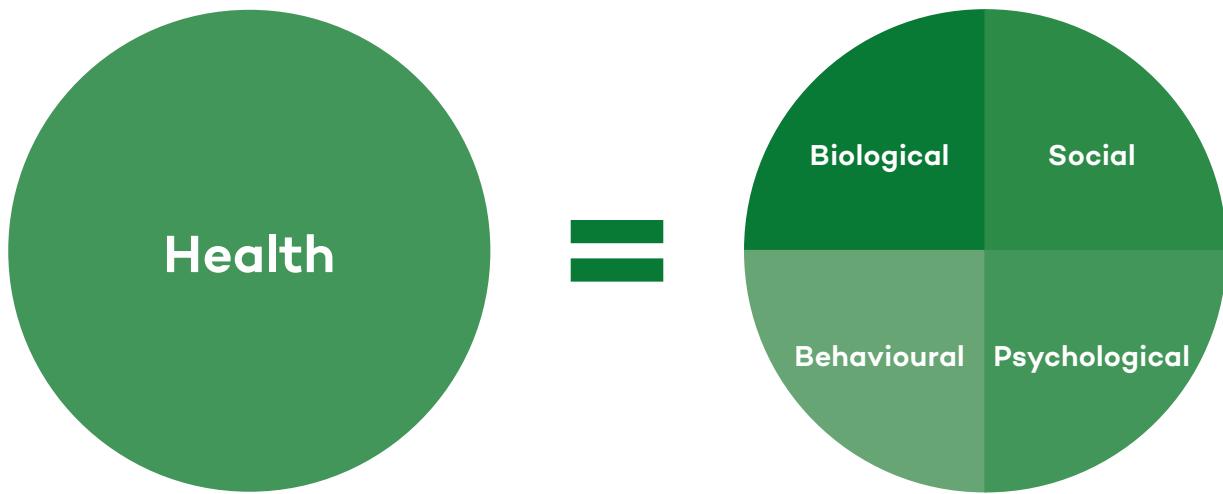


Figure 1.1 The biopsychosocial model

#### ***Biological component***

Biological components of health include factors such as genetics or family history, age, sex, race and physiological health status, e.g. if an individual is pre- or post-menopausal or has existing medical conditions. All these components have an impact on an individual's health and wellbeing.

#### ***Behavioural component***

Everyday behaviours have a direct impact on an individual's health and wellbeing. Many major chronic diseases stem from (or are exacerbated by) choices individuals make every single day, such as:

- Health beliefs.
- Smoking.
- Misuse of alcohol, e.g. drinking in excess of the recommended guidelines.
- Unhealthy eating, e.g. too much salt, sugar and fatty foods and insufficient fruit, vegetables, oily fish and fibre. Eating too many or too few calories compared to energy requirements.
- Inactivity and sedentary living, e.g. not achieving the recommended 150 minutes of moderate-intensity activity each week and sitting down more than moving.
- Stress management.
- Adherence to medications.
- Regularly visiting healthcare professionals.

## Psychological component

There are psychological variables that have an impact on wellbeing. These can include certain forms of depression, anxiety disorders, stress and anger. One example is the effect long-term anger and hostility can have on health and disease. Studies show that being angry, or even recalling an incident in the past that made an individual angry, can cause a cascade of events. It can increase inflammation, put stress on the heart muscle, increase calcium build-up in arteries and stir up stress hormones.

Managing mental health, including self-esteem, self-worth, perception and self-efficacy, can have a positive impact on an individual's overall health and wellbeing. Also, how individuals respond to illness can have a significant impact on their health and recovery. For example, an individual with a positive mind-set is more likely to have a positive outcome than someone with a negative mind-set.



An individual with a positive mind-set would:

- Proactively search for self-help solutions.
- Accept some responsibility.
- Engage with positive changes.
- Maintain a positive attitude.

An individual with a negative mind-set would:

- Believe there is nothing they can do to help their health.
- Depend solely on medical professionals and medication.

This is to do with 'locus of control'. The first example is an internal locus of control and the second example is an external locus of control.

## Social component

The social aspect of this model includes cultural, familial, socioeconomic and religious factors which can all play a role in an individual's overall health. Examples of these include social support, workplace, quality of marriage and finances. Social support is the amount of support an individual has in terms of family, friends and peers and is key to health. A strong social network can have a protective effect in that it is associated with good mental and physical health, helps to speed up recovery from illness, and helps individuals remain healthier in the face of stress.

### Social factors that can have a negative impact on health and wellbeing

- Being from a low socioeconomic background with a low household income.
- Having lower levels of educational attainment.
- Living in a deprived area.
- Unemployment.
- Being employed in non-professional and non-managerial work.
- Work stress.
- Peer group pressure.
- Unhealthy/negative family relationships.
- Being older and part of the ageing population.

Privileges that have a positive effect on health and wellbeing and which are often taken for granted are being employed, being educated and having a generous household and disposable income. At the very least, these privileges enable individuals to access services that support health and wellbeing, e.g. owning a computer/tablet/smartphone to search for information on the internet, gym memberships, private healthcare, personal trainers, dietitians and counsellors.



### POINT OF INTEREST

### LOCUS OF CONTROL

**Internal** – Those with an internal locus of control are more likely to adopt health behaviours because they believe that they are in control of their lives.

**External** – Those with an external locus of control are more likely **not** to adopt health behaviours because they believe that external forces are in control of their lives.

Individuals from different cultural groups (including different religions and faiths) may have different attitudes and beliefs about health, activity, diet, alcohol consumption and sexual behaviour. These attitudes and beliefs can influence the extent to which they engage in or abstain from specific behaviours, which in turn affects their health status.

The BPS approach is sociological, humanistic and biological in that it considers all the levels in a system (e.g. from the beliefs of the community to individual perceptions; from the effects of internal physiological processes to cellular actions and interactions). This differs from a traditional biomedical perspective that focusses immediately on the lower levels of chemical and biological structures to explain cause and identify a solution, or a humanistic psychological approach that works purely at the personal level. By considering all levels of the system, it is argued that the cause of a problem, and therefore the best solution, can be identified and resolved at the appropriate level.

The BPS model has been adopted in some areas and organisations, including the National Health Service (NHS). In part it is responsible for the development and structure of multidisciplinary teams, where each aspect of an individual's need is addressed by a suitably qualified individual with the relevant expertise.

## The lifestyle factors that can affect an individual's health and wellbeing

### Determinants of health

The factors which have the most significant influence on an individual's health and wellbeing are known as the determinants of health (see Figure 1.2) and these factors clearly link in with the BPS model. These include:

- Individual differences amongst the population (demographics, e.g. age and ethnicity).
- Population lifestyles, e.g. lifestyle behaviours, use of recreation and leisure time.
- Local economy, e.g. employment, funding and budget to address health needs and services available locally.
- Activities, e.g. working, shopping, moving, playing, recreational and leisure.
- Built environment, e.g. buildings and streets.
- Natural environment, e.g. open spaces and parks available.
- Global ecosystem and global economy, e.g. climate change.



Figure 1.2 Determinants of health and wellbeing (Dahlgren and Whitehead, 1991)

## Determinants that have a negative effect on health

There are many social and environmental risk factors and lifestyle behaviours that negatively affect health and wellbeing and offer a risk to health status. Some of these are listed below.

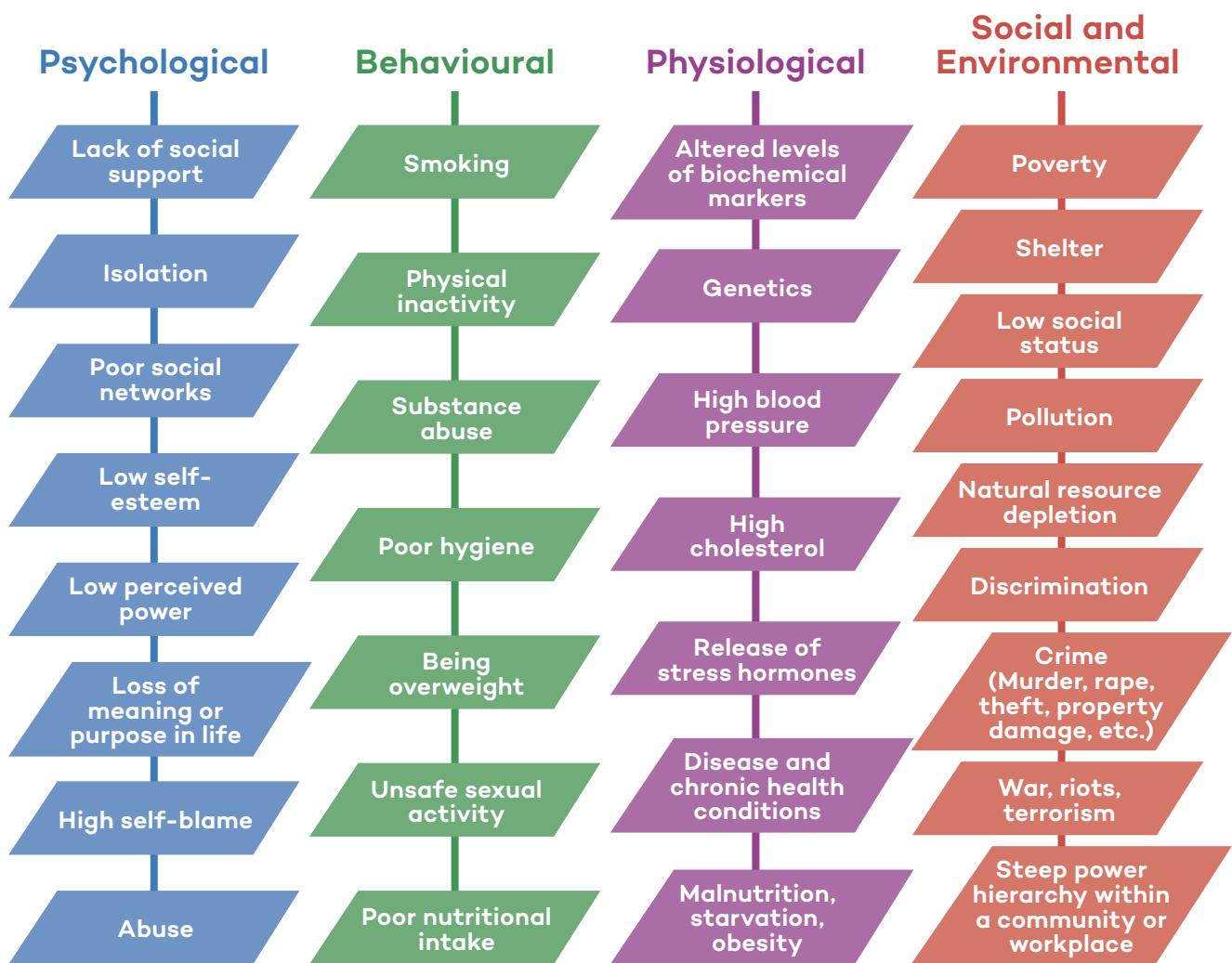


Table 1.1 Risk factors and behaviours that negatively influence health and wellbeing (Labonte, 1998)

The lifestyle choices that individuals make and behaviours they follow in their lifetime can all have an impact on both their current and future health. Those which offer the greatest potential to improve health and reduce morbidity associated with chronic health conditions include:

- Reducing inactivity.
- Smoking cessation.
- Reducing alcohol and drug misuse.
- Diet/healthy eating (with an emphasis on fruit and vegetable consumption).
- Managing stress.
- Improving the quality of sleep.

Unhealthy lifestyle choices can reduce the quality and quantity of years lived. These unhealthy choices are contributory factors for many chronic health conditions, including cancer, COPD, obesity, diabetes, osteoporosis, liver cirrhosis, cardiovascular disease (hypertension, CHD and stroke) and some mental health conditions.

## Inactivity

Physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure. Lack of physical activity (inactivity) is estimated to be the main cause of approximately 21-25% of breast and colon cancers, 27% of type 2 diabetes cases and 30% of ischaemic heart disease burden (World Health Organization, 2010).

The decline in levels of physical activity over the last 50 years could be attributed to many factors, including:

- Increased reliance on technology (online shopping, electronic household devices, etc.).
- Reduced opportunities for physical activity and sporting activities at work or school.
- Increased sedentary working activities and fewer manual jobs.
- Decreased participation in sport.
- More time spent engaging in sedentary leisure behaviours – watching television, playing computer games, etc.
- Less active travel and transportation; cars and public transport are being used more often for short journeys to school or work that could be made on foot or via other modes (e.g. cycling).
- Negative experiences from activity participation (at school or elsewhere).
- Lack of positive role models, e.g. inactive parents or carers, fewer ‘active and sporting’ role models from some populations (e.g. disabled people, some ethnic groups).
- Psychological factors – lack of confidence, motivation, interest, etc.
- Parental fear for children’s safety when playing outdoors.
- Other commitments taking priority – family, work, school, etc.

Physical inactivity increases the risk of:

- Cardiovascular disease (hypertension, high cholesterol, stroke, coronary heart disease).
- Musculoskeletal conditions (osteoporosis, low back pain).
- Mental health conditions (depression and anxiety).
- Obesity and type 2 diabetes.
- Certain cancers (e.g. breast and colon cancer).

(World Health Organization, 2010; ACSM, 2011).

Health benefits can be achieved by minimising sedentary time and increasing activity levels to meet the recommended activity targets.

## Physical activity guidelines for adults

Adults should aim to be active daily. Over a week, activity should add up to at least 150 minutes (2.5 hours) of moderate-intensity activity in bouts of 10 minutes or more – one way to approach this is to be physically active for 30 minutes at least 5 days a week. Alternatively, comparable benefits can be achieved through 75 minutes of vigorous-intensity activity spread across the week or combinations of moderate- and vigorous-intensity activity.

Adults should also undertake physical activity to improve muscle strength at least two days a week.

Moderate-intensity physical activities should cause individuals to get warmer and breathe harder and their hearts to beat faster, but they should still be able to carry on a conversation. Examples include brisk walking and cycling.

Vigorous-intensity physical activities should cause individuals to get warmer and breathe much harder and their hearts to beat rapidly, making it more difficult to carry on a conversation. Examples include running and sports such as swimming or football.

Physical activities that strengthen muscles involve using the body weight or working against a resistance. This should involve using all the major muscle groups. Examples include weight training and carrying or moving heavy loads such as groceries.

Ways to minimise sedentary behaviour include:

- Reducing time spent watching TV, using the computer or playing computer games.
- Taking regular breaks at work.
- Breaking up sedentary time by swapping a long bus or car journey for walking part of the way.

(NHS Choices, 2016a)



Interventions to promote physical activity can include a variety of exercise programmes and activities of daily living (ADLs).

Everyday activities	Active leisure and recreation	Sport
Vigorous housework.	Gym training.	Swimming.
Gardening.	Fitness classes.	Structured competitive activity.
Cleaning the car.	Aqua aerobics.	Games (rounders, football, etc.)
DIY.	Health walks.	Athletics (track and field).
Active travel.	Cycling.	Outdoor activities (climbing, hill walking, etc.).
Active work (not desk-based or sedentary).	Swimming.	Informal sport.
Active play.	Dance and movement.	
Using stairs more often.	Yoga, Pilates.	
	Running.	

Table 1.2 Examples of physical activity

### The benefits of activity

Being physically active to the recommended minimum levels is essential for health and wellbeing. An active and healthy lifestyle offers benefits in many areas.

Psychological benefits
<ul style="list-style-type: none"> <li>Improved self-esteem and self-confidence.</li> <li>Improved mental alertness.</li> <li>Reduced frustration with daily problems.</li> <li>A more constructive response to disappointments and failures.</li> <li>Reduction in anxiety and stress.</li> <li>Improved ability to respond to and handle stressful situations.</li> </ul>
Social benefits
<ul style="list-style-type: none"> <li>The opportunity to make new friends at leisure facilities or at exercise sessions.</li> <li>The opportunity to share an active hobby with friends or family members.</li> <li>Reduced social isolation.</li> <li>Improved social confidence.</li> </ul>
Physiological benefits
<ul style="list-style-type: none"> <li>Improving all body systems: muscular, skeletal, cardiovascular, neuroendocrine.</li> <li>Stronger heart muscle.</li> <li>Improved circulation.</li> <li>Stronger bones and muscles.</li> </ul>

- Strengthening the immune system.
- Reducing the risk of many chronic diseases.
- Assisting with the management of many chronic health conditions.

### Health benefits

- Reduced likelihood of:
  - Premature death.
  - Hypertension.
  - Coronary heart disease.
  - Stroke.
  - Respiratory conditions.
  - Diabetes.
  - Certain cancers (e.g. breast and colon cancer).
  - Back pain.
  - Osteoporosis.
  - Falls in older adults.
  - Obesity.
  - Metabolic conditions.
  - Stress and anxiety.
  - Clinical depression and the symptoms of depression and anxiety.
- Improvements in:
  - Functional capacity and the maintenance of independence in older individuals.
  - Bone density.
  - Weight loss and weight management.
  - Psychological wellbeing.
  - Quality of life and general wellbeing.

Table 1.3 Benefits of activity

Despite the ever-growing evidence base to support the benefits of physical activity and the various legislation to support and promote active and healthy living, the reality is that most individuals are not sufficiently active to maintain good health.

### Smoking

Despite the well-established and widely known health risks of smoking, 19% of adults in Great Britain still smoke (20% of men and 17% of women). This means there are about 9.6 million adult smokers in Great Britain (ASH, 2016).

- Smoking prevalence is highest in the 25-34 age group (24%) and lowest amongst those aged 60 and over (11%).
- More than half (59%) of all adults report that they have never smoked.
- Two-thirds of smokers start before age 18. Of those who try smoking, between one-third and one-half will become regular smokers.
- Smoking rates are much higher among poorer people. In 2014, 13% of adults in managerial and professional occupations smoked compared with 30% of adults in routine and manual occupations (ASH, 2016).



### POINT OF INTEREST

Smoking rates have more than halved since 1974 when 51% of men and 41% of women smoked (ASH, 2016).

Smoking is the primary cause of preventable illness and death. Every year, around 96,000 people in the UK die from diseases caused by smoking. Smokers under the age of 40 have five times greater risk of a heart attack than non-smokers. Smoking causes around 80% of deaths from lung cancer, around 80% of deaths from bronchitis and emphysema, and about 14% of deaths from heart disease.

More than one-quarter of all cancer deaths can be attributed to smoking. These include cancer of the lung, mouth, lip, throat, bladder, kidney, pancreas, stomach, liver and cervix.

About half of all lifelong smokers will die prematurely. On average, cigarette smokers die ten years younger than non-smokers (ASH, 2016).

## What is in a cigarette?

Cigarettes contain over 4,000 toxic chemicals and around 50 of these cause cancer.

The three main toxins are nicotine, carbon monoxide and tar.

Other chemicals found in cigarettes include:

- Acetone – nail polish remover.
- Ammonia – toilet cleaner.
- Arsenic – rat poison.
- Benzo(a)pyrene – diesel exhaust fumes.
- Carbon monoxide – petrol exhaust fumes.
- DDT and dieldrin – insecticides.
- Formaldehyde – preservative for dead bodies.
- Hydrogen cyanide – poison used in gas chambers.
- Methanol – rocket fuel.
- Titanium – metal used to make aeroplanes.



(ASH, 2016).

## What happens when an individual stops smoking?

Time frame	What happens after quitting?
After 20 minutes.	Pulse rate returns to normal.
After 8 hours.	Nicotine and carbon monoxide levels in blood reduce by more than half and oxygen levels return to normal.
After 48 hours.	Carbon monoxide is eliminated from the body. Lungs start to clear out mucus and other smoking debris. There is no nicotine in the body. Ability to taste and smell is improved.
After 72 hours.	Breathing becomes easier. Bronchial tubes begin to relax and energy levels increase.
After 2-12 weeks.	Circulation improves.
After 3-9 months.	Coughs, wheezing and breathing problems improve as lung function increases by up to 10%.
After 1 year.	Risk of heart disease is about half that of a smoker.
After 10 years.	Risk of lung cancer falls to half that of a smoker.
After 15 years.	Risk of heart attack falls to the same as someone who has never smoked.

Table 1.4 What happens when you quit? (NHS Smokefree, 2016)

## USEFUL SOURCES

### Change4Life

[www.nhs.uk/change4life](http://www.nhs.uk/change4life)

### NHS Choices

[www.nhs.uk/livewell/smoking](http://www.nhs.uk/livewell/smoking)

### ASH

[www.ash.org.uk](http://www.ash.org.uk)

### NHS Smokefree

[www.nhs.uk/smokefree](http://www.nhs.uk/smokefree)



## Alcohol

- More than 9 million people in England drink more than the recommended daily limits.
- In 2014 there were 8,697 alcohol-related deaths in the UK.
- Alcohol is 10% of the UK burden of disease and death, making alcohol one of the three biggest lifestyle risk factors for disease and death in the UK (after smoking and obesity).
- An estimated 7.5 million people are unaware of the damage their drinking could be causing.

(Alcohol Concern, 2016)

The latest NHS guidance states there is no ‘safe’ drinking level, but less than 14 units a week is considered low-risk drinking. The recommended levels are now the same for men and women.



### UNITS OF ALCOHOL

- 1 unit – Single measure of spirits (25ml)
- 2 units – Pint of normal-strength beer/medium glass of wine (175ml)
- 3 units – Large glass of wine (250ml)
- 4 units – Pint of strong beer

Individuals who may be at risk of exceeding the recommended guidelines include:

- Individuals who drink at home – it is easier to have more.
- Individuals who drink at home with the aim of getting drunk before they go out.
- Professional men and women who balance work, family and home may use alcohol to relax and unwind at the end of a busy day.
- Individuals who have retired or lost a spouse and live in more affluent areas.

The reasons individuals start and continue to use cigarettes and alcohol could include:

- Experimentation, peer pressure and wanting to fit in.
- Copying the behaviours of others or following a cultural pattern of behaviour.
- A coping strategy to manage stress, e.g. a glass of wine or cigarette to relax or help cope with other emotions (e.g. anger or depression) or other issues (e.g. abuse or domestic violence).
- Socialisation, e.g. going to the pub or a bar with friends.
- A habit or addiction (physiological and/or psychological).
- Use as a replacement for food, e.g. smoking instead of eating in order to lose or control weight (this is thought to be a significant factor in the increase of young women taking up smoking).
- A lack of education; being unaware of the risks.
- Denial; refusal to believe they have a problem or will be affected by the behaviour.

### USEFUL SOURCES

**Change4Life**  
[www.nhs.uk/change4life](http://www.nhs.uk/change4life)

**Drinkaware**  
[www.drinkaware.co.uk](http://www.drinkaware.co.uk)

**NHS Choices**  
[www.nhs.uk/livewell/alcohol](http://www.nhs.uk/livewell/alcohol)



## Healthy eating

A healthy diet with a balanced intake of the main nutrients has a key role in both the prevention and management of many health problems. An imbalanced and unhealthy diet poses a significant risk to health and wellbeing.

The eating behaviours individuals adopt may be due to:

- Role modelling, e.g. eating the same portion sizes and types of diet/food as family, friends or colleagues.
- Financial reasons, e.g. eating food that is affordable.
- More convenience foods or more takeaway foods being available, e.g. busy families and some professionals may choose quick meals.
- Education, e.g. lack of knowledge about healthy eating, healthy foods and what constitutes a healthy diet.
- Ethnicity and religion, e.g. following a culturally specific diet, fasting during Ramadan.
- Advertising and media, e.g. being influenced to eat certain foods.
- Celebrities, e.g. following diets suggested by celebrities to lose weight.
- Body image disorders or anxieties, e.g. anorexia or binge eating disorder.
- Stress or other emotions, e.g. comfort eating.
- Celebrations, e.g. holiday or religious festivals (Christmas, Easter).

## USEFUL SOURCES

### **Change4Life**

[www.nhs.uk/change4life](http://www.nhs.uk/change4life)

### **NHS Choices**

[www.nhs.uk/livewell/goodfood](http://www.nhs.uk/livewell/goodfood)

### **The British Nutrition Society**

[www.nutrition.org.uk](http://www.nutrition.org.uk)

### **The Food Standards Agency**

[www.food.gov.uk](http://www.food.gov.uk)

## Stress

Stress is the feeling of being under too much mental or emotional pressure, and pressure turns into stress when an individual feels unable to cope. A bit of stress is normal and can help push someone to do something new or difficult, but too much stress can take its toll.

Stress can cause many health problems if it isn't addressed. It is important for individuals to recognise the symptoms of stress early and to implement healthy coping mechanisms rather than adopting unhealthy coping methods, such as drinking alcohol or smoking.

There is little that can be done to prevent stress as it is part of everyday life, but there are many things an individual can do to manage stress more effectively, such as:

- Learning how to relax.
- Taking part in regular physical activity.
- Adopting effective time-management techniques.
- Learning simple mindfulness techniques involving simple meditations.

## POINT OF INTEREST

Poor nutrition is a contributory factor to a number of physical and mental health conditions.

These include:

- Obesity.
- Type 2 diabetes.
- Hypertension.
- High cholesterol.
- Coronary heart disease.
- Stroke.
- Some cancers.
- Depression and stress.
- Dementia.
- Asthma.
- Some types of arthritis.

(BBC Bitesize 2016,  
BBC World Service 2016).

## Sleep

Sleep is one of the most important factors affecting an individual's health and wellbeing. When you sleep well you feel refreshed. Good-quality sleep is important for your health and wellbeing, helping you to de-stress, concentrate during the day and learn new things. The odd bad night's sleep can make an individual feel tired and irritable the next day, but it won't harm their health. However, regular poor-quality sleep can have a huge effect on health and wellbeing, putting individuals at increased risk of developing serious medical conditions such as heart disease and diabetes. Not getting enough sleep can take its toll on the mind and can even lead to mental health problems such as anxiety and depression. Studies have shown that individuals who sleep less than 7 hours a day are 30% more likely to be obese than those who sleep for 9 hours or more. This is believed to be because sleep-deprived individuals have lower levels of leptin (the chemical that makes you feel full) and more ghrelin (the hunger-stimulating hormone) (Public Health England, 2016).

The following recommendations can aid an individual's sleep:

- Having a regular bedtime routine.
- Going to bed at a set time.
- Cutting out smoking and reducing alcohol and caffeine consumption.
- Removing distractions (like the TV, computer and phone) from the bedroom.
- Having mechanisms to manage worry and stress.
- Being more active. Anything energetic, like cycling or running, should be done in the morning or late afternoon. Before bed, relaxing exercise (like yoga) can aid sleep.
- Not consuming large meals close to bedtime.

(Public Health England, 2016)

### The benefits of good sleep patterns

- Boosts energy.
- Boosts the immune system.
- Helps the body recover from illness.
- Helps the body rebuild and repair.
- Helps the mind unwind and de-stress, restoring mental and emotional wellbeing.
- Helps the brain recover and revive, storing memories and creating new ideas.

(Public Health England, 2016).

## The factors that determine successful behaviour change

Every individual has a different set of factors that will determine their success at changing a particular negative behaviour. There are many factors that provide potential barriers for participation in physical activity and the adoption of other healthy lifestyle choices. To overcome these barriers it is essential to be aware of what they are and why they exist. The health determinants introduced previously offer a starting point for recognising some of the factors that influence health and wellbeing and they may provide barriers to healthy living for some individuals.

Barriers can generally be grouped into the following areas:

- Environmental, e.g. lack of affordable or accessible resources, climate, lack of transport, distance from local leisure services (rural areas), a lack of safe outdoor play areas (inner city areas).
- Technological, e.g. labour-saving devices, computers and computer games, email communication, mobile phones, escalators.
- Psychological, e.g. low self-esteem, low motivation, lack of confidence or other mental health considerations.
- Health and physiological, e.g. hypertension, CHD or living with a physical disability or chronic health condition that affects mobility and/or independence, such as low back pain, rheumatoid arthritis, COPD.
- Social, e.g. isolation (rural areas), lack of social support, lack of positive role models, prejudice, fear of personal safety (i.e. some inner city areas), lack of time (other commitments), lack of culturally appropriate services, discrimination.
- Socioeconomic, e.g. lack of money, low education, inequalities and 'hidden' demographics (those under-represented in national surveys).
- Individual factors, e.g. age, gender, ethnicity, disability.

There are many behaviour change theories and awareness of these theoretical frameworks and of the different psychological stages and processes a client moves through when making changes is useful for guiding interventions to support client commitment.

### Example

- The theory of planned behaviour explains that in order for a person to make a behavioural change they need to have an appropriate combination of positivity, support and control.
- The trans-theoretical model of behaviour change helps to identify a client's readiness to make a change, using five stages (pre-contemplation, contemplation, preparation, action and maintenance). Skilled professionals also utilise the information provided by this model to individualise strategies to enhance the likelihood of success.
- Decisional balance is a method of weighing up the pros and cons of making a change or a specific behaviour. This will help to highlight the benefits of making a change and as such increase the likelihood of success.

## Strategies to overcome barriers

There is no single strategy nor intervention that will address an individual's barriers. To ensure long-term change, a holistic, integrated and strategic approach is needed to tackle the many barriers and factors influencing health.

### Positive role models

Most people are influenced at some point in their lives by others. The beliefs, attitudes, behaviours and choices demonstrated by these role models can influence the beliefs, attitudes, behaviours and choices of others.

The following all have the potential to act as powerful role models (positive or negative):

- Family (parents and siblings).
- Professionals, e.g. general practitioners (GPs), teachers and group leaders.
- Friends and peer group, e.g. an individual may join an activity group because their friend has joined.
- Celebrities and sports personalities.
- The media and advertising.

### Health education and promotion

Health education and promotion have the potential to raise awareness and consciousness. Providing education and knowledge about the positive benefits and negative impact of specific lifestyle behaviours is essential, if only to enable people to make more informed choices.

### Beliefs and attitudes

There are many beliefs and attitudes held by individuals that may prevent them from becoming more active or changing certain lifestyle behaviours. These can be recognised by the affirmations individuals use to describe themselves and are psychological barriers rather than actual barriers. However, for the individual, these will be very real.

Many people also hold specific beliefs about the type of people who attend exercise classes, leisure centres or gyms and use these beliefs to differentiate other people from themselves. For example, believing that the people who visit these places are young, fit, thin and healthy and not the same as the rest of the population. These perceptions trigger beliefs of fear and inadequacy which lower self-esteem and confidence. Activity and exercise have the potential to boost self-esteem and confidence and have a positive impact on other health behaviours (e.g. influencing smoking cessation and/or a change of diet), but these limiting beliefs have to be overcome before that potential is enabled.



Examples of strategies to overcome barriers may include:

- Using promotional materials to show visual images of people of all ages, genders, ethnic groups and physical abilities.
- Encouraging national and local health campaigns (e.g. Change4Life).
- Providing a broader range of activities (e.g. sport, active play or dance) to attract diverse groups (age-, gender-, ethnicity- and culturally-appropriate activities).
- Providing affordable services with concessionary rates (e.g. small group training sessions for a target group).
- Providing education on the benefits of activity for disease prevention.
- Providing activities to target specific groups (e.g. wheelchair basketball).
- Providing activities in locations that specific populations regularly attend (take activity to them, e.g. the community centre or church hall).
- Promoting activity at work and at school, including providing after-work/school services.
- Promoting active transport.
- Encouraging the community to be engaged in maintaining green space (allotments, green gyms, community gardens, etc.).
- Encouraging the use of outdoor gyms and trim trails in local parks.
- Utilising buddy systems.

**END OF SECTION Revision activities**

Answer the following questions and make notes to revise this section.

- What are the four components of the biopsychosocial model?
- Give two examples of each of the following determinants of health:
  - Individual differences.
  - Population lifestyles.
  - Local economy.
  - Activities.
  - Natural environment.
- What are the six areas that offer the greatest potential to improve health and reduce morbidity associated with chronic health conditions?
- Give two examples of each of the following barriers to lifestyle behaviour change:
  - Technological barriers.
  - Psychological barriers.
  - Health and physiological barriers.
  - Social barriers.

# Section 2: The impact of common medical conditions on an individual's lifestyle

This section will introduce a range of common medical conditions that affect many individuals in the UK. It will cover the progressions and risk factors to enable the skilled professional to understand the key considerations for individuals who are affected by these conditions.

In order to work with a client with a medical condition, the skilled professional (e.g. personal trainer, Pilates instructor or yoga teacher) should seek additional training and qualifications. If a skilled professional does not hold these specialist qualifications, they are still likely to be approached by individuals with these conditions when in health, exercise and fitness environments. It is therefore essential that the skilled professional understands their professional role boundaries and scope of practice and when to refer to other professionals. It is essential that the skilled professional also adheres to any code of ethics and regulations relevant to their area of expertise.

## Common medical conditions

In order to understand how medical conditions affect an individual's lifestyle, it is useful to understand the causes, progressions and risk factors of a range of conditions. Even though there are numerous medical conditions that individuals may present with when wanting to work with a skilled professional, this section will look at some of the most common, including:

- Hypertension.
- Obesity.
- Cardiorespiratory disease.
- Diabetes.
- Stress (not classified as a medical condition but has implications for many health conditions).



A risk factor is something that increases an individual's likelihood of getting a disease.

### Hypertension (high blood pressure)

#### Interesting statistics

- Approximately 16 million people in the UK have hypertension.
- 30% of women and 32% of men have hypertension.
- Approximately 62,000 unnecessary deaths from stroke and heart attacks occur due to poor blood pressure control.
- Approximately one-third of people with hypertension do not know they have it.
- The risks increase as blood pressure rises, whether an individual has high blood pressure or normal blood pressure. Between the ages of 40 and 70, for every rise of 20mmHg systolic or 10mmHg diastolic, the risk of heart disease and stroke doubles (Blood Pressure UK, 2016a).

#### Description of the condition

Hypertension is a common condition, affecting at least one-quarter of adults in the UK. It often has no symptoms and many individuals do not know they have it. The chance of developing hypertension increases with age.

When blood pressure remains higher than normal for some time (at least several months), this may mean an individual has hypertension. Hypertension will be diagnosed when measured in a medical professional's practice or clinic.

#### Classification of blood pressure levels

Table 2.1 shows classifications of blood pressure levels. If systolic and diastolic blood pressure fall into different categories, the higher value should be used for classification.

Category	Systolic blood pressure (SBP) in mmHg	Diastolic blood pressure (DBP) in mmHg	Recommendation for exercise
Low.	<100	<60	Seek medical guidance prior to exercising.
Optimal.	120	80	If the client has no other cause for concern, exercise is recommended.
Stage 1 hypertension.	140-159	90-99	Seek medical guidance prior to exercising.
Stage 2 hypertension.	160-179	100-109	Seek medical guidance prior to exercising.
Severe hypertension.	≥180	≥100	It is a complete contraindication to advise a client to exercise. Any medically recommended exercise should be performed in an appropriate environment under specialist supervision.

Table 2.1 British pressure classifications (BHF, 2010; NICE, 2011; ACSM, 2014)

### Causes of hypertension

For many individuals there is no specific reason why they have hypertension. It seems to be just one of those things. This type of hypertension is called **essential hypertension**. Roughly 90% of individuals with hypertension fall into this category. While the exact causes of essential hypertension are unknown, family history and lifestyle seem to play a role, but exactly how is not yet clear.

For the other 10% of individuals with hypertension, an underlying cause can be identified. This type of hypertension is called **secondary hypertension**. Individuals with secondary hypertension have high blood pressure that is being caused by another condition, so it may be that their blood pressure goes back to normal once the other problem has been treated. For example, individuals can develop hypertension due to problems with their kidneys or adrenal glands, and treating these problems may return their blood pressure to normal.

Another category (known as **malignant hypertension**) is very rare and has nothing to do with cancer. It affects less than 1% of all people with hypertension. Individuals with malignant hypertension have extremely high blood pressure which is often due to serious disorders of the kidneys or blood vessels. It can cause serious damage to the body's organs and is treated as a medical emergency (Blood pressure UK 2016a).

Factors that can increase the risk of individuals developing hypertension include modifiable (lifestyle) and non-modifiable factors plus diagnosed conditions and certain medications.



### POINT OF INTEREST

**White coat hypertension** is when an individual's blood pressure readings are consistently elevated in a clinical environment, whereas BP readings taken outside a clinical environment are normal. White coat hypertension may not necessarily require treatment initially, but individuals will require regular monitoring as up to 75% will go on to develop longer-term hypertension. White coat hypertension can be diagnosed by an individual wearing a blood pressure monitor for 24 hours which is automatically inflated at regular intervals with the BP values recorded for subsequent analysis.

Causes of hypertension	
Modifiable	Non-modifiable
Excessive salt (sodium) consumption.	Age – the risk of developing hypertension increases with age.
Low fruit and vegetable consumption.	A family history of hypertension.
Physical inactivity.	Being of African or Caribbean origin.
Overweight and obesity.	
Excessive alcohol consumption.	
Smoking.	
Long-term sleep deprivation.	

Table 2.2 Causes of hypertension (NHS Choices, 2011)

Causes of hypertension	
Conditions	Medicines and drugs*
Kidney problems (e.g. kidney disease, long-term kidney infections, narrowing of the arteries supplying the kidneys, damage to the kidneys' filters).	The combined oral contraceptive pill.
Diabetes (type 1 and type 2).	Steroid medication.
Scleroderma (a condition that causes thickened skin, and sometimes problems with organs and blood vessels).	Non-steroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen and naproxen.
Obstructive sleep apnoea (a condition in which the walls of the throat relax and narrow during sleep, interrupting normal breathing).	Some over-the-counter cough and cold remedies.
Lupus (a condition in which the immune system attacks parts of the body, such as the skin, joints and organs).	Some herbal remedies – particularly those containing liquorice.
Hormone problems (e.g. underactive thyroid, overactive thyroid, Cushing's syndrome).	Some recreational drugs, such as cocaine and amphetamines.
	Some selective serotonin-noradrenaline reuptake inhibitor (SSNRI) antidepressants, such as venlafaxine.
	*In these cases, blood pressure may return to normal once the medicine or drug is stopped.

Table 2.3 Causes of hypertension (NHS Choices, 2011)

### Signs and symptoms

Hypertension does not tend to produce obvious signs or symptoms but if left untreated, it increases an individual's risk of serious problems such as heart attacks and strokes. This is why it is often called the 'silent killer'. Occasionally, some people with very high blood pressure may get headaches or have problems with their vision. Hypertension is most often detected during an unrelated visit to a medical professional or as part of routine health screening.



Hypertension causes 60% of strokes and 40% of heart attacks and is a major risk factor for kidney disease and dementia (Blood Pressure UK, 2016a).

### Risk factors

With hypertension, the heart has to work harder to pump blood around the body. This means that an individual may be at risk of cardiovascular disease. A heart attack (when the blood supply to the heart is affected) or a stroke (when the blood supply to the brain is affected) may occur. An individual may also be at risk of damage to the blood vessels in the kidneys or eyes. The higher the blood pressure, the greater the risk.

Hypertension can affect the body in a number of ways:

- Extra strain on blood vessels can cause heart disease, heart attack and heart failure.
- Leading cause of strokes and closely linked to some forms of dementia.
- Kidney disease.

If an individual has other health conditions, such as diabetes or high cholesterol, the risk of health problems is increased. Reducing blood pressure levels by even a small amount can help lower an individual's risk.

### Recognised interventions

Thresholds for intervention vary according to the level of risk of different groups. The important point is that hypertension is not a disease itself, but a factor that may increase the chance of cardiovascular and other diseases.

Hypertension can be treated by making changes to an individual's lifestyle and with drugs, both of which can help to lower blood pressure. The aim of treatment is to get clinic blood pressure readings down to below 140/90 mmHg if the individual is aged under 80, or below 150/90 mmHg if aged 80 or over.

## Lifestyle interventions

Hypertension can often be prevented or reduced by eating healthily, maintaining a healthy weight, taking regular exercise, drinking alcohol in moderation and not smoking.

Specific lifestyle guidance to help manage hypertension includes:

- Cut down on the amount of salt in the diet. Salt raises blood pressure. The recommendations are to eat less than 6g (0.2oz) of salt a day (about a teaspoonful).
- Eat plenty of fruit and vegetables (at least five portions per day).
- Eat a low-fat diet that includes lots of fibre – such as wholegrain rice, bread and pasta – and plenty of fruit and vegetables.
- Limit alcohol intake. Regularly drinking alcohol above recommended limits can raise blood pressure over time.
- Lose weight if needed. Being overweight forces the heart to work harder to pump blood around the body, which can raise blood pressure.
- Be physically active. Taking regular exercise lowers blood pressure by keeping the heart and blood vessels in good condition. Regular exercise can also help weight management.
- Cut down on caffeine. Drinking more than four cups of coffee a day may increase blood pressure.
- Stop smoking. Smoking doesn't directly cause hypertension, but it puts an individual at a much higher risk of a heart attack and stroke. Smoking will cause the arteries to narrow. If an individual smokes and has hypertension, their arteries will narrow much more quickly, and their risk of heart or lung disease in the future is dramatically increased.
- Get a good night's sleep. Long-term sleep deprivation is associated with a rise in blood pressure and an increased risk of hypertension. The recommendations are to get at least six hours of sleep a night.

(NHS Choices, 2011)

## Treatment with drugs

A doctor is likely to offer drug treatment if an individual's blood pressure is considered to be high and any of the following apply:

- Damage to the blood vessels in the heart, brain, kidneys or eyes.
- Cardiovascular disease.
- Kidney disease.
- Diabetes.
- If the likely risk of developing cardiovascular disease during the next 10 years is 20% (a 1 in 5 chance) or more.
- If clinical blood pressure is 160/100mmHg or above and the average ambulatory or home blood pressure is 150/95mmHg or above.

Type of drug	Who does it work best for?
<b>ACE inhibitor</b> (e.g. enalapril, lisinopril, perindopril, ramipril).  ACE stands for angiotensin-converting enzyme. This enzyme is responsible for hormones that have a powerful narrowing effect on blood vessels, which increases blood pressure.	Individuals of any age who are not of black African or Caribbean family origin (ACE inhibitors do not work as well in these groups of people).  An ACE inhibitor is often the first drug offered to treat hypertension.
<b>Angiotensin II receptor blocker</b> sometimes known as an ARB (e.g. candesartan, irbesartan, losartan, valsartan).	Individuals who are not able to take ACE inhibitors because of side effects such as a dry cough.  An ARB is sometimes the first drug offered to treat hypertension.
<b>Calcium-channel blocker</b> (e.g. amlodipine, felodipine, nifedipine).	Individuals who are aged over 55 years.  People of any age who are of African or Caribbean family origin.

Type of drug	Who does it work best for?
<b>Diuretic</b> (e.g. chlortalidone, indapamide, bendroflumethiazide).	Individuals who need three or four drugs to lower their blood pressure. Individuals who cannot take a calcium-channel blocker because they have swelling caused by fluid retention or have a high risk of heart problems.
<b>Alpha-blocker</b> (e.g. doxazosin, prazosin) or <b>beta-blocker</b> (e.g. atenolol, bisoprolol).  Alpha-blockers and beta-blockers are used less commonly than other drugs for hypertension.	Individuals who need four drugs to lower their blood pressure and who cannot take some other drugs. For some individuals, a beta-blocker may be the first drug offered to lower their blood pressure.

Table 2.4 Drugs commonly used to treat hypertension (NICE, 2016)

### Benefits of exercise

If an individual has hypertension, it is highly probable that their general practitioner or nurse will suggest that they try to become more active to lower it. Many individuals will worry that regular exercise will increase their blood pressure to dangerous levels, but most individuals with hypertension should be able to increase their physical activity levels quite safely.

Regular exercise is very important for the health of the heart, lungs and blood vessels. It helps to make the heart and blood vessels more flexible and efficient, and it should help lower an individual's blood pressure and keep them fit.

### Exercise guidelines and restrictions

**Remember that a skilled professional with no further specialist qualifications may need to refer to a suitably qualified exercise professional if the severity of the condition means it is outside of the skilled professional's scope of practice.**

Table 2.1 gives a general idea of the blood pressure levels a skilled professional needs to be concerned about, but bear in mind that every person is different and medical professional guidance should be followed.

If an individual's blood pressure is relatively high, their general practitioner may prefer to lower it with medication before an exercise programme is commenced.

Different kinds of exercise have different effects on the body. For individuals with hypertension, the focus should be on activities that will help the heart and blood vessels, i.e. aerobic exercise. Aerobic activity is repetitive and rhythmic. Walking, jogging, swimming and digging are all aerobic activities. Other forms of activity are less helpful. For example, any activity that is very intensive for short periods of time, such as sprinting or weightlifting, will quickly raise blood pressure and put unwanted strain on an individual's heart and blood vessels.

Table 2.5 provides ideas of activities that an individual with hypertension can and cannot do:

Good for hypertension	Not good for hypertension
Cycling.	Weightlifting.
Brisk walking, jogging.	Squash.
Swimming.	Skydiving, parachuting.
Dancing.	Sprinting.
Tennis.	Scuba diving.

Table 2.5 (Blood Pressure UK, 2016b)

# Obesity

## Interesting statistics

- Worldwide, more than 1.4 billion adults were overweight and more than half a billion obese in 2008.
- Worldwide, at least 2.8 million people each year die as a result of being overweight or obese.
- Globally, 42 million preschool children were overweight in 2013 (WHO, 2016).
- The Health Survey for England (HSE) showed that, in 2014, around a quarter of adults were obese (24% of men and 27% of women). Being overweight was more common than being obese and 41% of men and 31% of women were overweight, but not obese.
- The prevalence of obesity is similar among men and women, but men are more likely to be overweight.
- In England, the prevalence of obesity among adults rose from 14.9% to 25.6% between 1993 and 2014 (HSE, 2014).
- By 2050, obesity is predicted to affect 60% of adult men, 50% of adult women and 25% of children (Foresight, 2007).

## Description of the condition

Overweight and obesity are defined as 'abnormal or excessive fat accumulation that may impair health'.

## Classification of obesity

Obesity is classified by the assessment of Body Mass Index (BMI), which is the chosen form for most clinical standards since it is easy to use and requires no specialist equipment. BMI is calculated by dividing weight in kilograms by height in metres squared ( $\text{kg}/\text{m}^2$ ).

Although BMI is useful on a population scale, it has limitations on an individual level, where more specific means of body composition measurement may be more useful and accurate. However, the use of alternative, more precise measurements on a large scale is simply not possible. Height and weight measurements are taken routinely across the globe and therefore this provides a simple but crude measure to estimate prevalence of overweight and obesity. One of the key weaknesses of BMI is that it does not account for body fat distribution; more recently, research has suggested that waist circumference has a closer association with morbidity and mortality. At present, however, waist measurements are not routinely taken (though health practitioners are increasingly being encouraged to do so) and errors in measurements may be substantial due to difficulties in identifying the waist.

Table 2.6 shows BMI classifications for a Caucasian population.

BMI classification	
Underweight	<18.5
Normal range	18.5-24.9
Overweight	$\geq 25.0$
Preobese	25.0-29.9
Obese	$\geq 30.0$
Obese class I	30.0-34.9
Obese class II	35.0-39.9
Obese class III	$\geq 40.0$

Table 2.6 BMI classifications (Foresight, 2007)



**POINT OF INTEREST**

A person is considered to be overweight if they have a body mass index (BMI) between 25 and 29, and obese with a BMI of 30 and above.

## Waist measurements

It is now well known that people who carry their excess fat centrally (within the abdominal cavity) are more likely to suffer the consequences of being overweight. That's because these fat cells are in close proximity to vital organs and produce pro-inflammatory toxic substances, causing damage (BHF, 2016).

Research shows that South Asian, African-Caribbean, Black African, Chinese, Middle Eastern individuals or individuals who have parents of two or more different ethnic groups, may be at increased risk of some health conditions at a lower BMI than people from white European backgrounds. This means the measurements that indicate severe risk are lower for people from these groups.

The waist circumference measurements for men and women at which there is an increased relative risk are defined as follows:

	<b>Increased risk</b>	<b>Substantially increased risk</b>
<b>Men</b>	Over 94cm.	Over 102cm.
<b>Men (African-Caribbean, South Asian and some other minority ethnic groups)</b>		Over 90cm.
<b>Women</b>	Over 80cm.	Over 88cm.
<b>Women (African-Caribbean, South Asian and some other minority ethnic groups)</b>		Over 80cm.

Table 2.7 Waist circumference risks (BHF, 2016)

### Causes of obesity

The causes of obesity are complex and multifaceted. Human biology, growth and development early in life, eating and physical activity behaviours, people's beliefs and attitudes, and broader economic and social drivers all have a role to play in determining obesity.

At first glance, the cause of obesity seems simple: over a period of time, energy intake exceeds energy expenditure. But this simplistic view, which is widely held to be true, hides the intricacies inherent in how individuals acquire and use energy.

The specific causes of obesity at an individual level are many and varied. They differ between population groups and across a person's life course, with the accumulation of excess fat, and therefore weight, being the end result of a variety of causal pathways. This variability is an important feature in that it points to a range of different solutions rather than a 'one size fits all' approach. Evidence from research on obesity from medicine, the life sciences, the social sciences and economics tells us a great deal about these different causes. One of the main aspects highlighted is that the environment has a major influence on the decisions people make about their lifestyle. Known as 'obesogenic environments', these are places, often urban, that encourage unhealthy eating and inactivity. Cars, TVs, computers, desk jobs, high-calorie food and clever food marketing have all contributed to encourage inactivity and overeating. Longer working hours and more desk-bound jobs over recent decades limit opportunities for other forms of activity during the working day.

#### POINT OF INTEREST

In 2012, only 67% of men and 55% of women aged 16 and over met the government's recommendations for physical activity of 150 minutes a week. Among children aged 5 to 15, more boys (21%) than girls (16%) met the recommendation to do an hour of activity every day (NHS Choices, 2016).

#### POINT OF INTEREST

Adults spend about six hours a day engaged in sedentary pursuits (watching TV and other screen time, reading and other low-energy activities). On average, men and women spend 2.8 hours watching television per weekday and this rises to about 3 hours on weekends (NHS Choices, 2016a,b).

### Signs and symptoms

Being slightly overweight may not present too many noticeable problems. However, as BMI increases to more than 30, a number of symptoms may develop that can carry over to activities of daily living.

Short-term issues may include:

- Breathlessness.
- Increased sweating.
- Snoring and/or difficulty sleeping.
- Inability to cope with sudden onset of physical activity.
- Joint pain.

Psychological issues associated with obesity may include:

- Low self-esteem and poor self-image.
- Low confidence levels.
- Feelings of isolation.
- Reduced mobility leading to a poor quality of life.

### Risk factors

Generally, although men have higher rates of overweight, women have higher rates of obesity. For both, obesity poses a major risk for many serious conditions such as type 2 diabetes, cardiovascular disease, hypertension, stroke and certain forms of cancer. Its health consequences range from increased risk of premature death to serious chronic conditions that reduce the overall quality of life (World Health Organization, 2003).

Compared with a healthy-weight man, an obese man is:

- Five times more likely to develop type 2 diabetes.
- Three times more likely to develop cancer of the colon.
- More than two and a half times more likely to develop hypertension.

Compared with a healthy-weight woman, an obese woman is:

- Almost 13 times more likely to develop type 2 diabetes.
- More than four times more likely to develop hypertension.
- More than three times more likely to have a heart attack.

A BMI of 30-35 has been found to reduce life expectancy by an average of 3 years, while a BMI of over 40 reduces longevity by 8-10 years, which is equivalent to a lifetime of smoking.

Alongside disease, obesity can affect people's self-esteem, wellbeing and mental health, as well as their ability to get and hold down a job.

Table 2.8 shows the links between increased body fat and serious medical complications.

Medical condition	Links with obesity
<b>Type 2 diabetes</b>	90% of type 2 diabetics have a BMI of >23.
<b>Hypertension</b>	66% of hypertension cases are linked to excess weight. 85% of hypertension cases are associated with a BMI of >25.
<b>Coronary artery disease and stroke</b>	Obesity is a contributing factor to cardiac failure in >10% of patients. Overweight/obesity plus hypertension is associated with increased risk of ischaemic stroke.
<b>Respiratory effects</b>	Neck circumference of >43cm in men and >40.5cm in women is associated with obstructive sleep apnoea, excessive daytime sleepiness and development of pulmonary hypertension.
<b>Cancers</b>	10% of all cancer deaths among non-smokers are related to obesity (30% of endometrial cancers).
<b>Osteoarthritis (OA)</b>	Frequent association in the elderly with increasing body weight – risk of disability attributable to OA equal to heart disease and greater than any other medical disorder of the elderly.
<b>Liver and gall bladder disease</b>	Overweight and obesity are associated with non-alcoholic fatty liver disease. 3 times risk of gall bladder disease in women with a BMI of >32; 7 times risk if BMI is >45.

Table 2.8 Links between obesity and serious medical conditions (Foresight, 2007)



### POINT OF INTEREST

Overweight children are likely to become obese adults. They are more likely than non-overweight children to develop diabetes and cardiovascular diseases at a younger age, which in turn are associated with a higher chance of premature death and disability.

Risk factors for some conditions start to increase at relatively low BMIs (e.g. hypertension and type 2 diabetes).

Abdominal obesity is a particular risk for the cluster of diseases that have become known as **metabolic syndrome** – type 2 diabetes, hypertension and dyslipidaemia – and is strongly linked to an increased risk of cardiovascular disease. Features of metabolic syndrome can be found in 30% of middle-aged people in developed countries. Its association with abdominal fat suggests that specific measures of excess weight distribution in the body may be more accurate predictors of disease among some groups than BMI.

### **Recognised interventions**

The World Health Organization now recognises obesity and overweight as a global epidemic ('globesity') and a disease in its own right – one which is largely preventable through changes in lifestyle.

Tackling obesity involves a variety of short- and longer-term goals, including what may be challenging alterations to diet, changes in shopping behaviour, increases in exercise, different choices of transport and reductions in alcohol consumption (including binge-drinking).

The UK government has recognised that past efforts have not succeeded in turning the tide and that a new approach is required. In 2011, it published 'Healthy lives, healthy people', a policy document setting out its vision for how society as a whole can work together to turn the tide on obesity by 2020. Some of the government's measures to help people make healthier choices include:

- Giving people advice on healthier food choices and physical activity through the 'Change4Life' programme.
- Improving labelling on food and drink to help people make healthy choices.
- Encouraging businesses on the high street to include calorie information on their menus so people can make healthy choices.
- Giving people guidance on how much physical activity they should be doing.

Food manufacturers, retailers and the hospitality sector have committed to cutting down on the amount of fat, sugar and salt in popular food products, encouraging people to eat more fruit and vegetables, reducing portion sizes and putting calorie information on menus.

Given all the external causes of the obesity epidemic, for the individual, it boils down to a simple message: to lose weight, eat less and move more. Individuals don't choose to be obese, it happens for a number of reasons. In our environment, it's easy to overeat and be less active.

The primary strategy for dealing with overweight and obesity through a medical professional is as follows:

1. Lifestyle intervention introduced: defined as reducing calorie intake and becoming more active. The accepted dietary advice, at present, is to encourage a low-fat diet and reduce daily calorie intake to 600 calories less than your body requires. Individuals should aim to do 30-60 minutes of moderate activity per day to stop gaining weight.
2. Where BMI is greater than 30 and weight loss has slowed, the individual is moved to a 'very low calorie diet' (below 1000kcal per day) for up to 12 weeks or on certain days of the week.
3. Pharmacological intervention may be introduced for those with a BMI in excess of 30 who have already applied lifestyle advice and still not lost enough weight. The medication currently prescribed is orlistat (lipstatin). The common names of this are Xenical and Alli. Orlistat inhibits gastric and pancreatic enzymes that help in the breakdown of triglycerides into smaller fatty acids for absorption into the bloodstream. This action leads to increased excretion of undigested fats out of the bowel. The side effects include oily stools, faecal urgency, mild gastrointestinal discomfort, bloating and/or flatulence and headaches.
4. Surgery is normally a last resort, but may be suggested for those who are morbidly obese and have not had success using the previous three methods. Surgery involves reducing the size of the stomach to prevent larger food intake or bypassing part of the gut altogether to prevent the absorption of food into the bloodstream and increase excretion.



## Benefits of exercise

Reducing body fat levels has always been identified as a benefit of exercise. The theory behind this is that by increasing energy expenditure beyond energy intake, there is a shift towards a negative energy balance and the body becomes reliant on fat stores to provide the lacking energy. Those seeking an even greater energy deficit will likely use a combination of restricting food intake and increasing exercise, thereby achieving better results. During exercise many adjustments take place to the regulatory mechanisms in the body which alter metabolism for longer periods of time than just the actual exercise session.

Increasing aerobic fitness levels shifts the body towards its most efficient energy producing pathways that provide the largest amount of total energy. The greater the utilisation of aerobic pathways, the greater the chance of oxidising fats during exercise. A gradual increase in the intensity of training will lead not only to improved aerobic capacity and therefore better fat oxidation, but also greater caloric expenditure overall.

Research has shown that a combination of a healthy diet and regular exercise helps an individual lose and maintain a normal weight more than just a diet or exercise regime in isolation.

## Exercise guidelines and restrictions

**Remember that a skilled professional with no further specialist qualifications may need to refer to a suitably qualified exercise professional if the severity of the condition means it is outside of the skilled professional's scope of practice.**

The ability to tolerate increased intensity and volume during exercise must be a major focus in the early weeks of training with a client intending to lose weight.

Exercise training must optimise energy expenditure, yet minimise potential for injury. Exercise should also be enjoyable and practical and fit into the person's lifestyle (Durstine et al., 2009). The accumulation of physical activity during the day may help to distribute energy expenditure throughout the day, especially when it is challenging to participate in formal exercise sessions. In the early stages of exercise training, it may be more suitable to focus on optimising fat-burning potential within the exercise session. Excessive exertion for an overweight client in these early stages increases the risk of injury and muscular soreness, and may reduce the likelihood of adherence. However, the client needs to understand that more significant improvements in weight loss will be seen once they can raise their tolerance of exercise to higher levels. It is also important to know what exercise intensity will optimise fat burning in the early stages.

The American College of Sports Medicine (ACSM) recommends accumulating 200-300 minutes per week, or >2000kcal per week of physical activity for weight loss (ACSM, 2014).

In contrast, high intensity interval training (HIIT) is a more intense, shorter type of exercise that may be suitable for obese clients. Research has shown that HIIT performed 3 times per week for 20 minutes per session resulted in greater amounts of body fat loss over 15 weeks than the same energy expended doing 40 minutes of steady state exercise 3 times per week (Trapp et al., 2008). HIIT appears to be a method of training with many benefits for the overweight individual and requires a smaller time commitment, although more effort.

Exercise recommendations are fairly general because initial exercise duration and intensity levels are low for obese individuals.

Mode of exercise	Benefits	FITT principles
<b>Aerobic</b>  Large muscle group activities that are rhythmic and/or dynamic, e.g. walking, swimming, cycling.	Sustained moderate-intensity exercise increases fat loss and reduces risk of cardiovascular disease.  Regular exercise also increases work capacity and endurance and increases functional performance in activities of daily living.	40-70% maximum heart rate.  >5 days/week 30-60 mins per session or 2-3 sessions per day of 20-30 mins each; accumulate 200-300 mins of activity per week.

Mode of exercise	Benefits	FITT principles
<b>Resistance</b> Large muscle group activities using added resistance or load, e.g. fixed resistance machines, free weights, body weight.	Maintenance/enhancement of muscular strength and endurance. Increases in bone mass and strength of connective tissue. Increase independence for activities of daily living, vocational potential and physical self-confidence. Not recommended as the only form of exercise, as it does not significantly contribute to total energy expenditure. It could be incorporated within a circuit-style exercise programme with aerobic exercise.	2-4 sets, 10-15 reps. 60-75% 1RM. 20-30 mins per session. 1-3 days/week.
<b>Flexibility</b> Stretching of muscles as part of a warm-up and/or cool-down.	Helps to reduce the risk of injury from training. Can include activities such as yoga and Pilates. Can enhance mental wellbeing through relaxation and proper breathing.	Static stretches hold for 10-30 seconds. Daily or at least 5 sessions per week.

Table 2.9 Exercise recommendations for obese individuals

### Self-esteem and confidence

Overweight and obese clients are likely to be self-conscious when starting an exercise programme and skilled professionals should be sensitive to this; their approach should be empathetic, non-judgemental and non-shaming. Considerations may include:

- The positioning of equipment, e.g. is it positioned directly in front of a mirror?
- The advice provided to the person on what to wear, e.g. some clients may want to wear baggy items to cover their body.
- The timing of exercise. The client may find that exercising at cooler times in the day can help to avoid overheating. The client may also want to exercise at less busy times.
- The equipment or exercises that may need to be avoided due to physical restrictions.

## Cardiorespiratory disease

### Description of the condition

Cardiorespiratory diseases are those that affect the heart and respiratory system. Cardiorespiratory refers to the heart (cardio) and the lungs (respiratory), which work together to transport oxygen throughout the body.

Cardiorespiratory conditions can restrict an individual's ability to breathe in enough air and deliver enough oxygen to their body when needed, leaving them coughing or wheezing and short of breath. Conditions that limit the cardiorespiratory function of an individual can affect their strength, vitality and sense of wellbeing. Individuals often respond to these limitations by reducing their physical activity which only worsens the situation and reduces overall fitness.

The following cardiorespiratory conditions are covered within this section:

- Cardiovascular disease.
- Chronic obstructive pulmonary disease (COPD).

### Cardiovascular disease

Cardiovascular disease (CVD) is a general term that describes a disease of the heart or blood vessels. Blood flow to the heart, brain or body can be reduced as the result of a blood clot (thrombosis) or by a build-up of fatty deposits inside an artery that causes the artery to harden and narrow (atherosclerosis).



Cardiorespiratory fitness, also called aerobic capacity, is the ability of the lungs, heart and circulatory system to supply the body with the oxygen it needs to maintain a physically active lifestyle.

There are four main types of CVD. They are:

- Coronary heart disease.
- Stroke.
- Peripheral arterial disease.
- Aortic disease.

### Coronary heart disease

The coronary arteries are the major blood vessels that supply your heart with blood. As they narrow because of plaque build-up, the blood supply to the heart will be restricted. This can cause angina pectoris. Angina often feels like a heaviness or tightness in the chest, which may spread to the arms, neck, jaw, back or stomach as well. Some individuals experience a feeling of severe tightness, while others say it's more of a dull ache. Some experience shortness of breath too. If a coronary artery becomes completely blocked, it can cause a heart attack. Heart attack symptoms vary from one person to another. The most common signs are:

- Chest pain: tightness, heaviness, pain or a burning feeling in the chest.
- Pain in arms, neck, jaw, back or stomach (for some people, the pain or tightness is severe, while other people just feel uncomfortable).
- Sweating.
- Feeling light-headed.
- Becoming short of breath.
- Feeling nauseous or vomiting.

### Stroke

A stroke is a serious medical condition that occurs when the blood supply to part of the brain is cut off. Like all organs, the brain needs a constant supply of oxygen and nutrients to function properly. This is provided by the blood, so if the blood flow is restricted or stopped, brain cells will begin to die. This can cause brain damage and possibly death. A stroke is a medical emergency and prompt treatment is essential. The sooner a person who has had a stroke receives treatment, the less damage is likely to occur.

The two most common types of stroke are ischaemic and haemorrhagic stroke:

- **Ischaemic** strokes happen when the artery that supplies blood to the brain is blocked, e.g. by a blood clot.
- **Haemorrhagic** strokes happen when a blood vessel bursts and bleeds into the brain, damaging brain tissue and starving some of the brain cells of blood and oxygen.

A **transient ischaemic attack** (also called a TIA or mini-stroke) happens when there is a temporary blockage in the blood supply to the brain. A TIA doesn't cause permanent damage to the brain and the symptoms usually pass within 24 hours.

It's often hard to tell the difference between a stroke and TIA, but both are medical emergencies.

The acronym, FAST describes the symptoms of a stroke:

- Facial weakness – can they smile? Has their mouth or eye drooped?
- Arm weakness – can they raise both arms?
- Speech problems – can they speak clearly and can they understand what you are saying?
- Time is critical. If any of these signs are evident call 999 straight away.



### Peripheral arterial disease

Peripheral arterial disease (PAD), also known as peripheral vascular disease, occurs when there's a blockage in the arteries to the limbs (usually the legs). The most common symptom of peripheral arterial disease is pain in the legs when walking. This is usually in one or both thighs, hips or calves. The pain can feel like cramp, a dull pain or a sensation of heaviness in the leg muscles. The pain usually comes and goes, and gets worse during exercise that uses the legs, such as walking or climbing stairs. The pain is caused by the narrowing (stenosis) of the arteries in the legs, due to atherosclerosis. PAD can affect any artery in the body (excluding those that supply the heart), but it most commonly affects the arteries that supply the legs.

### Aortic disease

The aorta is the largest blood vessel in the body. It carries blood from the heart to the rest of the body. The most common type of aortic disease is an aortic aneurysm. An aneurysm is a blood vessel dilation, where the artery or vein swells to an abnormal size. An aneurysm usually grows slowly, around 1-2mm per year. Once it reaches a certain size, the risk of it rupturing (bursting) becomes too high and surgery is needed to repair it.

Three-quarters of aortic aneurysms occur in the abdomen and this type is relatively common, affecting about 1.5% of men over 65. If it ruptures, it's an emergency situation and fatal in 80% of cases. A thoracic aortic aneurysm is higher up the aorta, in the chest. These are less common than the abdominal kind, but equally dangerous if they rupture. Pain will usually be experienced in the chest, back or abdomen.

### Causes of cardiovascular diseases

According to the British Heart Foundation (2016), all cardiovascular diseases may be caused by the same problem – atherosclerosis. This is where the arteries narrow due to a gradual build-up of fatty material, called atheroma (plaques), within their walls. In time the arteries may become so narrow that they cannot deliver oxygen-rich blood to the heart.

### Risk factors for cardiovascular diseases

The main risk factors are:

- Smoking.
- A family history of heart disease.
- High blood pressure.
- High blood cholesterol.
- Diabetes.
- Being overweight or obese.
- Physical inactivity.
- Poor diet.
- Certain ethnic backgrounds.
- Sex – men are more likely to develop CVD at an earlier age than women.
- Age – the older you are, the more likely you are to develop CVD.

How an individual deals with stress, the amount of alcohol they drink and the type of job they do also influence the risk of developing CVD.

The more risk factors an individual has, the higher the possibility they will develop CVD. Even though some risk factors cannot be changed, the risk can be reduced by making lifestyle changes.

## Recognised interventions

### Lifestyle interventions

Addressing one risk factor, such as giving up smoking, will elicit health benefits, but to significantly reduce the risk of developing CVD, an individual will need to look at their lifestyle as a whole.

In the first instance, individuals should aim to:

- Give up smoking if a smoker.
- Ensure alcohol levels are within low-risk limits.
- Ensure a healthy diet is followed.
- Ensure weight is at a healthy level.
- Ensure the recommended exercise/physical activity is carried out regularly.

### Medical interventions

If an individual has a particularly high risk of developing CVD, their general practitioner may prescribe medication to reduce the risk. Medication that's sometimes used to help prevent CVD includes:

- **Blood pressure tablets**, e.g. angiotensin-converting enzyme (ACE) inhibitors.
- **Statins** – used to lower blood cholesterol levels.
- **Low-dose aspirin** – used to prevent blood clots.

Cardiac rehabilitation is available to anyone who has had:

- A heart attack.
- A coronary angioplasty.
- Heart surgery.
- Angina or heart failure.

Cardiac rehabilitation programmes will help individuals:

- Understand their condition.
- Recover from any surgery, procedure or heart attack.
- Make changes to their lifestyle that will help improve heart health.
- Reduce the risk of further heart problems.

## Exercise guidelines and restrictions

**Remember that a skilled professional with no further specialist qualifications may need to refer to a suitably qualified exercise professional if the severity of the condition means it is outside of the skilled professional's scope of practice.**

The NICE guidelines (2014) advise that individuals who have or are at high risk of CVD do the following every week:

- At least 150 minutes of moderate-intensity aerobic activity, 75 minutes of vigorous-intensity aerobic activity or a mix of moderate and vigorous aerobic activity in line with national guidance for the general population.
- Muscle-strengthening activities on two or more days a week that work all major muscle groups (legs, hips, back, abdomen, chest, shoulders and arms) in line with national guidance for the general population.

Individuals who are unable to perform moderate-intensity physical activity because of comorbidity, medical conditions or personal circumstances should be encouraged to exercise at their maximum safe capacity. Advice about physical activity should take into account an individual's needs, preferences and circumstances.

Part of a cardiac rehabilitation programme will involve a specialist introducing exercise. Exercise can help the individual recover from their surgery or treatment and improve their fitness, strength and general wellbeing. A nurse, physiotherapist or an exercise specialist will work out a programme of exercises for each individual, tailoring the programme to their particular needs. At first, it will be very tiring for the individual. If an individual's heart disease limits what they can do or if they have another condition that affects movement, such as arthritis, they may not be able to do the exercise sessions. Some cardiac rehab programmes will also teach relaxation techniques to help individuals manage stress.

### **Chronic obstructive pulmonary disease**

Chronic obstructive pulmonary disease (COPD) is the name for a collection of lung diseases including:

- Chronic bronchitis.
- Emphysema.
- Chronic asthma.

People with COPD have difficulties breathing, primarily due to the narrowing of their airways (airflow obstruction).

COPD is one of the most common respiratory diseases in the UK. It usually only starts to affect people over the age of 35, although most people are not diagnosed until they are in their 50s. COPD affects more men than women, although rates in women are increasing (NHS Choices, 2016e).

### **Causes of chronic obstructive pulmonary disease**

The main cause of COPD is smoking. The likelihood of developing COPD increases the more an individual smokes and the longer they've been smoking (25% of smokers develop COPD). This is because smoking irritates and inflames the lungs, which results in scarring. Over many years, the inflammation leads to permanent changes in the lung. The walls of the airways thicken and more mucus is produced. Damage to the delicate walls of the air sacs in the lungs causes emphysema and the lungs lose their normal elasticity. The smaller airways also become scarred and narrowed. These changes cause the symptoms of breathlessness, cough and phlegm associated with COPD.

Some cases of COPD are caused by fumes, dust, air pollution and genetic disorders, but these are rarer.

### **Signs and symptoms of chronic obstructive pulmonary disease**

The following symptoms may be signs of COPD:

- Increased breathlessness when exercising or moving around.
- A persistent cough with phlegm that never seems to go away.
- Frequent chest infections.
- Wheezing.

Other signs of COPD can include:

- Weight loss.
- Tiredness and fatigue.
- Swollen ankles.



### **POINT OF INTEREST**

It is thought there are more than 3 million people living with COPD in the UK, of which only about 900,000 have been diagnosed. This is because many people who develop symptoms do not get medical help as they often dismiss their symptoms as a 'smoker's cough' (NHS Choices, 2016e).



### **POINT OF INTEREST**

It is important that COPD is diagnosed as early as possible so treatment can try to slow down the deterioration of the lungs.

## Risk factors for chronic obstructive pulmonary disease

An individual can reduce their risk of developing COPD by not smoking and by avoiding other risk factors including:

- Passive smoking.
- Exposure to certain types of fumes, dust and chemicals at work, including grains, isocyanates, cadmium and coal.
- Air pollution.

There are a few factors for COPD that an individual cannot change:

- Having a brother or sister with severe COPD. A research study has shown that smokers who have siblings with severe COPD are at greater risk of developing the condition than smokers who do not.
- Having a genetic tendency to develop COPD. There is a rare genetic tendency to develop COPD called alpha-1-antitrypsin deficiency. This causes COPD in a small number of people (about 1%). Alpha-1-antitrypsin is a protein that protects your lungs. Without it, the lungs can be damaged by other enzymes that occur naturally in the body. People who have an alpha-1-antitrypsin deficiency usually develop COPD at a younger age, often under 35. (NHS Choices, 2016e).

## Recognised interventions

### Lifestyle interventions

COPD can usually be prevented by making changes to an individual's lifestyle. Stopping smoking is the single most effective way to reduce an individual's risk of getting the condition. It is also important to avoid exposure to tobacco smoke as much as possible, along with fumes, dust and chemicals as per the risk factors.

Once an individual has been diagnosed with COPD, the damage that has already occurred to the lungs cannot be reversed but the progression of the disease can be slowed down. Stopping smoking is particularly effective at doing this.

### Medical interventions

Treatments for COPD usually involve relieving the symptoms with medication, e.g. using an inhaler to make breathing easier. Pulmonary rehabilitation can also help increase the amount of exercise an individual is capable of doing. Surgery is only an option for a small number of people with COPD.

### Benefits of exercise

Individuals with COPD who exercise and keep active have improved breathing, less severe symptoms and a better quality of life. Almost any level of physical activity can result in favourable improvements in oxygen utilisation, work capacity and anxiety in individuals with COPD.

The benefits include:

- Cardiovascular reconditioning.
- Improved breathing efficiency at different workloads.
- Reduction in dyspnoea (difficult or laboured breathing).
- Increased muscle strength.
- Increased flexibility.
- Enhanced body image.

The achievement of these benefits will require careful management of medications to obtain optimal breathing mechanics during exercise.

### Exercise guidelines and restrictions

**Remember that a skilled professional with no further specialist qualifications may need to refer to a suitably qualified exercise professional if the severity of the condition means it is outside of the skilled professional's scope of practice.**

Individuals who are disabled by their breathlessness find that a structured programme of pulmonary rehabilitation provided by experienced healthcare professionals does the most good. Even though getting breathless is unpleasant, it is not harmful. Every individual with COPD should exercise as much as they can, however limited, twice a day. Even if the individual is chair-bound, they can do some arm and upper-body movements. Research shows that

pulmonary rehabilitation improves exercise capacity, breathlessness and health-related quality of life. It results in people seeing doctors less often and spending less time in hospital.

The preferred mode of exercise should be one that is based on an individual's motivation and enjoyment, and improves their ability to perform activities of daily living.

An individual with COPD may not be able to sustain 20-30 minutes of exercise, and an accumulated approach to building activity may be needed. Short interval training of 5-10-minute sessions may be necessary until suitable adaptations have occurred that allow appropriate reductions in rest intervals and increases in work intervals.

Other exercise considerations for individuals with COPD:

- The intensity of exercises must be adapted to meet individual needs (reduced range of motion, speed of movement, repetitions, etc.).
- Modification of some exercise positions from disciplines such as yoga and Pilates can be useful.
- Exercise mid to late morning, as symptoms are often worse upon waking.
- Avoid extremes of temperature and humidity, which can exacerbate symptoms of breathlessness.
- If exercising outdoors in cold weather, the nose and mouth should be covered with a scarf, as sudden changes in temperature can cause narrowing of the airways or bronchospasm.
- Avoid floor exercises as individuals may become short of breath when lying down and may have difficulty getting up again.
- Be sensitive to anxiety, fear and depression experienced due to breathlessness and disability.

## Diabetes

### Interesting statistics

- There are 3.5 million people diagnosed with diabetes in the UK and an estimated 549,000 people who have the condition but don't know it (Diabetes UK, 2016).
- Type 2 diabetes is far more common than type 1. In the UK, around 90% of all adults with diabetes have type 2 and 10% have type 1 (NHS Choices, 2016f).
- 11.5 million people in the UK are at increased risk of type 2 diabetes (Diabetes UK, 2016).

### Description of the condition

Diabetes is a common lifelong health condition where the amount of glucose in the blood is too high because the body cannot use it properly. This is due to the pancreas not producing enough (or any) insulin that helps glucose enter the body's cells, or the insulin that is produced does not work properly (known as insulin resistance).

**Insulin** is the hormone produced by the pancreas that allows glucose to enter the body's cells, where it is used as fuel for energy. It is vital for life.

**Glucose** comes from digesting carbohydrate and is also produced by the liver. Individuals with diabetes cannot make proper use of glucose so it builds up in the blood and can't be used as fuel.

There are two main types of diabetes:

- **Type 1 diabetes** can develop at any age but usually appears before the age of 40 (usually in childhood). It is the most common type of diabetes found in childhood.
- **Type 2 diabetes** usually appears in people over the age of 40, though in South Asian people, who are at greater risk, it often appears from the age of 25. It is also becoming more common in children, adolescents and young people of all ethnicities.

**Pre-diabetes** – Many individuals have blood sugar levels above the normal range but not high enough to be diagnosed as having diabetes. This is sometimes known as pre-diabetes. If blood sugar levels are above the normal range, the risk of developing full-blown diabetes is increased.



### POINT OF INTEREST

During pregnancy, some women have such high levels of blood glucose that their body is unable to produce enough insulin to absorb it all. This is known as **gestational diabetes**.

Short-term complications of diabetes include:

- Hypoglycaemia – Low blood sugar level.
- Diabetic ketoacidosis (DKA) – Lack of insulin means the body cannot use glucose for energy, and the body starts to break down other body tissue as an alternative energy source. Ketones are the by-product of this process. Ketones are poisonous chemicals which build up and, if left unchecked, will cause the body to become acidic – hence the name 'acidosis'.
- Hyperosmolar hyperglycaemic state (HHS) – This occurs in people with type 2 diabetes who experience very high blood glucose levels (often over 40mmol/l).

Long-term complications of diabetes include problems with:

- Eyes (retinopathy).
- Heart (cardiovascular disease).
- Kidneys (nephropathy).
- Nerves and feet (neuropathy).

### Risk factors for diabetes

There is nothing that can be done to prevent type 1 diabetes. But around 58% of cases of type 2 diabetes can be prevented or delayed by maintaining a healthy weight, eating well and being active (Diabetes UK, 2016).

Anyone can get type 2 diabetes and individuals are more at risk if they:

- Are overweight or have a high body mass index.
- Eat a poor diet and regularly flood their body with large amounts of fat and sugar.
- Have a large waist (more than 80cm/31.5 inches in women, 94cm/37 inches in men or 90cm/35 inches in South Asian men).
- Are from an African-Caribbean, Black African, Chinese or South Asian background and over 25.
- Are from another ethnic background and over 40.
- Have a parent, brother or sister with diabetes.
- Have ever had high blood pressure, a heart attack or a stroke.
- Have a history of polycystic ovaries, gestational diabetes or have given birth to a baby weighing over 10lbs/4.5kg.
- Suffer from schizophrenia, bipolar illness or depression, or are taking antipsychotic medication.

(Diabetes UK, 2016).

### Signs and symptoms

The common symptoms of diabetes are:

- Going to the toilet a lot, especially at night.
- Feeling really thirsty.
- Feeling more tired than usual.
- Losing weight without trying to.
- Genital itching or thrush.
- Cuts and wounds take longer to heal.
- Blurred vision.

Although the majority of people with type 1 diabetes are diagnosed in childhood and early adulthood, the symptoms are the same at any age. Adults diagnosed with type 1 diabetes may not recognise their symptoms as quickly as seeing them in their children, which can prove detrimental as diagnosis and treatment will be delayed. The four T's campaign (toilet, thirsty, tired and thinner) describes the symptoms to recognise in children; however, these will match symptoms in adults and could include a further 'T': Thrush (high levels of glucose being passed in the urine are a perfect breeding ground for the bacteria which cause thrush).

These symptoms occur because some or all of the glucose stays in the blood and isn't being used as fuel for energy. The body tries to reduce blood glucose levels by flushing the excess glucose out of the body in the urine.

Type 1 diabetes can develop quickly over weeks or even days but many people have type 2 diabetes for years without realising because the early symptoms tend to be general.

Leaving type 1 diabetes untreated can lead to serious health problems, including diabetic ketoacidosis (DKA). Although most common in people with type 1 diabetes, anyone who depends on insulin could develop DKA.

The most likely times for DKA to occur are:

- At diagnosis (some individuals who do not realise they have type 1 diabetes do not get diagnosed until they are very unwell with DKA).
- When an individual is ill.
- During a growth spurt/puberty.
- If an individual does not take their insulin.

DKA usually develops over 24 hours but can develop faster, particularly in young children. Hospital admission is essential to correct the life-threatening acidosis. Treatment involves closely monitored intravenous fluids, insulin and glucose.

Type 2 diabetes can be easier to miss as it develops more slowly, especially in the early stages when it can be harder to spot the symptoms. But untreated diabetes affects many major organs, including the heart, blood vessels, nerves, eyes and kidneys. Being diagnosed early and controlling blood sugar levels can help prevent these complications.

### Hypoglycaemia

Hypoglycaemia means low blood glucose levels – less than 4mmol/l, which is too low to provide enough energy for the body's activities. Hypos can come on quickly and everyone has different symptoms, but common ones include feeling shaky, sweating, hunger, tiredness, blurred vision, lack of concentration, headaches, feeling tearful or moody and going pale. Possible causes include excess insulin, a delayed/missed meal or snack, not enough carbohydrates, unplanned physical activity and drinking large quantities of alcohol or alcohol without food. Sometimes there is no obvious cause.

### Hyperglycaemia

Hyperglycaemia happens when blood glucose levels are too high – usually above 7mmol/l before a meal and above 8.5mmol/l two hours after a meal. Symptoms include passing more urine than normal (especially at night), being very thirsty, headaches, tiredness and lethargy.

Possible causes include missing a dose of medication, eating more carbohydrate than the body and/or medication can cope with, feeling stressed or unwell and over-treating a hypo.



**POINT OF  
INTEREST**

**ROOT  
WORDS**

- Hypo = 'under' or 'less'
- Hyper = 'over', 'above' or 'too much'

### Recognised interventions

#### Lifestyle interventions

An important part of managing diabetes is to eat a healthy, balanced diet. Foods labelled as 'diabetic' offer no benefit to people with diabetes and may still affect blood glucose levels. They are expensive and contain as much fat and calories as ordinary versions, and they can also have a laxative effect.

The general healthy eating guidance applies for diabetics as well as:

- Eat regular meals and ensure breakfast is eaten every day.
- Regulate portion sizes.
- Include carbohydrates (but as all carbohydrates affect blood glucose levels, be conscious about the amounts eaten).
- Cut back on salt as too much salt is associated with high blood pressure, which increases the risk of diabetes complications.
- Cut back on sugar.

Diabetes UK recommends that everyone with diabetes should see a registered dietitian at diagnosis, and then have regular reviews.

### **Specific dietary advice for type 1 diabetes and carbohydrates**

Individuals with type 1 diabetes on a basal bolus insulin regime or insulin pump can match the amount of insulin given at meal times to the amount of carbohydrate eaten. By reading labels and weighing food portions, total carbohydrate can be estimated. Insulin ratios can then be adjusted with help from an individual's diabetes healthcare professional. This is known as 'carb counting'. For individuals on fixed daily doses of insulin, eating consistent amounts of carbohydrates on a day-to-day basis and at similar times each day can help to control blood glucose levels.

### **Specific dietary advice for type 2 diabetes and carbohydrates**

For individuals with type 2 diabetes, being aware of the total amount of carbohydrate eaten, including both starchy and sugary carbohydrates, can help blood glucose control. Research has shown that choosing low-GI foods can particularly help manage glucose levels in people with type 2 diabetes. There is less evidence to suggest it can help with blood glucose control in people with type 1 diabetes.

### **Physical activity**

Getting active and staying active can help individuals manage type 1 and type 2 diabetes or help reduce the risk of type 2 diabetes. The UK Chief Medical Officers' Guidelines state that physical activity can reduce the chance of type 2 diabetes by up to 40% (Diabetes UK, 2016).

### **Medical interventions**

As well as making lifestyle changes, people with type 1 and type 2 diabetes often need additional treatments such as medication (like insulin) to control their diabetes, blood pressure and blood fats. Diabetes medication lowers blood sugar levels, and there are a number of different types which work in different ways. Diabetes medication cannot cure diabetes, and most people will have to take it for the rest of their lives.

Despite keeping to a healthy diet, taking part in regular physical activity and taking diabetes medication regularly, an individual's diabetes may not stay under control. This is because type 2 diabetes is a progressive condition and, over time, more help is needed to manage blood sugar levels.

### **Insulin**

Insulin is a hormone made by the pancreas which helps the body use the glucose in the blood. Everyone with type 1 diabetes and some people with type 2 diabetes need to take insulin to control their blood sugar levels. Insulin is taken either by injection or a pump. Once insulin has been injected, it soaks into small blood vessels and is taken into the bloodstream.

### **Benefits of exercise**

Physical activity will:

- Aid weight loss or maintenance of a healthy weight.
- Increase the amount of glucose used by the muscles for energy, so it may sometimes lower blood glucose (sugar) levels.
- Help the body use insulin more efficiently – regular activity can help reduce the amount of insulin an individual needs to take.
- Improve diabetes management (particularly type 2 diabetes).
- Reduce stress levels and symptoms of depression and anxiety.
- Improve sleep.

## Exercise guidelines and restrictions

**Remember that a skilled professional with no further specialist qualifications may need to refer to a suitably qualified exercise professional if the severity of the condition means it is outside of the skilled professional's scope of practice.**

All physical activity is beneficial for diabetes as the less time spent sedentary the better, except for time spent sleeping. Diabetes UK recommends that diabetics are encouraged to follow the national recommendations for activity levels.

### Exercise and blood sugar levels

Activity can affect blood sugar levels both during and after exercise. Regular checking will help an individual understand how activity affects their blood sugar levels. Diabetics will need to test their levels more often before, during and after any physical activity.

### Avoiding hypos

If an individual's blood sugar levels are below 7mmol/l before they exercise, they will need to take some extra carbohydrate. A diabetic should always have a hypo treatment with them as well as their medical ID. They will need to let someone who is with them know how to recognise and treat a hypo and, if they are exercising alone, they must always let someone know where they are. For individuals trying to lose weight, it is best to reduce insulin doses in advance rather than increasing their intake of carbs (a diabetic advisor will guide them on this).

### Avoiding high blood sugar levels

A diabetic will need to be careful when blood sugar levels are above 13mmol/l as activity can raise it higher. If this happens, it is probably due to not having enough insulin. A diabetic should know how to give themselves a correction dose (a diabetic advisor will guide them on this).

## Stress

### Interesting statistics

- In 2014-15 stress accounted for 35% of all work-related ill health cases and 43% of all working days lost in the UK due to ill health.
- By occupation, jobs that are common across public service industries (such as health, teaching, business and media) show higher levels of stress compared to all jobs.
- The main factors causing work-related stress, depression or anxiety are workload pressures, including tight deadlines, too much responsibility and a lack of managerial support.

Labour Force Survey (LFS) – HSE, 2016

### Description of the condition

There is no medical definition of stress, and healthcare professionals often disagree over whether stress is the cause of problems or the result of them.

Everyone knows what it is like to feel stressed, but it's not easy to pin down exactly what stress means. When individuals say things like 'this is stressful' or 'I'm stressed', they might be talking about:

- Situations or events that put pressure on them – for example, times when there is lots to do and think about, or when they don't have much control over what happens.
- The reaction to being placed under pressure – the feelings individuals get when they have demands placed on them that they find difficult to cope with.

Being under pressure is a normal part of life. It can be a useful driver that helps individuals take action, feel more energised and get results. But if they often become overwhelmed by stress, these feelings could start to be a problem.

Stress is closely linked to mental health in two important ways:

- Stress can cause mental health problems and make existing problems worse. For example, if individuals often struggle to manage feelings of stress, they might develop a mental health problem like anxiety or depression.
- Mental health problems can cause stress. Coping with the day-to-day symptoms of a mental health problem, as well as potentially needing to manage medication, healthcare appointments or treatments, can become extra sources of stress.

Individuals can learn to manage stress better by:

- Managing external pressures so stressful events occur less often.
- Developing emotional resilience so tough situations can be dealt with more easily.

### Causes of stress

Feelings of stress are normally triggered by life events which involve:

- Being under lots of pressure.
- Facing big changes.
- Worrying about something.
- Not having much or any control over the outcome of a situation.
- Having overwhelming responsibilities.
- Not having enough work, activities or change in life.
- A build-up of small challenges/events.

The amount of stress felt in different situations can depend on:

- An individual's perception of the situation – this might be connected to past experiences, self-esteem and how an individual's thought processes work (e.g. if an individual tends to interpret things positively or negatively).
- How skilled an individual is at dealing with pressure.
- An individual's emotional resilience to stressful situations.



### POINT OF INTEREST

Everyone is different, so a situation that doesn't bother one person at all might cause someone else a lot of stress. For example, if an individual feels confident or usually enjoys public speaking, they might find that giving a speech in front of a room of people feels comfortable and fun. But if an individual feels low or usually prefers not to be the centre of attention, this situation might cause them to experience signs of stress.

Common situations that cause stress				
Personal issues	Friends and family	Employment and study	Housing	Money
<ul style="list-style-type: none"> <li>• Illness or injury.</li> <li>• Pregnancy and becoming a parent.</li> <li>• Bereavement.</li> <li>• Long-term health problems.</li> <li>• Organising a complicated event, e.g. a family holiday.</li> </ul>	<ul style="list-style-type: none"> <li>• Getting married or entering a civil partnership.</li> <li>• Going through a break-up or divorce.</li> <li>• Difficult relationships with parents, siblings, friends or children.</li> <li>• Being a carer for a child, partner, relative or friend who needs lots of support.</li> </ul>	<ul style="list-style-type: none"> <li>• Redundancy.</li> <li>• Long-term unemployment.</li> <li>• Retiring.</li> <li>• Exams and deadlines.</li> <li>• Difficult issues at work.</li> <li>• Work deadlines.</li> <li>• Starting a new job.</li> </ul>	<ul style="list-style-type: none"> <li>• Poor housing conditions.</li> <li>• Moving house.</li> <li>• Problems with neighbours.</li> </ul>	<ul style="list-style-type: none"> <li>• Worries about money or benefits.</li> <li>• Poverty.</li> <li>• Debt.</li> </ul>

Table 2.10 Causes of stress (Mind, 2016)

Some of the situations listed in Table 2.10 can be thought of as happy events, but because they bring big changes or make unusual demands on an individual, they can still be very stressful. This can be particularly difficult to deal with as an individual might feel there's additional pressure on them to be positive.

## Risk factors for stress

Stress is not an illness itself, but if it isn't under control it can increase the risk of serious illnesses (e.g. various mental health conditions, heart disease, asthma, stroke, diabetes and some types of cancer). Spotting the early signs of stress, like sweating, loss of appetite, headaches and loss of concentration will help prevent it getting worse.

## Signs and symptoms

When an individual feels stressed, hormones called **cortisol** and **adrenaline** are released. This is the body's automatic way of preparing to respond to a threat (fight or flight). An individual who is often stressed will produce high levels of these hormones, which can make them feel physically unwell and could affect their health in the longer term.

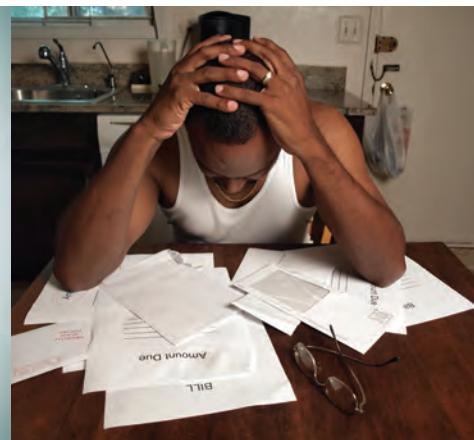


### FIGHT OR FLIGHT

Human beings have evolved ways to protect themselves from dangerous, life-threatening situations. When an individual feels under threat, the body releases hormones, such as adrenalin and cortisol, which help physically prepare an individual to either fight the danger or run away from it. These hormones can make individuals feel more alert, so they can act faster, and make the heart beat faster to carry blood quickly to where it's needed most.

Feelings	Behaviour	Physical effects
<ul style="list-style-type: none"> <li>Irritable, aggressive, impatient, wound up.</li> <li>Over-burdened.</li> <li>Anxious, nervous, afraid.</li> <li>Racing thoughts, inability to switch off.</li> <li>Unable to enjoy oneself.</li> <li>Depressed.</li> <li>Uninterested in life.</li> <li>Loss of sense of humour.</li> <li>A sense of dread.</li> <li>Health worries.</li> <li>Neglected, lonely.</li> </ul>	<ul style="list-style-type: none"> <li>Finding it hard to make decisions.</li> <li>Avoiding troubling situations.</li> <li>Snapping at people.</li> <li>Nail biting.</li> <li>Picking at the skin.</li> <li>Unable to concentrate.</li> <li>Eating too much or too little.</li> <li>Smoking or drinking alcohol more than usual.</li> <li>Restless, can't sit still.</li> <li>Feeling tearful or crying.</li> </ul>	<ul style="list-style-type: none"> <li>Shallow breathing, hyperventilating.</li> <li>Panic attacks.</li> <li>Blurred eyesight, sore eyes.</li> <li>Sleep problems, nightmares.</li> <li>Tired all the time.</li> <li>Teeth grinding, jaw clenching.</li> <li>Headaches.</li> <li>Chest pains.</li> <li>High blood pressure.</li> <li>Indigestion, heartburn.</li> <li>Constipation, diarrhoea.</li> <li>Feeling sick, dizzy, fainting.</li> </ul>

Table 2.11 Effects of stress (Mind, 2016)



## Recognised interventions

### Lifestyle interventions

Even though an individual will not be able to control some stressful aspects of their lives, there are lots of practical things they can do to manage the amount of day-to-day pressure they are under. Working out their triggers for stress will help the individual anticipate problems and think of ways to solve them. Even if situations cannot be avoided, being prepared can help. Taking time to reflect on events and feelings that could be contributing to stress can be extremely helpful.

Consideration should be given to:

- Issues that come up regularly and that the individual worries about, e.g. paying a bill or attending an appointment.
- One-off events that are on the individual's mind, such as moving house or taking an exam.
- Ongoing stressful events, like being a carer or having problems at work.

Some of the following interventions have been proven to help alleviate stress.

### Time management

- Making some adjustments to the way an individual organises their time can help them feel more in control of any tasks they are facing and more able to handle pressure.
- Identifying the best time of day to do the important tasks that need the most energy and concentration.
- Making a list of things to do, arranging them in order of importance and focussing on the most urgent first.
- Varying activities: balancing interesting tasks with more mundane ones, and stressful tasks with easier ones.
- Trying not to do too much at once.
- Taking breaks and taking things slowly can be more productive than getting stressed and getting nothing done.

### Addressing some of the causes of stress

There might be some practical ways to resolve or improve some of the issues that are putting pressure on the individual. It may be helpful to read up on some information around mental health, family and personal life, work life, student life, finances, housing and legal rights (contacting organisations such as Mind ([www.mind.org.uk](http://www.mind.org.uk)) or looking for support groups).

### Accepting the things that cannot be changed

Accepting that there are some things that an individual cannot do anything about will help them focus their time and energy more productively.

### Lifestyle changes

Taking steps to look after personal wellbeing can help individuals deal with pressure and reduce the impact that stress has on their life. This is sometimes called developing emotional resilience – the ability to adapt and bounce back when something difficult happens in life.

There are some general changes that individuals can make to their lifestyle that can help them feel more able to cope with pressure and stressful situations, for example:

- Being assertive – practising being straightforward and assertive when communicating with others. If people are making unreasonable or unrealistic demands, it is important that an individual can tell them how they feel and say no.
- Using relaxation techniques – knowing what helps the individual relax, like having a bath, listening to music or taking their dog for a walk. It is important for an individual to set aside time to do the activities that help them relax.
- Developing interests and hobbies – finding an activity that's completely different from the things causing an individual stress is a great way for them to get away from everyday pressures. If stress is making them feel lonely or isolated, shared hobbies can also be a good way to meet new people.
- Making time for friends – this can help an individual feel more positive and less isolated. Chatting to friends about the things they find difficult can help keep things in perspective. Laughing and smiling with friends will also produce hormones that help relaxation.
- Finding a life-balance – if one part of life, such as a job or taking care of young children, is taking up almost all of an individual's time and energy, it is essential that they try to focus some energy on other parts of their life, like family, friends or hobbies. This can help spread the weight of pressures.

## Looking after physical health

Taking steps to look after their physical health can help individuals manage stress and lessen the impact on their overall mental health. For example:

- Getting a good night's sleep – stress can make it difficult to sleep. Being well-rested can increase an individual's ability to deal with difficult situations.
- Being more physically active – physical activity is important for reducing stress levels and preventing some of its damaging effects on the body.
- Eating healthily – what is eaten and when it is eaten can make a big difference to how well an individual feels.

## Taking a break

- Learning to be kinder to oneself in general can help an individual control the amount of pressure they feel in different situations, which can help them feel less stressed.
- Rewarding themselves for achievements – even small things like finishing a piece of work or making a decision. Rewards could include taking a walk, reading a book, having a bath and eating a dessert.
- Getting a change of scenery, e.g. going outside, to a friend's house or to a café for a break – even if it's just for a short time.
- Taking a break or holiday – time away from the normal routine can help relaxation and enable an individual to feel refreshed.
- Resolving conflicts, if possible – speaking to a manager, colleague or family member about problems can help.
- Learning to forgive oneself when mistakes are made or achievements are not as expected.

## Using a support network

Individuals need to remember that they don't have to cope with their stress alone.

- Friends and family – sometimes just telling the people close to the individual how they are feeling can make a big difference – and they might be able to help them out in other ways too.
- Support at work – talking to a line manager, human resources (HR) department or union representative or using an employee assistance scheme. Some individuals worry that talking to their manager or colleagues about stress will be seen as a sign of weakness, but an employee's wellbeing is important and responsible employers will take it seriously.
- Support at university or college, such as tutors, student union or student services.
- Online peer support – sometimes sharing experiences with people who've been through something similar can help individuals feel less alone.
- Specialist websites and organisations (see 'useful sources' list at end of this section).
- Medical professional – it is important for individuals to consult with their doctor if they feel they need some professional support. They can help an individual access treatments and may also recommend that they take some time off work, university or college, and sign off a medical note.

There's no quick-fix cure for stress, and no single method will work for everyone. However, there are simple things that can be done to change the common life problems that can cause stress or make stress a problem. If an individual is stressed, whether by their job or by something more personal, the first step to feeling better is to identify the cause.

The keys to good stress management are building emotional strength, being in control of a situation, having a good social network and adopting a positive outlook.

## Keeping a stress diary

Keeping a diary and noting stressful episodes for two to four weeks is a helpful way for individuals to spot the triggers of their stress, work out how they operate under pressure and develop better coping mechanisms.

Professor Cary Cooper, an occupational health expert has these top ten stress-busting suggestions:

## 1. Be active

Exercise will reduce some of the emotional intensity that an individual is feeling, clearing their thoughts and letting them deal with problems more calmly.

## 2. Take control

There's usually a solution to any problem. If an individual remains passive, thinking, 'I can't do anything about my problem', their stress will get worse. The feeling of loss of control is one of the main causes of stress and lack of wellbeing. The act of taking control is in itself empowering, and it's a crucial part of finding a solution.

## 3. Connect with others

A good support network of colleagues, friends and family can ease work troubles and help individuals see things in a different way when they are talked through. Activities with friends help individuals to relax and often to have a good laugh, which is an excellent stress-reliever.

## 4. Have time out

UK employees work the longest hours in Europe, which means individuals often don't spend enough time doing things they really enjoy. It is important for individuals to take some time out for socialising, relaxation or exercise.

## 5. Individual challenges

Setting goals and challenges, whether at work or outside, such as learning a new language or a new sport, helps to build confidence. This will help individuals deal with stress. By continuing to learn, individuals become more emotionally resilient, arming them with knowledge and making them want to do things rather than be passive (such as watching TV all the time).

## 6. Avoid unhealthy habits

It is important that individuals do not rely on alcohol, smoking or caffeine as ways to cope with stress. This is called avoidance behaviour. Men more than women are likely to do this as women tend to seek support from their social circle. Over the long term, these coping mechanisms just create new health problems.

## 7. Help others

Evidence shows that individuals who help others, through activities such as volunteering or community work, become more resilient. Helping those who are often in worse situations helps put problems into perspective. If an individual does not have time to volunteer, they can try to do someone a favour every day. It can be something as small as helping someone to cross the road or going on a coffee run for colleagues.

## 8. Work smarter, not harder

Working smarter means prioritising work, concentrating on the tasks that will make a real difference.

## 9. Try to be positive

Looking for the positives in life and things an individual feels grateful for can have a profound effect on wellbeing. Individuals don't always appreciate what they have. Encourage individuals to write down three things that went well, or for which they are grateful, at the end of every day.

## 10. Accept the things that cannot change

Changing a difficult situation isn't always possible. Concentrate on the things that can be changed. For example, if an individual's workplace is making redundancies, there's nothing they can do about it. In a situation like that, an individual needs to focus on the things that they can control, such as looking for a new job.



## POINT OF INTEREST

A stress diary should encourage an individual to reflect on the following:

- The date, time and place of a stressful episode.
- What they were doing.
- Who they were with.
- How they felt emotionally.
- What they were thinking.
- How they felt physically.
- A rating scale (0-10 where 10 is the most stressed they could ever feel).

## Medical interventions

As stress isn't a medical diagnosis, there's no specific treatment for it. However, if an individual is finding it very hard to cope with things going on in their life and are experiencing lots of signs of stress, there are treatments available that could help. To access most treatments, the first step is to talk to a medical professional.

### Talking treatments

Talking with a trained professional can help individuals to learn to deal with stress and become more aware of their own thoughts and feelings. Common types of talking treatment which can help with stress are:

- Cognitive behavioural therapy (CBT) which helps the individual understand their thought patterns, recognise their trigger points and identify positive actions they can take.
- Mindfulness-based stress reduction (MBSR) which combines mindfulness, meditation and yoga with a particular focus on reducing stress. The Be Mindful website ([www.bemindful.co.uk](http://www.bemindful.co.uk)) provides more guidance on mindfulness, including how to find a mindfulness-based stress reduction course.

## USEFUL SOURCES

### **Big White Wall**

[www.bigwhitewall.com](http://www.bigwhitewall.com)

### **Elefriends**

[www.elefriends.org.uk](http://www.elefriends.org.uk)

### **Health and Safety Executive**

[www.hse.gov.uk/stress](http://www.hse.gov.uk/stress)

### **International Stress Management Association**

[www.isma.org.uk](http://www.isma.org.uk)

### **Mind**

[www.mind.org.uk/information-support/tips-for-everyday-living/stress](http://www.mind.org.uk/information-support/tips-for-everyday-living/stress)

### **Mind Tools**

[www.mindtools.com](http://www.mindtools.com)

### **NHS Choices**

[www.nhs.uk/conditions/stress-anxiety-depression](http://www.nhs.uk/conditions/stress-anxiety-depression)

### **Stressbusting**

[www.stressbusting.co.uk](http://www.stressbusting.co.uk)

### **Stress Management Society**

[www.stress.org.uk](http://www.stress.org.uk)

### **The New Economics Foundation**

[www.fivewaystowellbeing.org](http://www.fivewaystowellbeing.org)

### **Time to Change**

[www.time-to-change.org.uk](http://www.time-to-change.org.uk)

## Medication

Feelings of stress are a reaction to things happening in an individual's life, not a mental health problem, so there's no specific medication for stress. However, there are various medications available which can help to reduce or manage some of the signs of stress. A doctor might offer to prescribe:

- Sleeping pills or minor tranquillisers for individuals who are having trouble sleeping.
- Antidepressants for individuals who are experiencing depression or anxiety.
- Medication to treat any physical symptoms of stress, such as irritable bowel syndrome (IBS) or high blood pressure.

## Ecotherapy

Ecotherapy is a way of improving an individual's wellbeing and self-esteem by spending time in nature. This can include physical exercise in green spaces or taking part in a gardening or conservation project.

## Complementary and alternative therapies

Certain alternative therapies can help individuals manage feelings of stress. These might include acupuncture, aromatherapy, massage and traditional Chinese medicine.

The 'Five Ways to Wellbeing' (connect, be active, take notice, keep learning and give) developed by the New Economics Foundation can be used to help an individual deal with stress by promoting their wellbeing.

**END OF SECTION Revision activities**

Answer the following questions and make notes to revise this section.

- What is the main cause of hypertension?
- What blood pressure reading suggests an individual has hypertension?
- What are the benefits of exercise for an individual with hypertension?
- What is obesity and how is it measured?
- What are the different types of cardiovascular disease?
- What are the three different types of COPD?
- What are the main risk factors for cardiorespiratory diseases?
- What are the two different types of diabetes?
- What are the main signs and symptoms of diabetes?
- What is insulin?
- How does stress affect an individual's health and wellbeing?

Design a table that indicates the guidelines, restrictions and contraindications for all of the medical conditions listed in this unit. You can also include others that you are interested in.

# Section 3: Risk stratification and when to refer clients with medical conditions

Participation in exercise and physical activity offers many benefits for maintaining health and reducing the risk of chronic disease. There is substantial evidence reporting the health risks of being sedentary and inactive. There are also potential risks attached to becoming more active and taking part in exercise. These risks increase for people who are inactive and/or have risk factors, signs and symptoms or a diagnosis of cardiovascular disease or another medical condition.

## Screening

Skilled professionals have a legal duty to minimise the risks and maximise the benefits of exercise for their clients and to protect themselves from litigation. It is therefore essential that, prior to participation, clients are:

- Screened to identify potential risks of participation that may need to be referred to a medical professional for clearance.
- Consulted to gather information that can be used to guide the planning of the personal training programme. This may include the client's:
  - Personal goals.
  - Lifestyle.
  - Medical history.
  - Physical activity history.
  - Physical activity likes and dislikes.
  - Motivation and barriers to participation.
  - Current fitness level.
  - Stage of readiness.
  - Posture and alignment.
  - Functional ability.

The reasons for screening and consulting the client include the following:

## Safety

- Written questionnaires and oral questioning (interview/consultation) can be used to identify clients at high risk (medical contraindications).
- High-risk clients can be referred to appropriate healthcare professionals for medical clearance.
- Client informed consent can be gained prior to participation.

## Programme design and goals

- Results from health and fitness assessments can be used to establish a set of fitness baselines and a starting point for the programme.
- Goals can be agreed.
- An individualised exercise programme can be prescribed.
- Client preferences and specific needs can be accommodated.

## Monitoring

- Information gathered can be used to monitor a client's rate of progress.
- Health and fitness assessments can be repeated at staged intervals to identify changes.
- Goals can be reviewed and updated.

## Total lifestyle evaluation

- Consideration can be given to all lifestyle factors that might influence progress, including stress, daily activity levels, occupation, eating habits and other lifestyle habits (e.g. smoking and drinking).

## Establishing rapport

- A consultation interview provides an opportunity for the skilled professional to get to know the client and establish a positive connection. Successful working relationships are always built on rapport.
- Consultation also provides the opportunity to determine an appropriate communication style to show empathy and understanding of a client's personal circumstances.
- Rapport and a good relationship with the client enhance the potential for long-term commitment.

## Motivation and adherence

- Client motivation can be gauged by actively listening to the client and hearing their motivations and barriers for making changes.
- Consultation enables short-, medium- and long-term goals to be established and agreed with the client, which can increase their focus and raise levels of motivation and exercise adherence.

## Education

- Consultation with the client gives the skilled professional the opportunity to discuss the advantages and disadvantages of pursuing certain lifestyle behaviours.
- The skilled professional can listen to the client and provide education and information so that they make informed lifestyle choices.

## Professionalism

- Consultation with the client is a part of professional practice and reflects trainer credibility.
- It provides an opportunity to explain working practices, policies and procedures to the client.

## Pre-screening tools

Industry-accepted pre-screening tools should be used to identify individuals who require further medical evaluation before embarking on an exercise programme.

### Informed consent

Informed consent must be obtained from the client prior to participation in any fitness testing or exercise session.

### PAR-Q

The Physical Activity Readiness Questionnaire (PAR-Q) is one of a range of screening tools and it identifies any medical contraindications to exercise. The questions on the PAR-Q are carefully worded so that a healthy individual will answer 'no' to them all. If the client answers 'yes' to any of the questions, medical clearance should be sought from their medical professional before exercise begins. If they answer 'no' to all questions, they can participate.

One consideration is that there may be some health complaints that have not been diagnosed or are outside the client's awareness, e.g. elevated blood pressure may be present but undiagnosed and this will not be flagged up through a questionnaire. Therefore it must be recognised and accepted that questionnaires, while valuable, still have limitations.

## Medical referral and guidance

Referral to a medical professional for clearance prior to exercise is recommended in the following situations:

### **PAR-Q response**

If the client answers 'yes' to one or more questions on the PAR-Q form or if they have a diagnosed metabolic, pulmonary or cardiovascular disease (or signs or symptoms of a pulmonary or cardiovascular disease) this places the client at higher risk.

### **Combined risk factors**

Clients who have several risk factors for cardiovascular disease (CVD) may be at higher risk during exercise and should be advised to check with their medical professional first. CVD risk factors include inactivity, hypertension, current smoking habit, age, obesity, stress, diabetes, high cholesterol and family history of CVD (genetics).

### **DOUBT OR UNCERTAINTY**

If the skilled professional has any doubt or uncertainty regarding any aspect of the client's health, they should advise the client to check with their GP first.

### **Injuries that may be aggravated by exercise**

Clients with minor injuries, such as sprains and strains, may also need to check with their medical professional if there is any concern that the injury could be aggravated by exercise.

If a client is considered unsuitable for immediate exercise, they can be signposted to an appropriate medical professional. These clients will need to obtain medical clearance before starting an exercise programme. Managed (stable and controlled) clients (e.g. with angina or another cardiac-related condition) may be able to exercise under specialist supervision.

## Medical conditions outside a personal trainer's scope of practice

Personal trainers are not qualified to work with clients with medical conditions or rehabilitate clients from injury. This would be beyond their scope of practice without further qualifications and training. Clients with certain medical conditions need to exercise under the supervision of a level 3 exercise referral instructor or level 4 specialist instructor. Higher risk clients may also need clinical supervision.

These conditions include, but are not limited to:

- Cardiovascular disease.
- Stroke.
- Cancer.
- Type 1 and 2 diabetes mellitus.
- Parkinson's or Alzheimer's disease.
- Neurological conditions, e.g. multiple sclerosis.
- Mental health conditions, e.g. depression, anxiety or eating disorders.
- Dementia.
- Obesity.
- Risk of falls, e.g. frail older adults.

Medical professional clearance should be sought for clients with medical conditions or multiple cardiovascular disease risk factors. These groups may need to work with an exercise referral or specialist instructor.

## Risk stratification

Most newcomers to exercise are apparently healthy individuals who will benefit from becoming more active and taking part in regular exercise. However, there are some individuals for whom participation in exercise may offer increased risk. For example, a diagnosed hypertensive may be at risk during physical activity due to an already elevated blood pressure; a client with an injury may be at risk of aggravating the injury.

The key factor for determining participation in activity should be the extent to which the potential or actual risks are outweighed by the benefits (risk stratification).

In most instances, the benefits of being more active far outweigh the risks. Potential risks (e.g. accidents) and complications (e.g. medical emergency) attached to being active include those in Table 3.1.

Risks attached to becoming more active
Muscular/skeletal complications, such as stress fractures, strains and sprains from overuse and trauma (collisions, falls, etc.).
Overtraining syndrome (e.g. fatigue, loss of vitality).
Respiratory complications, such as exercise-induced asthma or bronchospasm.
Cardiovascular complications, such as heart attack or arrhythmias.
Hypertension or hypotension.
Gastrointestinal and metabolic complications, such as cramps, vomiting, dehydration.
Neurological and endocrine complications, e.g. dizziness, stroke, hypoglycaemia.
Immune impairment resulting in colds, flu, viruses.
Amenorrhoea or dysmenorrhoea.
Thermal complications, such as hypo or hyperthermia.
General accidents and complications, such as:
<ul style="list-style-type: none"> <li>• Potential drowning (during water sports and recreational water activities).</li> <li>• Collisions and falls (during games, cycling, running, athletic track events).</li> <li>• Fractures, bruising and bleeding (during contact sports, games, track and field events).</li> </ul>

Table 3.1 Risks of becoming active

The likelihood and severity of these risks need to be assessed and managed.

## The purpose of risk stratification

The main objectives of risk stratification are:

- To identify people who may be at risk during exercise (or a physical assessment/test).
- To assess the level of risk (low, moderate, high) and the likelihood and severity of risk attached to a client becoming more active.
- To assist with exercise prescription and recommendations.
- To enable the development of a suitably informed, safe and effective exercise programme, where the level of risk is acceptable and minimised.
- To identify the appropriate level of monitoring and supervision.

## Risk stratification tools

In the UK, most exercise referral schemes have developed their own risk stratification tools and protocols for working with specific individuals and groups. In most instances these tools have been developed by working collaboratively with local medical practitioners (nurse, doctor, physiotherapists, etc.). To date there has been no single model used and this has raised concerns in recent years because it was believed that a standardised approach should be adopted across schemes for both safety standards and monitoring and evaluation purposes.

There are a number of models available to stratify risk. Each of the following risk stratification tools can be found in section 1 of the PT toolkit.

### The risk stratification pyramid

The risk stratification pyramid presented in the National Quality Assurance Framework for Exercise Referral report (DoH, 2001) provided one of the earliest UK models for risk stratification. The model used guidance from the ACSM and identified four levels of client (apparently healthy populations at the bottom of the pyramid, followed by low-risk populations, moderate-risk populations and high-risk populations at the top). At each stage of the pyramid, the qualifications that an instructor needed in order to work with these groups were stated (based on the qualifications available at that time), along with the type of exercise environment/activity setting.

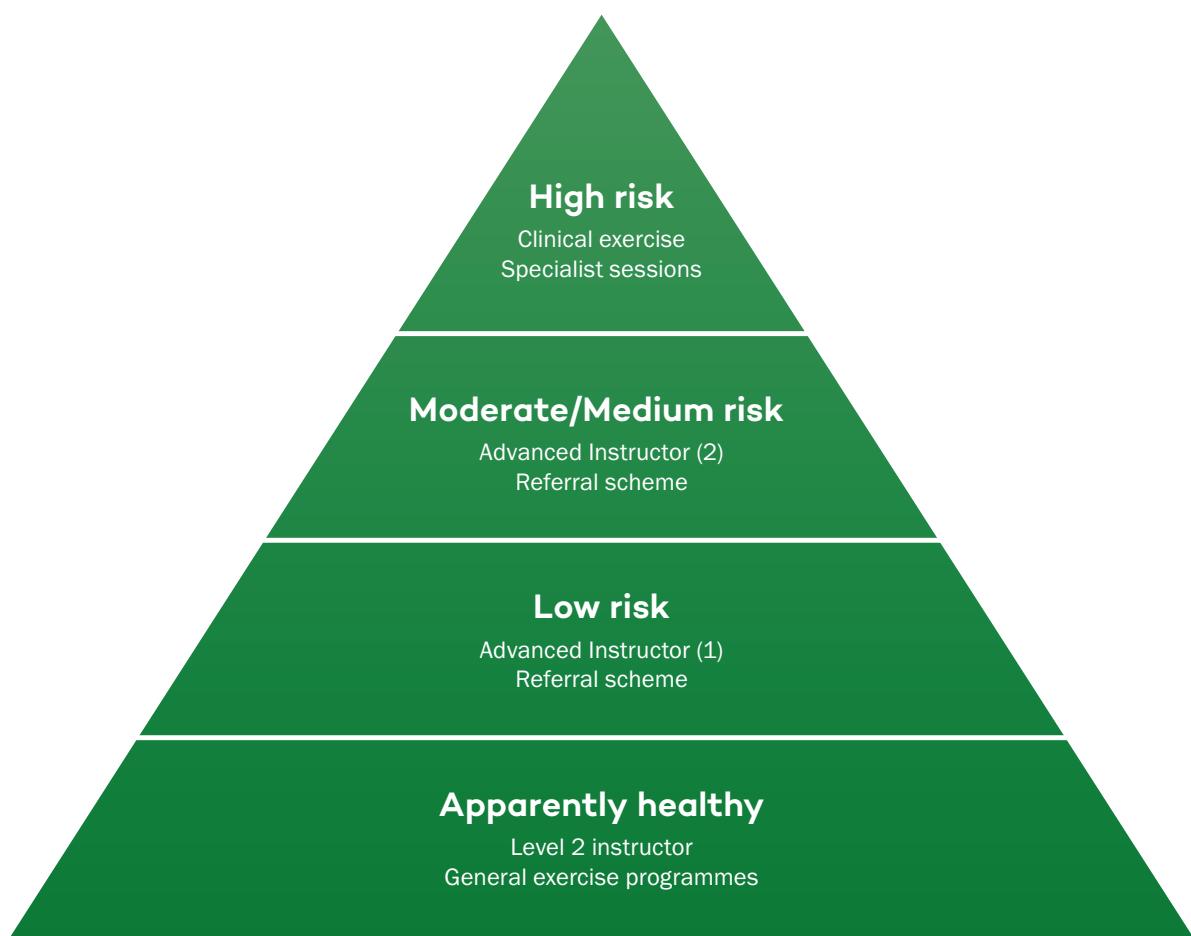


Figure 3.1 The risk stratification pyramid

### Logic model for risk stratification

The logic model for risk stratification (ACSM, 2014) suggests that the health and medical history of the person should be reviewed to check for the presence of:

- Known cardiovascular disease (CVD) conditions (diagnosis).
- Signs and symptoms to indicate the presence of cardiovascular disease, pulmonary disease and/or metabolic disease.
- CVD risk factors.

This model has been the most commonly used by exercise referral instructors. Individuals who show more than two signs and symptoms (as per the PAR-Q) are signposted to a general practitioner prior to participation and may then be referred for a more specialist programme, depending on other factors (e.g. current activity levels and overall health status).

The logic and cardiovascular disease risk stratification models provide some guidance that can be used by the skilled professional to identify the client's cardiovascular disease (CVD) risk factors and other lifestyle factors that could increase risks. The client can usually be assigned to one of following categories:

**Medical referral** – Clients in this category have a serious condition or serious medical risk factor for CVD. They should always be referred to a medical professional for clearance. The majority of clients in this group will benefit from a regular exercise programme but need to be supervised by an appropriately qualified instructor.

**Special attention** – Clients may be placed in this category for several reasons; they may present with several factors that contribute a higher risk for CVD or it may simply be because they are older or have not exercised before. Many factors have to be taken into consideration. Two or more risk factors place the client at low to moderate risk and multiple factors will increase the risk. These clients should be referred to a medical professional for clearance and might be best suited to a trainer qualified in exercise referral.

**Normal (fit and healthy)** – Clients in this group have no health problems, no identified risk factors for CVD and have been following a regular exercise programme for at least two months.

## Irwin and Morgan risk stratification tool

In the absence of a national standardised risk stratification tool, the risk tool developed by Irwin and Morgan provides straightforward referral guidelines for healthcare professionals which can be used to categorise patients during a clinical consultation. This tool has been integrated into the British Heart Foundation toolkit (2014) and can be found in section 1 of the PT toolkit.

## Absolute contraindications to exercise

A contraindication is a situation in which the application of a particular treatment or intervention (e.g. activity) is not advisable because it may increase the risks to the client.

A **relative contraindication** indicates that the intervention or treatment could increase the client's risks, but sometimes it may still go ahead if the benefits outweigh the risks.

An **absolute contraindication** cannot be ignored because the immediate risk is considered to be high (high severity and high likelihood).

The absolute contraindications for exercise are listed in Table 3.2. Clients with these symptoms and conditions should be advised not to exercise or participate in physical activity, until the condition is optimally managed (stable and controlled), and should be signposted back to their general practitioner.

BACR (2005) and ACSM (2005) guidelines for absolute contraindications	BHF (2010) guidelines for absolute contraindications
<ul style="list-style-type: none"> <li>Unstable* angina.</li> <li>Resting systolic blood pressure of more than 180mmHg and/or resting diastolic blood pressure of more than 100mmHg.</li> <li>Symptomatic hypotension (BP drop &gt;20mmHg demonstrated during exercise tolerance testing (ETT)). This will not be evident unless client undergoes an exercise stress test or has exercising blood pressure measured.</li> <li>Resting or uncontrolled tachycardia &gt;100bpm.</li> <li>Unstable* or acute heart failure.</li> <li>New or uncontrolled arrhythmias (atrial or ventricular).</li> <li>Valvular heart disease/aortic stenosis.</li> <li>Unstable* diabetes.</li> <li>Febrile illness.</li> <li>Acute systemic disease (such as cancer).</li> <li>Neuromuscular, musculoskeletal or rheumatoid disorders that are exacerbated by exercise.</li> <li>Unmanaged pain.</li> </ul>	<ul style="list-style-type: none"> <li>A recent significant change in a resting ECG, recent myocardial infarction or other acute cardiac event.</li> <li>Symptomatic severe aortic stenosis.</li> <li>Acute pulmonary embolus or pulmonary infarction.</li> <li>Acute myocarditis or pericarditis.</li> <li>Suspected or known dissecting aneurysm.</li> <li>Resting systolic blood pressure ≥180mmHg; diastolic BP ≥100mmHg.</li> <li>Uncontrolled/unstable* angina.</li> <li>Acute uncontrolled psychiatric illness.</li> <li>Unstable* or acute heart failure.</li> <li>New or uncontrolled arrhythmias.</li> <li>Other rapidly progressing terminal illness.</li> <li>Experience of significant drop in BP during exercise.</li> <li>Uncontrolled resting tachycardia (≥100bpm).</li> <li>Febrile illness.</li> <li>Experience of pain, dizziness or excessive breathlessness during exertion.</li> <li>Any unstable, uncontrolled condition.</li> </ul>

\*unstable – a change in medication or deterioration in symptoms in the previous month.

Table 3.2 Absolute contraindications to exercise (BHF, 2010; ACSM, 2014; BACR, 2015)

## Signposting clients for appropriate support

Signposting is interpreted to have a different meaning to referral. A person may be signposted to a general service or type of service that could offer additional support or information rather than being directed to a specific individual. Signposting is appropriate at any time as a way of informing a client about information or services that may be of interest or benefit to them and may be compatible with the service being provided.

Signposting can be made to several people or organisations at once and can take many forms:

- Providing verbal information about services.
- Providing contact details for services, e.g. business cards, flyers or a list.
- Providing written information about services, e.g. posters, leaflets or brochures.
- Providing information via technology, e.g. email newsletters, website links or social media feeds.
- Introducing representatives of organisations to clients in group sessions or at events.

### POINT OF INTEREST

Skilled professionals need to keep up to date with services available in their local community, so they can signpost people to the right service.

Services may include:

- Alcohol support services.
- Alternative therapy practitioners.
- Chiropractor.
- Community mental health team.
- Counselling services. When clients are experiencing psychological problems related to their condition (and diagnosis) and may need to speak with a counsellor to help them manage.
- Dietitian.
- Exercise referral scheme.
- Physiotherapist.
- Self-help groups.
- Sexual health services.
- Specialist instructors (e.g. for low back pain, cardiac rehabilitation, stroke, falls prevention, mental health, neurological conditions, obesity and diabetes).
- Sports massage therapist.
- Sports therapists.
- Smoking cessation services.
- Other qualified instructors, e.g. a client may wish to join a different type of session, such as t'ai chi, yoga, Pilates or an aqua class or walking group and should be directed to instructors who are able to lead these sessions and qualified to manage clients referred with specific conditions.

Some people may also disclose the need for support with other areas, e.g. financial, housing or domestic violence. Information about local services that support these issues is usually listed on a local authority or local council website, which can easily be found via the internet using the name of the local authority/council and the specific need (e.g. housing).

Group sessions and clubs are a cost-effective delivery format for behaviour change programmes. The benefits to clients of attending groups or clubs of like-minded people who have similar behaviour change goals include:

- Reduction of possible loneliness and isolation by providing an opportunity to meet others who understand or share similar goals or needs.
- Empowering people to improve their own situations in a supportive environment.
- Providing a useful source of information and news on relevant topics.
- Providing opportunities to experience genuine empathy.
- Providing role models for group members to follow and the opportunity to act as a role model for others, which in itself can be empowering.
- Enabling people to feel more comfortable to discuss problems than they would with a health professional.

If an individual's needs fall outside a skilled professional's role boundaries, it is essential to signpost them towards services and other professionals who can offer the appropriate support to meet their needs. Some of these professionals and services are listed below. In all instances the first point for contact is the person's general practitioner who can then make a diagnosis and instigate an official referral to the relevant service.

**END OF SECTION Revision activities**

Answer the following questions and make notes to revise this section.

- Why is it important for a skilled professional to screen their clients?
- What is the purpose of ‘informed consent’?
- When would a skilled professional refer a client back to their general practitioner?
- Name four medical conditions outside a personal trainer’s scope of practice.
- What is the purpose of risk stratification?
- Name four risks attached to becoming more active.
- Draw and explain the risk stratification pyramid.
- Explain the logic model of risk stratification.
- Using the Irwin and Morgan risk stratification tool, name two conditions from each category that are classified as low-, medium- and high-risk.
- List six absolute contraindications to exercise.
- Describe three situations where it would be appropriate to signpost a client to other professionals.
- What additional signposting can be offered to support a client’s behaviour change journey?

# References

- ACSM. (2011). Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal and Neuromotor Fitness in Apparently Healthy Adults: Guidance for Prescribing Exercise. *Medicine and Science in Sports and Exercise*. DOI: 10.1249/MSS.0b013e318213fefb.
- ACSM. (2014). *Guidelines for Exercise Testing and Prescription*. 9th edition. Philadelphia, PA: Wolters Kluwer/Lippincott Williams and Wilkins.
- Alcohol Concern. (2016). 'Statistics on Alcohol' [online]. Available at <https://www.alcoholconcern.org.uk/help-and-advice/statistics-on-alcohol/> [Accessed: 15 August 2016].
- ASH. (2016). 'Facts at a glance. Statistics on smoking' [online]. Available at [http://www.ash.org.uk/files/documents/ASH\\_93.pdf](http://www.ash.org.uk/files/documents/ASH_93.pdf) [Accessed: 15 August 2016].
- Association of Chartered Physiotherapists in Cardiac Rehabilitation. (2015). 'Standards for Physical Activity and Exercise in the Cardiovascular Population' [online]. Available at [http://www.acpicr.com/sites/default/files/ACPICR%20Standards%202015\\_0.pdf](http://www.acpicr.com/sites/default/files/ACPICR%20Standards%202015_0.pdf) [Accessed: 15 August 2016].
- BBC Bitesize. (2016) [online]. Risks of unhealthy eating. Available at <http://www.bbc.co.uk/schools/gcsebitesize/design/foodtech/socialenvironmentalissuesrev4.shtml> [Accessed 1 September 2016].
- BBC World Service (2016) [online]. Risks of unhealthy eating. Available at [http://www.bbc.co.uk/worldservice/sci\\_tech/features/health/healthyliving/dietrisk.shtml](http://www.bbc.co.uk/worldservice/sci_tech/features/health/healthyliving/dietrisk.shtml) [Accessed 1 September 2016].
- BACR. (2015). 'Risk Stratification' [online]. Available at [http://www.bacpr.com/pages/page\\_box\\_contents.asp?PageID=788](http://www.bacpr.com/pages/page_box_contents.asp?PageID=788) [Accessed: 15 August 2016].
- BBC. (2012). 'Inactivity Killing as many as Smoking' [online]. Available at <http://www.bbc.co.uk/news/uk-wales-politics-18876880> [Accessed: 7 August 2016].
- BHF – British Heart Foundation. (2010). 'Exercise Referral Toolkit' [online]. Available at <http://www.bhfactive.org.uk/sites/Exercise-Referral-Toolkit/downloads.html> [Accessed: 16 August 2016].
- BHF. (2011). 'Healthy Eating' [online]. Available at <http://www.bhf.org.uk/heart-health/prevention/healthy-eating.aspx> [Accessed: 12 June 2011].
- BHF. (2012a). 'Current levels of physical activity in the early years' [online]. Available at <http://www.bhfactive.org.uk/homepage-resources-and-publications-item/336/index.html> [Accessed: 23 July 2012].
- BHF. (2012b). 'Factors influencing physical activity in the early years' [online]. Available at <http://www.bhfactive.org.uk/homepage-resources-and-publications-item/336/index.html> [Accessed: 23 July 2012].
- BHF. (2012c). 'Interventions to increase physical activity in the early years' [online]. Available at <http://www.bhfactive.org.uk/homepage-resources-and-publications-item/336/index.html> [Accessed: 23 July 2012].
- BHF. (2016) [online] How atherosoma builds up. Available at <https://www.bhf.org.uk/heart-health/conditions/cardiovascular-disease> [Accessed 1 September 2016].
- BHF. (2016). Waist circumference information [online]. Available at <https://www.bhf.org.uk/heart-health/preventing-heart-disease/managing-your-weight> [Accessed 1 September 2016]
- Blood Pressure UK. (2016a). 'Facts and figures' [online]. Available at <http://www.bloodpressureuk.org/microsites/kyn/Home/Media/Factsandfigures> [Accessed: 8 August 2016].
- Blood Pressure UK. (2016b). 'Healthy lifestyle and blood pressure booklet' [online]. Available at [http://www.bloodpressureuk.org/BloodPressureandyou>Yourlifestyle/Beingactive/main\\_content/GDsK/downloadPublication](http://www.bloodpressureuk.org/BloodPressureandyou>Yourlifestyle/Beingactive/main_content/GDsK/downloadPublication) [Accessed: 8 August 2016].
- Change4Life. (2016). Available at <http://www.nhs.uk/Change4Life/Pages/change-for-life.aspx> [Accessed: 8 August 2016].

- Deci, E.L., Koestner, R. and Ryan, R.M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, vol.125, pp.627-668.
- Deci, E.L. and Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behaviour*. New York: Plenum Publishing Co.
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). 'A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation'. *Psychological Bulletin*, Vol. 125 pp.627-668.
- Dahlgren, G. and Whitehead, M. (1991). *Policies and Strategies to Promote Social Equity in Health*. Stockholm, Sweden: Institute for Futures Studies [online]. Available at <http://www.empho.org.uk/THEMES/KHI/determinantsofhealth.aspx> [Accessed: 19 May 2013].
- Department of Health. (2001). 'Exercise referral systems: A national quality assurance framework (NQAF)' [online]. Available at [http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH\\_4009671](http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4009671) [Accessed: 16 August 2016].
- Diabetes UK. (2016) [online]. Available at <https://www.diabetes.org.uk/> [Accessed 1 September 2016]
- Durstine, L. J. and Moore, G. (2003). 2nd Edition. ACSM's Exercise Management for Persons with Chronic Diseases and Disabilities. USA. Human Kinetics.
- Durstine, J., Moore, G., Painter, P. and Roberts, S. (2009) ACSM's Exercise Management for Persons with Chronic Diseases and Disabilities, 3rd edition, Champaign: Human Kinetics.
- Exercise Register. (2016). 'Occupational Descriptor for Level 3 Personal Trainer' [online]. Available at <http://www.exerciseregister.org/images/documents/l3%20personal%20trainer%20-%20v7%20sept%2009.pdf> [Accessed: 10 August 2016].
- Fitness Australia. (2016). 'Scope of practice' [online]. Available at [https://fitnessaustralia.s3.amazonaws.com/uploads/uploaded\\_file/file/224/Scope-of-Practice-for-Registered-Exercise-Professionals.pdf](https://fitnessaustralia.s3.amazonaws.com/uploads/uploaded_file/file/224/Scope-of-Practice-for-Registered-Exercise-Professionals.pdf) [Accessed: 10 August 2016].
- Foresight. (2007). Tackling obesities project [online]. Available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/287937/07-1184x-tackling-obesities-future-choices-report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/287937/07-1184x-tackling-obesities-future-choices-report.pdf) [Accessed 1 September 2016].
- Health and safety executive. (2016) [online]. Labour Force Survey (LFS) – Work related stress, anxiety and depression statistics in Great Britain 2014/15. Available at <http://www.hse.gov.uk/statistics/causdis/stress/> [Accessed 1 September 2016].
- Healthy lives, healthy people. (2011) [online]. Available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/216096/dh\\_127424.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216096/dh_127424.pdf) [Accessed 1 September 2016].
- Health Survey for England. (2014). [online]. Available at <http://digital.nhs.uk/catalogue/PUB19295> [Accessed on 1 September 2016].
- Kasser, T. and Ryan, R.M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin*, vol.22, pp.280-287.
- Labonte, R. (1998). A community development approach to health promotion: a background paper on practice, tensions, strategic models and accountability requirements for health authority work on the broad determinants of health. Health Education Board of Scotland, Research unit on Health and Behaviour Change, University of Edinburgh, Edinburgh [online]. Available at [http://www.health.vic.gov.au/healthpromotion/downloads/factors\\_hlth\\_wellbeing.pdf](http://www.health.vic.gov.au/healthpromotion/downloads/factors_hlth_wellbeing.pdf) [Accessed on 27 March 2013].
- Mason, P. and Butler, C.C. (2010). *Health Behavior Change*. 2nd edition. Philadelphia: Churchill Livingstone Elsevier.
- Michie, S. et al. (2011). The Behaviour Change Wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, DOI: 10.1186/1748-5908-6-42 [online]. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096582> [Accessed: 16 August 2016].
- Michie, S. et al. (2014a). *ABC of Behaviour Change Theories*. UK: Silverback Publishing.
- Michie, S. et al. (2014b). *The Behaviour Change Wheel: A Guide to Designing Interventions*. UK: Silverback Publishing.

- Miller, W.R. and Rollnick, S. (2013). *Motivational Interviewing*. 3rd edition. New York: The Guilford Press.
- Mind. (2016) [online]. Causes of stress. Available at <http://www.mind.org.uk/information-support/tips-for-everyday-living/stress/causes-of-stress/#.V8gkVmdFC1s/> [Assessed 1 September 2016].
- NHS Choices. (2011). 'Hypertension Treatment' [online]. Available at [http://www.nhs.uk/Conditions/Bloodpressure-\(high\)/Pages/Treatment.aspx](http://www.nhs.uk/Conditions/Bloodpressure-(high)/Pages/Treatment.aspx). [Accessed: 9 August 2016].
- NHS Choices. (2016a). 'Activity guidelines for adults' [online]. Available at <http://www.nhs.uk/Livewell/fitness/Documents/adults-19-64-years.pdf> [Accessed: 9 August 2016].
- NHS Choices. (2016b). 'The benefits of exercise' [online]. Available at <http://www.nhs.uk/Livewell/fitness/Pages/physical-activity-guidelines-for-adults.aspx> [Accessed: 9 August 2016].
- NHS Choices. (2016c). 'Safe alcohol levels' [online]. Available at <http://www.nhs.uk/Livewell/alcohol/Pages/Effectsofalcohol.aspx> [Accessed: 16 August 2016].
- NHS Choices. (2016d). 'Stress, anxiety and depression' [online]. Available at <http://www.nhs.uk/Conditions/stress-anxiety-depression/Pages/reduce-stress.aspx> [Accessed: 9 August 2016].
- NHS Choices. (2016e) [online] The causes of COPD. Available at <http://www.nhs.uk/Conditions/Chronic-obstructive-pulmonary-disease/Pages/Causes.aspx> [Accessed 1 September 2016].
- NHS Choices. (2016f) [online] Diabetes. Available at <http://www.nhs.uk/Conditions/Diabetes/Pages/Diabetes.aspx> [accessed on 1 September 2016].
- NHS Smokefree. (2016). [online]. Available at <https://www.nhs.uk/smokefree/why-quit/what-happens-when-you-quit#fqmBH5uXzTVWgBqX.99> [Accessed: 9 August 2016].
- NICE – National Institute for Health and Care Excellence. (2004). Hypertension – Management of Hypertension in Adults in Primary Care. *Clinical Guideline 18*. London: NICE.
- NICE. (2005). 'Review of hypertension guidelines' [online]. Available at [www.nice.org.uk](http://www.nice.org.uk) [Accessed: 9 August 2016].
- NICE. (2011). 'Hypertension in Adults: diagnosis and management' [online]. Available at: <https://www.nice.org.uk/guidance/cg127/chapter/1-Guidance> [Accessed 17 June 2016].
- NICE. (2016). 'Drugs used to treat hypertension – Nice Guidance 2016' [online]. Available at <https://www.nice.org.uk/guidance/cg127/ifp/chapter/treating-high-blood-pressure-with-drugs#some-drugs-used-to-treat-high-blood-pressure> [Accessed: 8 August 2016].
- O'Rourke, J. and Collins, S. (2009). *Interpersonal Communication: Listening and Responding*. 2nd edition. Mason, OH: South-Western Cengage Learning.
- Prochaska, J.O. and Diclemente, C.C. (1983). Stages of self-change of smoking: toward an integrative model of change. *Journal of Consultant Clinical Psychology*, vol.51(3), pp.390-395.
- Prochaska, J.O. and Velicer, W.F. (1997). The transtheoretical model of health behaviour change. *American Journal of Health Promotion*, vol.12(1), pp.38-48.
- Prochaska, J.O., Velicer W.F., Rossi J.S. et al. (1994). Stages of change and decisional balance for twelve problem behaviours. *Health Psychology*, 13, pp.39-46.
- Public Health England. (2016). 'Sleep' [online]. Available at <https://www.nhs.uk/oneyou/sleep#6FExvt5dYDtpbi.99> [Accessed: 9 August 2016].
- Rotter, J. (1966). 'Generalized expectancies for internal versus external control of reinforcement', *Psychological Monographs* 80 (1), (1-28).
- Ryan, R. M., and Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68-78.
- Schwarzer, R. et al. (2003). 'On the Assessment and Analysis of Variables in the Health Action Processing Approach: Conducting an Investigation' [online]. Available at [http://userpage.fu-berlin.de/gesund/hapa\\_web.pdf](http://userpage.fu-berlin.de/gesund/hapa_web.pdf) [Accessed: 16 August 2016].

The New Economics Foundation. (2016). 'The Five Ways to Wellbeing' [online]. Available at <http://www.fivewayswellbeing.org/> [Accessed: 24 June 2016].

Trapp, E., Chisholm, D., Freund, J. and Boutcher, S. (2008) 'The effects of high intensity intermittent exercise training on fat loss and fasting insulin levels of young women', International Journal of Obesity, vol. 32, pp. 684-691.

Venables, M., Achten, J. and Jeukendrup, A. (2005) 'Determinants of fat oxidation during exercise in healthy men and women: a cross-sectional study', Journal of Applied Physiology, vol. 98, pp. 160-167.

Wikipedia (2016) [online]. The Health Belief model. Available at [https://en.wikipedia.org/wiki/Health\\_belief\\_model](https://en.wikipedia.org/wiki/Health_belief_model) [Accessed 1 September 2016].

World Health Organization. (No date). 'Global Strategy on Diet, Physical Activity and Health/Physical Activity' [online]. Available at <http://www.who.int/dietphysicalactivity/pa/en/> [Accessed: 10 August 2016].

World Health Organization. (2003). 'Controlling the global obesity epidemic' [online]. Available at <http://www.who.int/nutrition/topics/obesity/en/> [Accessed: 9 August 2016].

World Health Organization. (2010). 'Global Recommendations on Physical Activity and Health' [online]. Available at: <http://www.who.int/dietphysicalactivity/publications/9789241599979/en/> [Accessed 10 August 2016].

World Health Organization. (2016). 'Facts on obesity' [online]. Available at <http://www.who.int/features/factfiles/obesity/facts/en/index9.html> [Accessed: 12 August 2016].



# Encouraging positive health and fitness behaviours in clients

## Aim

To understand and be able to utilise a range of methods that can encourage positive health and fitness behaviours in clients.

## Learning outcomes

At the end of this unit, you will:

- Understand the importance of communication skills to effectively communicate and engage with clients.
- Understand techniques used to effectively communicate and engage with clients.
- Understand techniques used to support clients making lifestyle behaviour changes.
- Understand how to create a positive environment that motivates and empowers clients to meet their desired goals.
- Know how to collect and interpret health screening and fitness assessment data.
- Understand how technological advancements can help clients increase their activity levels and stay motivated and focussed.
- Understand how to monitor and interpret client data from a range of current information technology (IT) applications.
- Be able to establish rapport and engage clients in conversation about their health and fitness.
- Be able to collect meaningful information about clients.
- Be able to assess clients' readiness to change behaviour.
- Be able to facilitate goal-setting and action planning.
- Be able to provide relevant information to clients.
- Be able to close sessions in a way that encourages ongoing client motivation and goal achievement.
- Be able to use information technology (IT) applications in line with legislation and professional standards.
- Be able to evaluate and adapt own communication styles.

# Introduction

Skilled professionals utilise a wide variety of skills based on theoretical models and experientially learned strategies in order to be able to encourage positive health and fitness behaviours in clients, including:

- Communication styles, skills and techniques.
- Behaviour change techniques.
- Motivational strategies.
- Creating a positive, motivational and encouraging environment.
- Health and lifestyle screening and fitness assessments.
- Technological applications.
- Social media and digital communications.
- Rapport development.
- Goal-setting and action planning.

This unit will review a variety of methods that have been tried, tested and found to be effective when working with a wide range of clients.

# Section 1: Communication to encourage positive health and fitness behaviours

## Touch points

'Touch points' is a marketing term used to describe the different interactions an organisation has with their customers. Touch points in a health and fitness context could be described as all communication that takes place between a client and a professional. Methods of communication commonly used to encourage positive health and fitness behaviours include:

- Face-to-face.
- Telephone.
- Email.
- Social media.
- Digital or traditional marketing or sales.
- Advertisements and advertorials.
- Articles, newsletters and editorials.
- Video or live presentations.
- Workshops and short courses.
- Group activity facilitation and delivery.
- Social events and occasions.

Adherence to physical activity, exercise and fitness is not only essential to maintain the viability of health and fitness businesses, it is also essential for a client – in order to benefit from the physical activity or exercise, they need to take part regularly (reversibility principle – 'use it or lose it'). Each one of these touch points can be used to market and sell products and services in a traditional manner, but in a health and fitness environment, there is an additional opportunity: to motivate and encourage positive health and fitness behaviours. If touch points are viewed by skilled health and fitness professionals as opportunities to increase the likelihood of adherence to physical activity, then the added long-term bonus will be that a client continues to have a positive perception and therefore continues to purchase products and services. This will organically drive sales, and financial income will be improved as a result.

The most important concept to note is that negative touch points are more powerful than positive ones. For example, a client who has had a positive personal training (PT) session will be likely to discuss their experience with one or two close friends. In contrast, a client who has turned up to a PT session where their trainer was late, looking at their phone and taking selfies for the entire session is likely to discuss their experience with everyone they come into contact with for days, even weeks.

It is also important to remember that many people view physical activity and exercise as a chore – something they have to do to maintain their health. Negative touch points can build strong barriers to adherence whereas positive touch points can create strong motivators that lead a client towards adherence.

For these reasons, touch points between the client and health and fitness professional should always:

- Be positive.
- Improve the client experience.
- Build rapport and trust between the client and the professional.
- Motivate and encourage adherence to physical activity and exercise.
- Educate and signpost clients to relevant products, services and resources that may benefit them as individuals.
- Reinforce the benefits of positive lifestyle behaviour changes including adherence to physical activity and exercise.

Positive touch points can, and should, occur regularly throughout all stages of the client's health and fitness journey (see Figure 1.1).

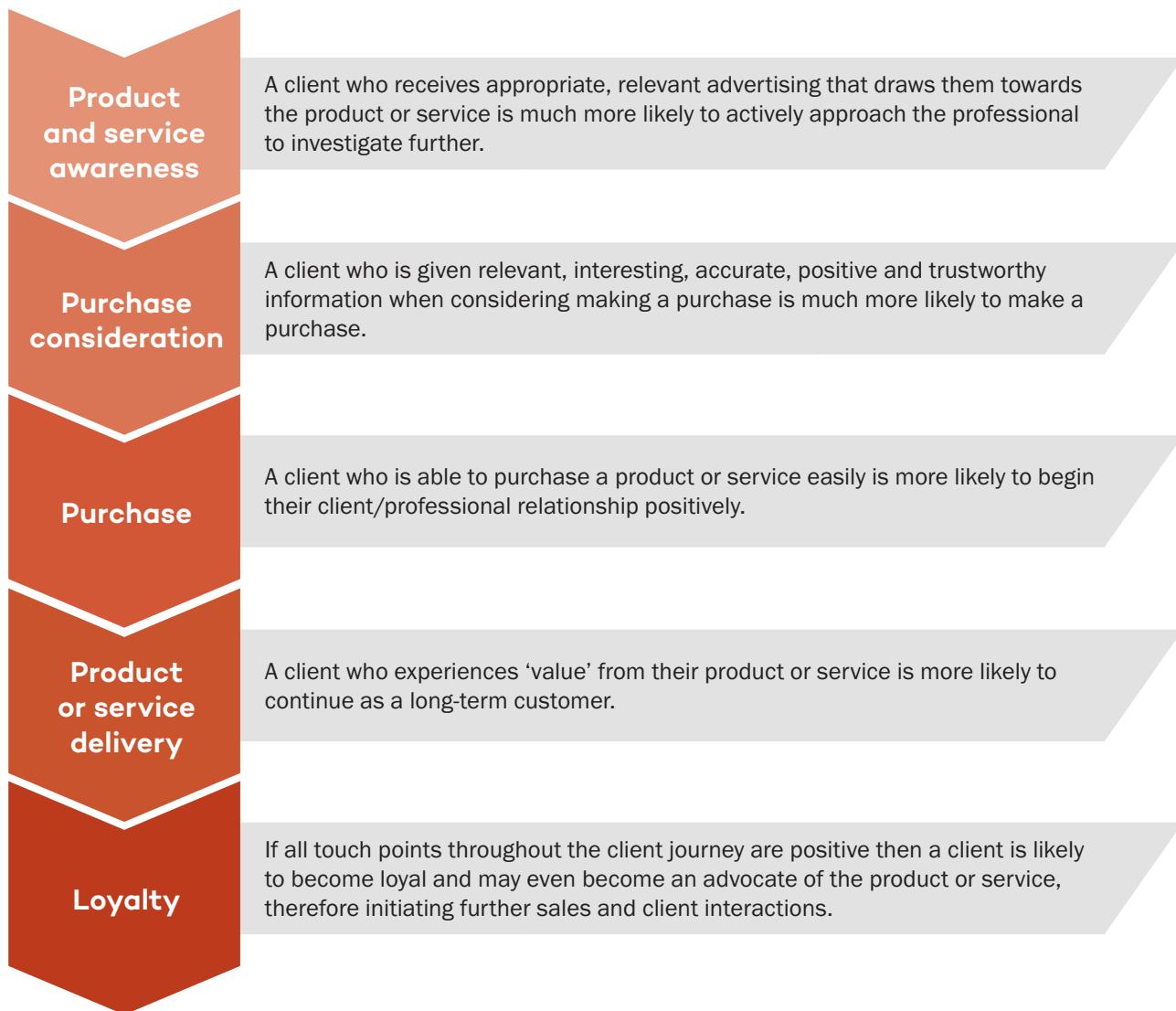


Figure 1.1 Touch points and example outcomes throughout the stages of the client journey

## Effective communication skills for a PT

Personal trainers must have a range of effective communication skills when working with clients to increase the likelihood that every touch point is positive. This will ensure that they are facilitating the best outcomes for every client and increasing the likelihood that the client will adhere to physical activity and exercise by using the professional's services and products.

PTs must therefore be aware of every communication they have with their clients and focus on making interactions:

- Positive.
- Clear and understandable.
- Motivating and encouraging.
- Informative and useful.
- Appropriate and professional.

Figure 1.2 shows a range of common communication methods that PTs use to interact with their clients.

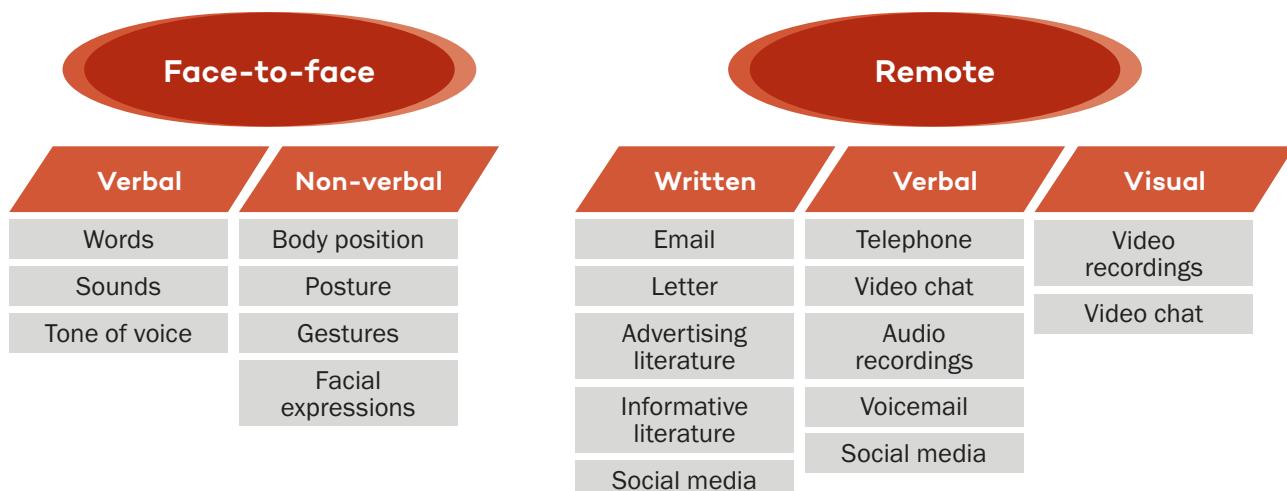


Figure 1.2 Communication methods commonly used by PTs

## Creating a positive impression

Making a positive impression is essential when initiating contact with a client for the first time. The initiation of contact could be formal or informal and could occur in a range of environments and situations, for example:

- Introductions completed before a walk round, sales tour or consultation.
- Offering assistance in a gym environment.
- Acknowledgements and greetings when passing.
- Client-initiated contact situations (e.g. when looking for assistance).

When initiating any client contact, it is essential that face-to-face, written and remote communication is positive, professional and appropriate for the client. Key considerations for all client interactions include:

The PT should always consider the potential that all communications made may be overheard, seen or read by other parties (e.g. friends, family, people in close proximity) and that they may not fully understand the context. The awareness of the fact that '**no message will be 100% private**' will mean that inappropriate 'sound bites' or interpretations are less likely.

It is common for PTs to develop strong rapport, friendships and bonds with clients because they are working with them and discussing very personal and intimate details about each client's personality, lifestyle and health. '**Familiarity is an important factor to both nurture and manage**' when considering client interactions and touch points. If a client or bystander were to misunderstand an over-familiar interaction, the consequences could be serious (e.g. loss of business, the initiation of disciplinary or grievance procedures, termination of employment or even prosecution).

**'Being over-formal can be adjusted easily.'** It is more difficult to recover from an over-familiar communication where the client has felt uncomfortable or embarrassed.

**'Choose words carefully.'** If the message or communication is unclear then the effect can be very negative, no matter how positive the intentions.

It takes different lengths of time for people to lower their personal barriers and inhibitions and respect should be shown to this diversity. '**Do not rush or force the development of rapport or trust.**' Go at the client's pace and adapt to their characteristics, rather than expecting them to adapt to yours.

## Face-to-face contact initiation

There are many ways to initiate client contact positively using any communication method. They could be formal or informal and they could include a brief, basic interaction or a longer, more in-depth discussion.

Key considerations for a PT when initiating face-to-face client contact include:

### What type of greeting would the client expect?

Different types of client are likely to expect different types of greeting. For example, younger clients may expect less formality than older clients, who may appreciate a formal, traditional introduction. Introverted clients may take time to feel comfortable and familiar enough to positively respond to an enthusiastic greeting. Initial eye contact and brief hellos may be a good way to slowly increase familiarity when approaching clients in a fitness facility.

### Focus on the client

When initiating contact with a client, the PT must be prepared to focus their attention on the client for the length of any interaction. Should the client want to speak for longer than the PT has available, the PT must be prepared to be polite and openly explain they need to go. Best practice would be to explain briefly what is taking them away and arrange another opportunity to communicate (e.g. 'I just have to go and meet a client for an appointment. Can I catch up with you after the session or next time you are in?').

### Show interest and enthusiasm

The use of positive body language, active listening skills and questioning techniques can help to demonstrate interest in any interaction.

### Be yourself

'People buy people' and the best way to sell yourself is to promote your best characteristics. A client will be able to sense when an interaction is natural, or when it is forced and uncomfortable. Showing the best parts of yourself will allow the client to assess whether they want to continue to build a rapport. If they don't, this is okay. A PT being true to their natural character may lead to a client warming to them at a later time and this may eventually lead to a sale. If a client feels a PT is being false they will either not make a purchase, or they will make a purchase only to find out later that what they purchased is not what they wanted. This would result in a much more negative outcome than the original true interaction.

## Building rapport

Rapport can be described in simple terms as a state of familiarity that allows comfortable, trusting interactions. Rapport cannot be immediately assumed, and often the factors which helped build or destroy rapport between two people cannot be accurately pinpointed. This makes it challenging for a PT who is expected to build rapport with almost everyone they come into contact with.

All people who come into contact with a PT will have different aspects of character, communication and interests that will affect whether a strong rapport is more or less likely. Although, in an ideal world, it would be great if a PT could build strong relationships with every person they communicate with on a professional level, it is unlikely that this will happen. A PT can, however, develop skills that maximise the potential for rapport building with as many clients and potential clients as possible.

By continuing to be positive, professional, approachable, interested, enthusiastic, informative and helpful following an initial communication, a PT will be able to build rapport and get to know clients over time. As familiarity grows, the client will increase their trust and understanding and generally improve their perception of the PT. By aiming to make every interaction positive, the PT will build a strong reputation with a wide range of clients and others. Consistency is the key. If every interaction builds on the last, the rapport and relationship can develop positively.



## Active listening

Active listening is an essential communication skill for building and maintaining rapport with clients. When a trainer is actively listening, they are simultaneously checking the accuracy of what they have heard and communicating to the speaker that they are listening and interested in what is being said.

Active listening can be used to:

- Demonstrate to the speaker that you are actively listening using body language, eye contact and gestures.
- Encourage the speaker to continue speaking using positive reinforcement, paraphrasing, summarising and conversation development.
- Observe the speaker to recognise non-verbal communication signals that may be important or relevant to the conversation.
- Understand the main points and ensure the speaker recognises that the main points are being understood.
- Demonstrate to the speaker that what is being said is being valued.
- Identify **change talk** (speech that reveals a client's desire, consideration of or motivation and commitment to change).

Methods of actively listening include:

- Nodding the head when positive points are made.
- Open and interested body language (e.g. leaning forwards in the chair slightly and opening arms).
- Mirroring body language (e.g. naturally copying a client's body language to demonstrate affinity with them).
- Paraphrasing, summarising and reflecting on client statements.
- Using encouraging statements and probing questions to encourage further client discussion.

## Affirmations

Affirmations are positive statements that are used to:

- Demonstrate empathy.
- Provide support or encouragement.
- Recognise strengths, abilities and intentions that may or may not have been noted before.
- Place the emphasis on the positive and move away from the negative.
- Highlight success and build self-efficacy.
- Encourage more change talk.



### POINT OF INTEREST

**Self-efficacy** is a person's confidence in their ability to succeed in a specific situation or activity. Self-efficacy is important for developing the motivation to change and determining the level of perseverance to maintain a change.

Affirmations can be used in consultations and throughout sessions, discussions and conversations to highlight the positive points of any situation (e.g. good client technique or effort, positive aspects of lifestyle or health, positive attitudes, approaches or statements). They can instantly highlight positive points which a client may or may not have noticed. These statements can also facilitate increased motivation, confidence, belief and self-efficacy.

### Example

- Client:** 'I need to be more active so I tried to walk the dogs every day for half an hour and attend at least two circuit classes per week. I could only make time to walk the dogs for ten minutes each day and I had to take the kids swimming when the circuit classes were on so I didn't manage to do that either.'
- Trainer:** 'So last week you managed to walk every day for ten minutes and you did two swimming sessions.'

## Reflective statements

Reflective statements can be:

- Simple reflections – repeating back the exact words that have been said or repeating back what has been said using different words or phrasing.
- Complex reflections – completing the paragraph by taking a guess at what the speaker means or where they are going with their thought process.

### Simple reflection example

Client: ‘I would like to reduce the amount of junk food I eat each week.’

Trainer: ‘So you would like to reduce the amount of junk food you eat each week?’

### Complex reflection example

Client: ‘I need to improve my diet as I eat a lot of junk food and I am not very healthy.’

Trainer: ‘So you would like to reduce the amount of junk food you eat each week?’

Reflective statements are really useful to demonstrate active listening, to build rapport by demonstrating affinity and understanding with the client's opinions and to clarify understanding. Another key purpose of reflection and reflective statements is to close the feedback loop of communication (see Figure 1.3). These statements help to ensure that the message is clear and the PT's meaning and the client's interpretation are the same.

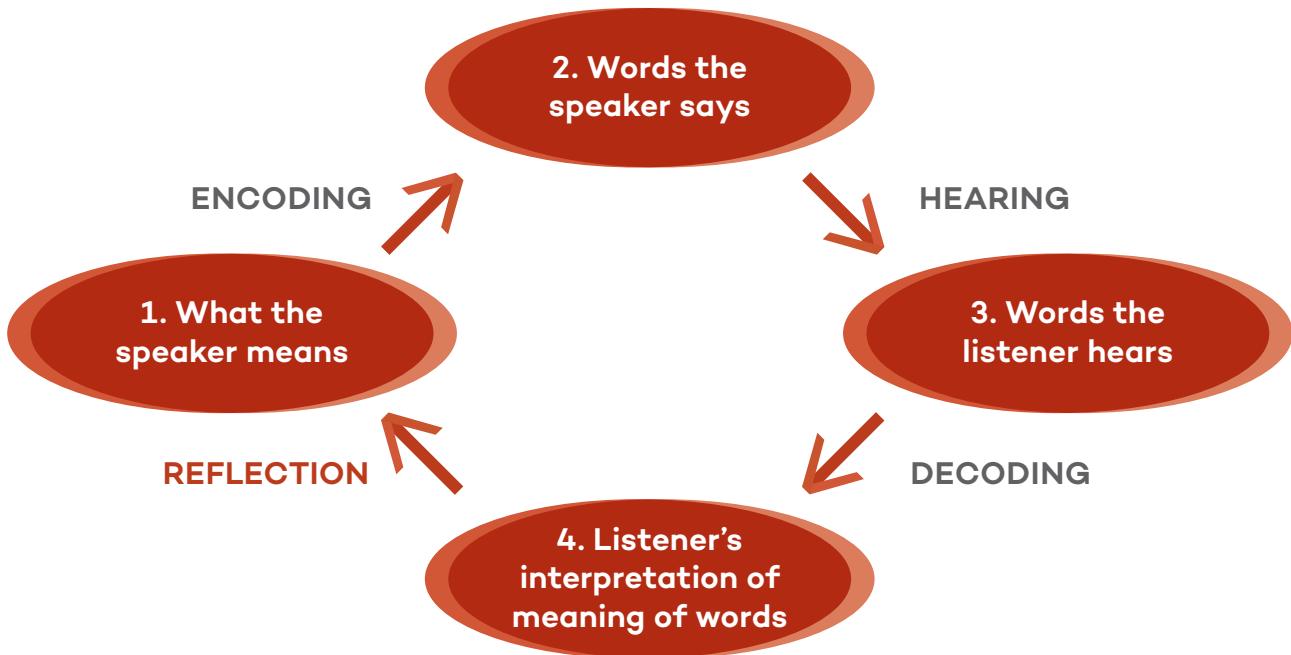


Figure 1.3 The communication process adapted from Miller and Rollnick (2013)

## Summaries

Summaries can be used at a number of points in a consultation, but they are most useful for punctuating or highlighting the main points of a discussion before moving onto the next subject, topic or question. Summaries include a collection of reflective statements that are used to tell the story of the conversation so far. To ensure the most positive points are highlighted, the trainer should focus on summarising change talk rather than more negative points, e.g. barriers to change.

## Questioning techniques

Questions can be used very effectively to demonstrate active listening and interest in a client and their statements during all types of client interaction. They are also useful to gather information and clarify key points during consultations and sessions.

There are many different types of question (see Figure 1.4) that are useful to collect and gather relevant information. Whichever type of question is being asked, there are some simple guidelines that help to ensure questioning is being used to maximum effect. These include:

- Keep questions short and simple.
- Make sure the purpose of the question is understood.
- Ensure all questions serve the client's interests and needs.
- Use words that match the language style of the client.
- Positively acknowledge client responses.
- Allow the client time for reflection to answer a question.
- Be encouraging and supportive when asking questions.
- Avoid asking too many questions as this may feel like an interrogation.
- Try to encourage client conversation by using open questions as much as possible. Use closed questions sparingly.
- Clarify and re-word questions if the client is struggling to answer.

### Types of question

There are two main types of question, and they are categorised based on the responses they facilitate:

- **Open** – questions that require a full response, including some explanation or discussion.
- **Closed** – questions that require very short one- or two-word answers (e.g. 'yes' or 'no', 'true' or 'false').

Open questions are useful for provoking discussion and encouraging debate which can draw out opinions, thoughts, feelings and emotions, as well as other useful information that the client may not have initially considered. Closed questions are useful for clarifying information, knowledge and understanding in specific circumstances.

<b>Nominal</b>	Questions that have specific numbers as answers. These questions usually elicit closed responses.
<b>Factual</b>	Questions that are based on facts and consequently have a right or wrong answer. These questions usually elicit closed responses.
<b>Clarification</b>	A type of probing question used to clarify the understanding of points already made. The answer to a clarification question is likely to be shorter and more factual than a predominantly open, probing question. In fact, while a clarification question is often intended to be open, the response may be closed.
<b>Hypothetical</b>	A situation, statement or assumed fact is presented as part of the question to elicit an opinion-based response. These questions usually elicit open responses.
<b>Probing</b>	A question used to dig deeper and find out more about a subject/person. Often used for clarification, these responses tend to be more open in nature than those given following a clarification question.
<b>Elaborating or divergent</b>	Questions that have no specific answer and they encourage the client to extend and broaden the discussion. These responses should always be open if the question is asked well.
<b>Leading</b>	Questions that suggest or lead a client towards an answer. These types of question usually elicit a closed response.
<b>Evocative</b>	Questions that are designed to create a response or feeling (e.g. a question that stimulates change talk). These responses should always be open if the question is asked well.

Figure 1.4 Types of questioning

## The influence good communication skills can have on a client's health and fitness experience

Effective communication skills can help the PT build rapport which in turn can help a client feel comfortable and trusting. This will enable the PT to:

- Gather more relevant information from the client.
- Gather better quality information from the client.
- Increase the likelihood that the client will adhere to the guidance and programmes given, increasing the chances of successfully achieving valuable, relevant goals.
- Adapt communication and motivational strategies to meet the needs of the individual client, positively influencing the client's motivation and commitment to making lifestyle changes.
- Maximise the strength of the overall message by using consistent verbal and non-verbal communication methods in synchronicity.
- Use non-verbal communication (e.g. body language, gestures and exercise demonstrations) to influence the client's understanding of the programme and session requirements.

The use of good communication skills will inherently add value to any client experience. The nature of any PT/client relationship relies on trust, understanding and a general affinity with one another. If a client takes on board guidance and advice and adheres to their programmed exercise because they like and trust their trainer, they will elicit the benefits and be more likely to continue long term.

Gathering quality, relevant information and demonstrating interest and enthusiasm in a client will allow the PT to target promotions, special offers, marketing and sales towards the individual. This will help to focus and individualise sales strategies (whether in a consciously driven, structured, written format, or in a subconscious, organic, unwritten, informal manner) and will increase the likelihood of a client making another purchase (e.g. a personalised water bottle or a group PT session with some friends). These targeted promotions and special offers, if highlighted to the client in a personalised manner, can also help to add value to the client experience.

## Evaluating and adapting communication styles

Communication skills can be read about in a manual, however in order for them to be effectively developed, they need to be practised in simulated and real environments. Every interaction with a client offers an opportunity to evaluate current practice and highlight strengths and weaknesses as well as strategies that have worked and not worked with particular individuals. The information used for evaluation should include a combination of client feedback and self-reflection.

It may also be useful to review recent business performance – clients may not always be forthcoming with constructive feedback because they feel anything negative may create discomfort or conflict. By reviewing recent business trends, a PT may be able to identify areas where other improvements could be made.

### Example

A PT requests feedback from clients regarding the services they enjoy, things that could be improved and reasons why. Clients offer some constructive feedback that relates to the facility and availability of equipment at peak times. They state that it is a small concern as the PT is very good at adapting the session accordingly.

Upon further analysis of recent bookings, the PT notices that the number of group PT sessions has been falling recently in comparison with individual session bookings.

The PT speaks to one of the clients who has recently stopped booking in an additional group session per week. When the PT asks the client about this in a polite and appropriate manner during normal conversation, the client explains that the lack of equipment at peak times is a particular problem for group sessions.

The PT decides that as their group sessions are very profitable and useful to drive further individual session sales, they will purchase some additional equipment.

Once the feedback and self-reflection process is complete, the PT should evaluate the collected information, then identify and implement adaptations to further improve communication skills, client rapport and perceived professionalism and the quality of their products and services.

This process of feedback gathering, self-reflection, evaluation and improvement implementation must be ongoing throughout a PT's career, although the actual process may become more natural and less structured as the PT gains experience. For example, a newly qualified PT may write SMART goals and action plans for development. In contrast, a PT who has developed the habit of continuous development may run through the evaluation process in their head, naturally adapt their current practice and only write a clear SMART list of actions for anything that requires follow-up.

## Going the extra mile

Doing more than what your job profile calls for with sincerity and integrity (going the extra mile) can be a very important part of making a client feel special. Clients invest time and effort to earn money and should be expected to exercise great caution when spending it. A client should therefore be presented with the best quality service at all touch points to ensure there is sufficient reason to justify their decisions. This would include the PT going the extra mile whenever possible.

'Going the extra mile' does not mean that a client should be showered with attention and given everything they want or need. This would inevitably mean that the cost of delivering a product or service would significantly rise, therefore risking the future profitability of the business and it may even make the client feel uncomfortable and have a counterintuitive negative effect. Often small gestures and actions can be used to 'go the extra mile' with great effect. These gestures and actions include:

- Be courteous and polite at all times. Invite and welcome the client with a smile. Greet the client using appropriate words (e.g. 'sir' or 'madam' in formal circumstances, or addressing a regular customer by their first name in less formal surroundings).
- Ask the client about their needs and be interested in their answers. Pay full attention to the client and make eye contact when speaking to them.
- Be informative and happy to explain the benefits of a product or service in a way that meets the client's needs, wants and expectations (even if this requires additional time or effort).
- If the information the client requires is not readily available, be honest. In an ideal world, the PT should then decide what research needs to be done (e.g. ask a manager or search the internet) and how long the investigation will take, and agree a future meeting to pass on the required information.
- If the most appropriate course of action is to signpost the client to another professional or source of information, the PT should provide as much information and support as possible to reduce the amount of effort and time the client has to put in. For example, if a PT feels a client would like to find out about massage therapy, then it would be best practice for the PT to provide a number of local contacts. If the PT has a sports massage contact then it would also be beneficial to suggest that the client's details could be passed to the sports massage therapist so the therapist can contact the client, rather than the client having to initiate the contact. This will make the client feel they are getting special service from the PT and the massage therapist and is likely to further build the rapport, trust and positivity about the professional relationship.
- Honour every promise made to the client and be punctual. If problems are anticipated, inform the client beforehand, seek more time or make alternative arrangements to avoid inconvenience.
- Keep up to date with the changing landscape of client needs and wants.
- Be sensitive to the client's needs and wants and constantly evaluate whether the products and services offered meet those wants and needs. This should be an ongoing process.
- Deliver the unexpected and pleasantly surprise your client by providing a value-added service. For example, if a client has left their belongings in the facility after a session, arrange delivery back to their house.
- Follow up with clients and seek feedback about products and services. Take on board the feedback and help to sort out any issues a client may be experiencing with the product or service.

## Providing relevant, credible information to clients

There is a huge amount of information available to clients in a huge range of formats. These can include:

- Webpages.
- Leaflets.
- Books.
- Magazine articles.
- Support packs.

Information can be provided by reputable organisations or people who are presenting the information for valid reasons. Alternatively, information may be presented by people or organisations who are not experts in their field and their reasons for presenting the information could influence the quality and accuracy in a biased way. The most common example of this is when companies who want to sell a product or service pay for research to be carried out on their behalf. The findings of this research are often (not always) skewed in the organisation's favour so they can increase their sales.

As a PT, it is essential that the information presented to clients is credible, reputable and based on fact. In order to ensure that a particular piece of supporting information is of sufficient quality, PTs need to be able to analyse and evaluate effectively so they can be confident that they are only giving their clients the best service, support and guidance.

When considering the provision of information about supporting services or facilities, it is essential for the PT to consider whether the service or facility is:

- Available locally.
- Reputable.
- Good quality.
- Reliable.
- Appropriate.

It could be detrimental to client rapport and trust if a PT recommended a service or facility that was unavailable in the local area, of low quality, unreliable or inappropriate for the individual.

When considering the provision of supporting information to further educate and raise awareness in a client, it can be even more challenging for the trainer to determine what is suitable and of sufficient quality. Healthy living, nutrition and exercise are now big business, so there is a lot of information that may be biased in favour of selling related products or services. For this reason, when determining whether a source of information is of adequate quality and suitable for a client, the trainer must critically evaluate each source prior to use. Sources can include:

- Research articles.
- Books.
- Magazine articles.
- Websites and pages.
- Leaflets.
- Posters.

### Research articles

Research articles are thought to be the gold standard source of quality information, with reviews (especially systematic reviews) being the best of the best. The problem with providing these to clients is that they are written in academic formats and use terminology that can be unfamiliar to some clients. In some cases, they can also be biased or of poor quality.

If the aim is to produce in-house materials using quality sources of information, research articles may be appropriate as they can offer some very up-to-date and cutting edge information that has not yet diffused into the wider information environment. Research articles are also useful when evaluating other sources of information. For example, if a magazine article references a specific study, the source research is useful for finding out whether the magazine article is reporting the research correctly.

There are a range of structured critical analysis tools available on the internet that can help with evaluating research articles. These tools are usually in the form of checklists that ask you to consider certain questions when reviewing the article. These tools are called CASP checklists and recognised versions are available online ([www.casp-uk.net](http://www.casp-uk.net)). A less formal method of performing analysis can be seen in Figure 1.5.

## Books

Books are usually published by large publishing houses who have fact-checkers to ensure that the information presented is accurate. The issue with this can be that by the time a book is published, the information may have been superseded. In recent times another issue has emerged; with the dawn of e-books and self-funded publications, books are not always scrutinised and fact-checked. Books can also be open to marketing bias and it could be that a supplier wants to develop a book that upsells its equipment or product. A PT should be mindful of this and consider the quality of the source.

## Other sources of information

Websites, leaflets, magazine articles, etc. could be produced by industry experts who reference their quality sources effectively and provide quality information. Unfortunately, these quality information sources are often mixed up with sales tools and biased or low-quality sources.

A PT must therefore check and analyse each source to verify its quality and suitability for a client. The strategy shown in Figure 1.5 can be used to help evaluate the quality of each source or more formal tools are available online.

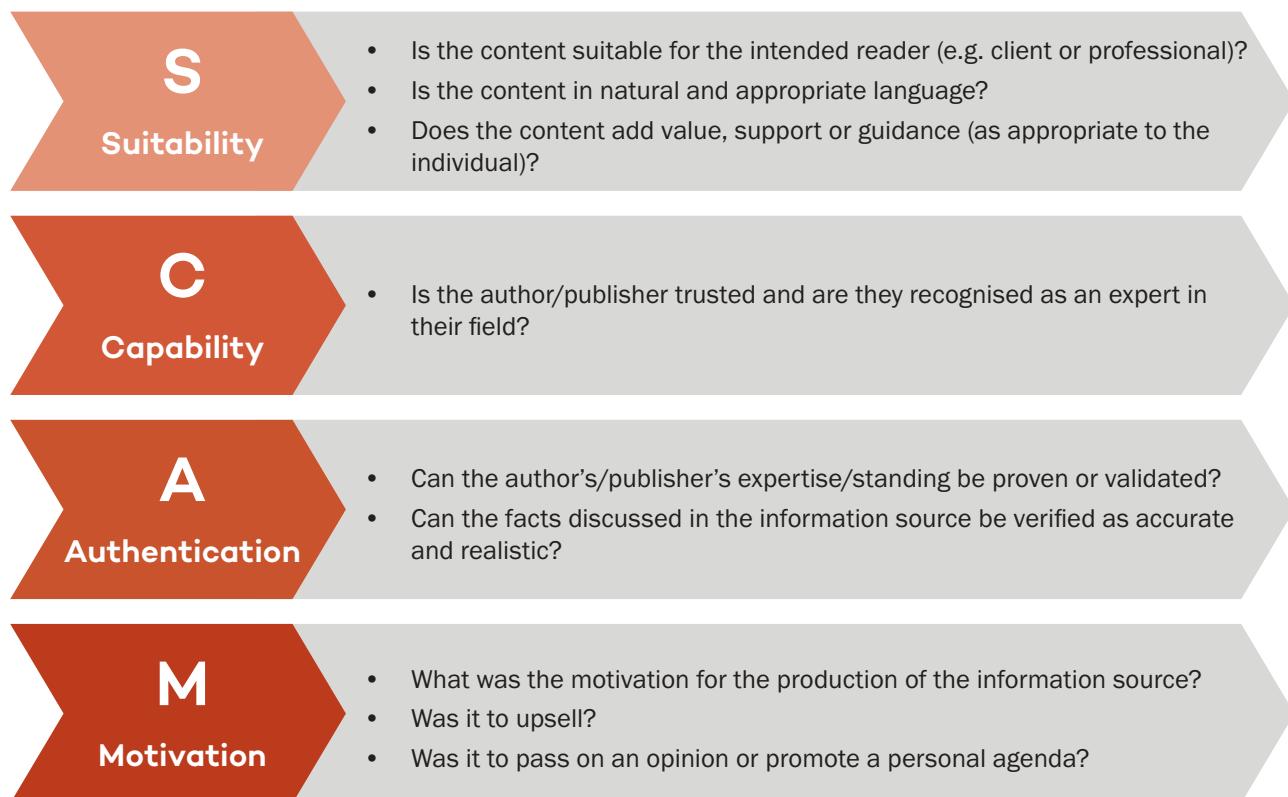


Figure 1.5 Resource evaluation strategy

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- In your own words, explain what a ‘touch point’ is.
- Make a list of reasons why it is important to ensure that every touch point is positive.
- Make a list of things which would make a positive impression on a client.
- In your own words, explain how you would prefer to be greeted by a new PT on the first and subsequent occasions.
- Make a list of techniques that would feel comfortable and a list of techniques that would feel uncomfortable when building rapport with clients.
- Identify methods of communication that you would be comfortable/uncomfortable using.
- Identify ways to integrate strong communication skills into current practice.
- Identify ways to strengthen weaker communication skills so they can be used as experience develops.
- Have a discussion with a friend or family member and try to use a range of communication techniques to stimulate constructive discussion. Evaluate strengths and weaknesses and identify actions to develop future practice.
- Take a friend or family member through a PAR-Q and use a range of questioning techniques to draw as much information out as possible. Evaluate strengths and weaknesses and identify actions to develop future practice.
- Carry out some research to find sources of information on a topic of interest. Critically evaluate each source of information.

# Section 2: Behaviour change techniques and motivational strategies

## Theory of reasoned action and planned behaviour

Ajzen and Fishbein initially developed the theory of reasoned action in 1967 to explain the interaction between an individual's beliefs, intentions and behaviours. This theory states that in order for an individual to make a behavioural change, they need to have an appropriate combination of:

- Positive attitudes towards the behaviour.
- The perception that important others in their life also view the behaviour as positive.
- Control over making the behaviour change.

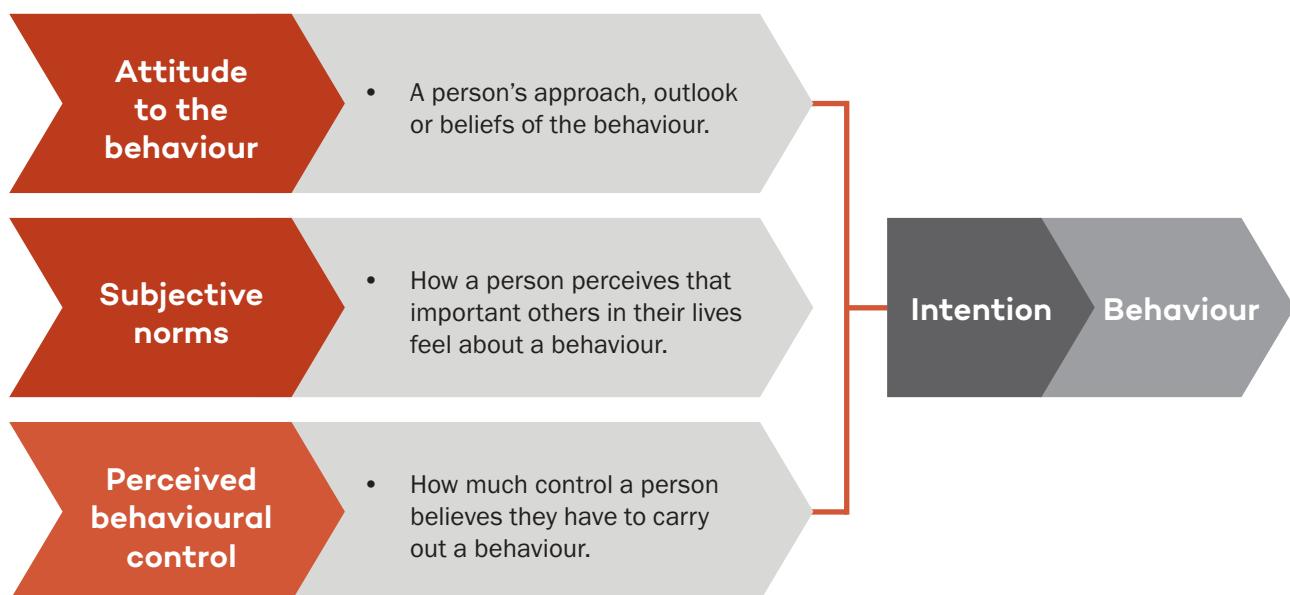


Figure 2.1 Theory of reasoned action and planned behaviour

To summarise, the top two rows of Figure 2.1 explain the original theory of reasoned action and the lower row demonstrates the addition that amended the theory from that of reasoned action to planned behaviour.

## Transtheoretical model of behaviour change

The transtheoretical model (TTM) proposed by Prochaska and Velicer (1997) identifies:

- Different stages of the change process – pre-contemplation, contemplation, preparation, action, maintenance, relapse and termination.
- Attitude of the client at each stage – resistant, contemplating, etc.
- Stage-appropriate strategies – either to reframe thinking (cognitive) or take action (behavioural) to assist change.

There are four core constructs within TTM:

### 1. Stages of change

There are five main stages of change:

- Pre-contemplation.
- Contemplation.
- Preparation.
- Action.
- Maintenance.

**Termination** is a theorised end-point rather than a stage and is not achievable for behaviours such as physical activity and healthy eating.

**Relapse** is not considered a stage of change but describes the process of moving backwards in the model – typically only by one or two stages, although occasionally it can mean returning to pre-contemplation.

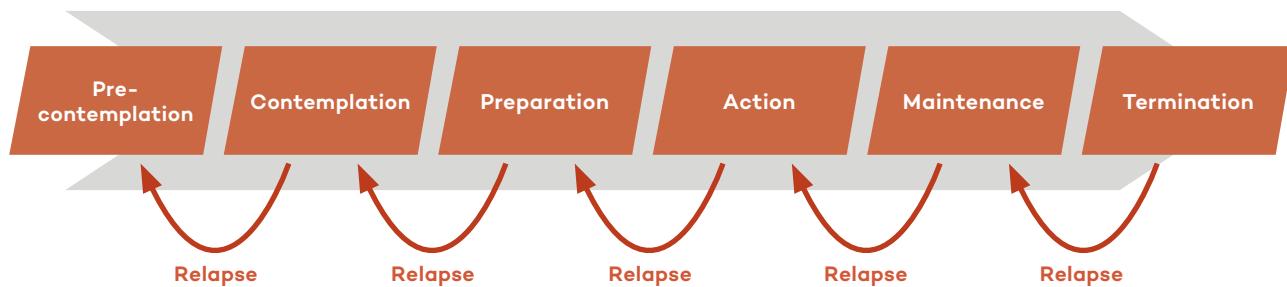


Figure 2.2 Stages of change

Despite the linear format of the model, it is commonly accepted that it is not normal for individuals to progress smoothly through it in a linear fashion. Relapse is accepted as a normal part of the learning process and for most individuals it takes four or five serious attempts at changing a problem behaviour before the new, desired behaviour is maintained. This has important implications for setting realistic client expectations, dealing with setbacks and exploring what has been learned from past experiences.

### 2. Processes of change

These are the internal attitudes (cognitive beliefs) and observable strategies (behavioural interventions) that individuals use to progress through the stages of change. There are ten processes that are well supported by research and these can be used as a guide when structuring behaviour change interventions to have greatest impact. Support and motivation offered by a skilled professional is one way of encouraging this commitment. During the initial consultation, the skilled professional will get to know a little about the client's motivations and barriers for making changes. They will continue to learn more about the client as the working relationship and level of trust develop.

Stage of change	Client attitude (cognitive)	Intervention (behavioural)
Pre-contemplation	Denial of any need to change. 'I don't see why I should exercise.'	Active listening. Provide information, e.g. handouts.
Contemplation	Considering change, but need to overcome internal conflicts – barriers versus motivation. 'I know I should be more active but I just don't have time right now.'	Active listening. Explore the client's motivation and barriers. Use decisional balance grid. Use reflective statements and summaries.
Preparation	Small changes are made. 'I've chosen the outfit I want to wear comfortably again by my next holiday.'	Active listening, praise and encouragement. Goal-setting. Explore support systems, rewards and incentives and relapse prevention strategies.

Stage of change	Client attitude (cognitive)	Intervention (behavioural)
Action	Changes made – one day to six months. ‘I’ve stopped buying fast food and cook all my meals at home.’	Active listening, praise and encouragement for changes. Review goals. Explore support systems, rewards and incentives and relapse prevention strategies.
Maintenance	Changes sustained for beyond six months, some coping strategies in place. ‘Running is just a part of my normal routine now; I don’t think I’d ever want to stop.’	Active listening, praise, encouragement and building confidence. Review goals and highlight successes. Discuss triggers for relapse. Increase strategies to manage relapse.
Relapse	Return to old behaviour. ‘Since I got this knee injury I haven’t been able to run. I guess that’s it for me now, probably just getting too old for this exercise nonsense.’	Active listening, empathy and non-judgement. Explore triggers for relapse. Normalise experience (not failure, opportunity to learn). Discuss re-planning. Review and action plan.

Table 2.1 Cognitive beliefs and behavioural strategies related to each stage of change

### 3. Decisional balance

Decisional balance is a process of weighing up the pros and cons of making a change for a specific behaviour. When clients consider making changes they weigh up the benefits and the sacrifices (or barriers). They will see the benefits and the positive reasons for making a change but they may also see all the things they will have to give up or start doing to make the change happen. If the benefits outweigh the barriers, the change will be made. If the benefits continue to outweigh the barriers, the change will be more likely to be sustained.

Advantages of changing	Disadvantages of changing
‘I would be fitter than I am.’ ‘It could help me to feel better.’ ‘I would have more energy.’ ‘I would feel better about myself.’	‘I would have to find a way to summon energy that I don’t have.’
Advantages of not changing	Disadvantages of not changing
‘I can stay as I am. I don’t have to do anything.’ ‘I don’t have to find time or energy.’	‘Nothing will change.’ ‘I could end up feeling worse than I do now.’ ‘My health could suffer.’

Table 2.2 Decisional balance examples

There will always be reasons to change and reasons not to change which are constantly being evaluated, shifted in priority and re-evaluated in the mind of each individual. Often the benefits and disadvantages of changing are not consciously considered. Awareness of these is at an unconscious level. A conscious decision is not made on each occasion that an individual engages in an unhealthy behaviour. The behaviour has become the result of an unconscious choice or habit. Asking an individual about the pros and cons of a behaviour raises their awareness of it, causing them to re-evaluate their current habitual choices.

Prochaska et al. (1994) evaluated the perceived pros and cons at each stage of change for different health behaviours. They found that:

- Pros are lower than cons in the pre-contemplation stage.
- Pros increase between pre-contemplation and contemplation, while cons do not change at this stage.
- The cons reduce from contemplation, through preparation, to the action stage.
- In the action stage the pros outweigh the cons for the vast majority of individuals.

This provides the following insights regarding change:

- To progress from pre-contemplation to contemplation the pros for changing must increase, so interventions for individuals in pre-contemplation must focus on raising awareness and the importance of the benefits and reasons for change.
- To progress from contemplation to action the cons of changing must decrease, so interventions for individuals in the contemplation stage should focus on reducing the disadvantages of changing and overcoming barriers.
- To be well-prepared for action the pros will be higher than the cons; this can be used as a predictor of readiness to progress to the action stage and highlight the need for more decisional balance prior to action if this is not the case.

### Practical example

If a sedentary person can only identify five pros for them to begin exercising, then a single con (such as being too busy) presents a major barrier to change. However, if they can identify 50 benefits of being more active, the issue of being busy becomes much smaller in comparison and action is more likely.

## 4. Self-efficacy

Self-efficacy is an individual's confidence about a specific situation or activity and the extent to which they think they can do it (their perception of the ease or difficulty of the task). Self-efficacy is important for developing the motivation to change and determining the level of perseverance to maintain a change. If a client thinks they can do something and believes their actions will make a difference, their motivation will be higher.

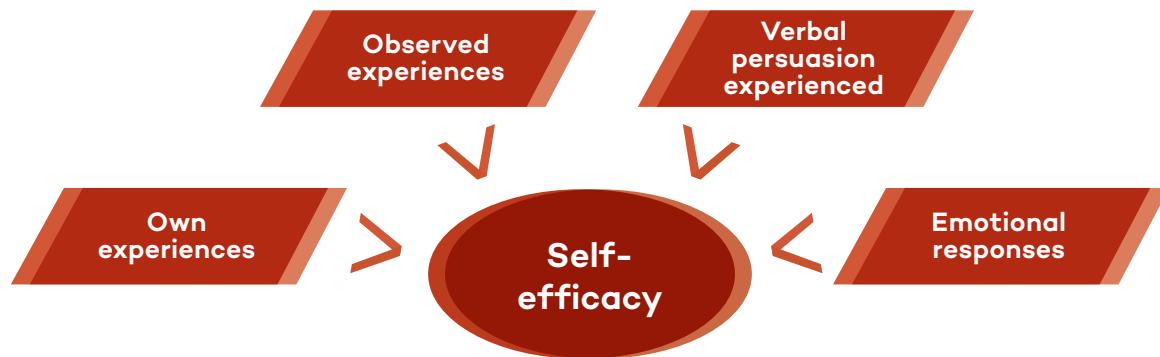


Figure 2.3 Self-efficacy

- Own experiences** could include trying a new activity and enjoying it, or committing to not smoking all day at work and succeeding. 'That wasn't as bad as I expected, maybe I could do it!'
- Observed experiences** involve seeing others succeed and using them as role models, for example: 'My friend managed to give up smoking and they used to smoke more than me. If they can do it, maybe I can!'
- Verbal persuasion** is talking about the problem behaviour with someone to increase confidence to change it, probably as a result of lots of affirmations and expression of their belief in the individual's ability to change. 'They seem to think I can do it, maybe I can!'
- Emotional responses** are feelings associated with the activity. 'I feel great today because I've eaten loads of healthy vegetables and not had any junk food. Maybe I'll feel this good all the time if I stick with it!'

### Temptation

Although it is not a core construct of the model, the concept of temptation in relation to relapse is important to TTM and identified by Prochaska and Velicer (1997) as the intensity of urges to engage in the unhealthy problem behaviour. Insufficient levels of self-efficacy in situations such as feeling lonely or bored, or when attending social events and celebrations, is likely to lead to relapse to an earlier stage of the TTM and a recurrence of the problem behaviour. For example, drinking alcohol is more likely to occur at a party or when alone and feeling sad than in a work environment. It is therefore important that stage-matched interventions are designed to support and develop self-efficacy in potential trigger situations. The impact of trigger situations is well-recognised and this theory is popular in the field of addiction therapy. Relapse is to be anticipated, as is the process of moving through the stages several times before eventual success.

### POINT OF INTEREST

Three key situations for temptation:

- Being upset or emotionally distressed.
- Enjoyable social situations.
- Physiological cravings.

## The COM-B model

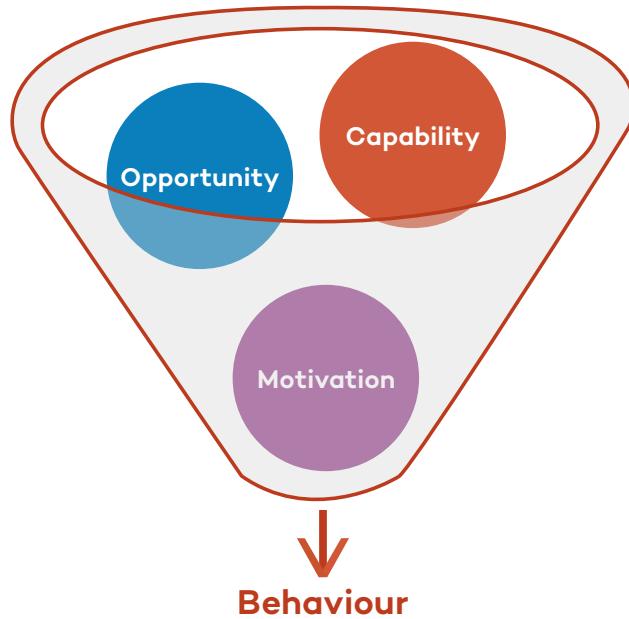


Figure 2.4 The COM-B model

The COM-B behaviour change model (Michie et al., 2011) explains that in order to make a behaviour change, the individual requires the correct balance of capability, motivation and opportunity. Without all three factors an individual is unlikely to make or maintain the behaviour change in the long term.

**Capability** – A client's psychological and physical ability to make a change.

**Opportunity** – The external resources, time and environmental and social opportunities to be able to make the behaviour change.

**Motivation** – The conscious and subconscious thought processes that drive a client towards making a behaviour change.

Each factor can affect the others. For example, if a client is looking to attend a gym three times per week and they have to pass their home on the way to the gym, their motivation may be affected by the opportunity. Alternatively, if they are really motivated but a recurring injury causes them to feel pain if they exercise too often or too intensely, the capability might be having an effect on their motivation. Therefore, ensuring a balance of capability, opportunity and motivation is essential for the success of any behaviour change.

### Practical example

A client who would like to increase their activity levels by attending a gym three times per week would need to:

- Be capable of attending the gym three times per week.
- Be physically capable of completing their exercise programme (a beginner who has been set an intense workout session using heavy weights and high-intensity cardiovascular intervals may not be physically capable of completing the workout).
- Be psychologically prepared for entering the gym environment and completing the programme (a beginner who is nervous about entering the gym environment may not be psychologically ready to enter on their own).
- Have the opportunity to attend the gym three times per week.
- Have transport to take them to the gym at the correct time.
- Have access to a gym that is an appropriate distance from their work or home.
- Have access to a gym that's open when they would like to train.
- Have sufficient motivation to attend the gym three times per week.
- Have motivators (e.g. improving health, reducing body fat or increasing energy) that outweigh the barriers (e.g. fatigue, other social activities or ambivalence to the method of exercise chosen).

## Goal-setting

Goal-setting can help clients to make and maintain changes. Deciding and agreeing goals with clients that are specific, measurable, achievable, realistic/relevant and time-bound (SMART) and reviewing these on a regular basis offers a strategic and staged approach to achievement. Targets and visible progress will assist motivation and increase the likelihood of adherence and long-term commitment.



Figure 2.5 The SMART acronym

The three main types of goal that can be used when working with PT clients are process goals, outcome goals and performance goals.

### KEY POINT

#### Process goal

A goal that can be achieved by completing an action.

#### Outcome and performance goals

Goals that can be achieved by reaching an end result.

#### Process goals

Process goals focus on the actions, tasks and activities a client must complete to achieve success. For example, a process goal would be to jog two miles twice a week for four consecutive weeks. These goals are really useful for beginner clients who are not used to habitual exercise, because success can be achieved simply by completing activities on a programme.

#### Outcome and performance goals

Outcome and performance goals are similar to process goals but focus on reaching a specific end result. Outcome goals tend to focus on results that can be compared to another party (e.g. coming within the top 20 in a 10km road race). Performance goals tend to focus on the individual (e.g. to lose 5kg or to beat personal best by 2 minutes in a 10km road race). Both of these types of goal work well with those who exercise habitually and are naturally competitive. Beginners and those who struggle to adhere will find the achievement of these goals challenging.

Outcome goals are useful for clients who thrive when trying to ‘win’, but not for those who need to experience regular achievement or success. This is because a client can perform to the best of their ability but not achieve their goals if their competitor(s) perform better, which can be demotivating.

#### Example

Outcome goal: Jenny will attend the gym more times than Anna in September.

Anna is a super-competitive person who attends the gym every weekday in September. Jenny sees that Anna has already attended the gym seven times by the middle of week two and realises that she can only actually attend a total of eight times in the whole of September. Jenny therefore realises she cannot ‘win’ and stops trying.

Performance goals are useful for people who thrive on competing with themselves as they require progression and improvement from one assessment to another. They can, however, be unpredictable and therefore less effective for those who need to experience continuous success.

Physiology-related performance goals (e.g. to lose 1kg per week for 8 weeks) can be problematic because even regular gym attendance and stringent dietary control provide no guarantee of successful achievement.

The client can also have little or no knowledge of how they are doing between assessments without becoming over-focussed on the measurement itself (e.g. weighing themselves or measuring blood pressure daily). This dysfunctional focus can cause a client to become so obsessed about the assessment result that they lose sight of the methods of achieving it (e.g. a client who starves themselves for two days prior to a weigh-in).

True performance goals (e.g. to be able to run at a constant speed of 8kph for 10 minutes by April) can be easier to manage in a health and fitness context as they involve competition with oneself. The goal should be relatively easy to achieve if it has been devised well (SMART acronym) and the programme has been appropriately designed and adhered to. A PT must be aware, however, that performance goal achievement can be hindered by many factors (e.g. illness during the programme period or lack of sleep the night before the assessment). To prevent demotivation, the PT must fully explain the challenges and mitigating circumstances prior to the agreement of the goal. If 'failures' to achieve goals are rationalised after the reassessment this can be seen as making excuses and the effect on the client's motivation and the PT's reputation can be very negative.

## The health belief model

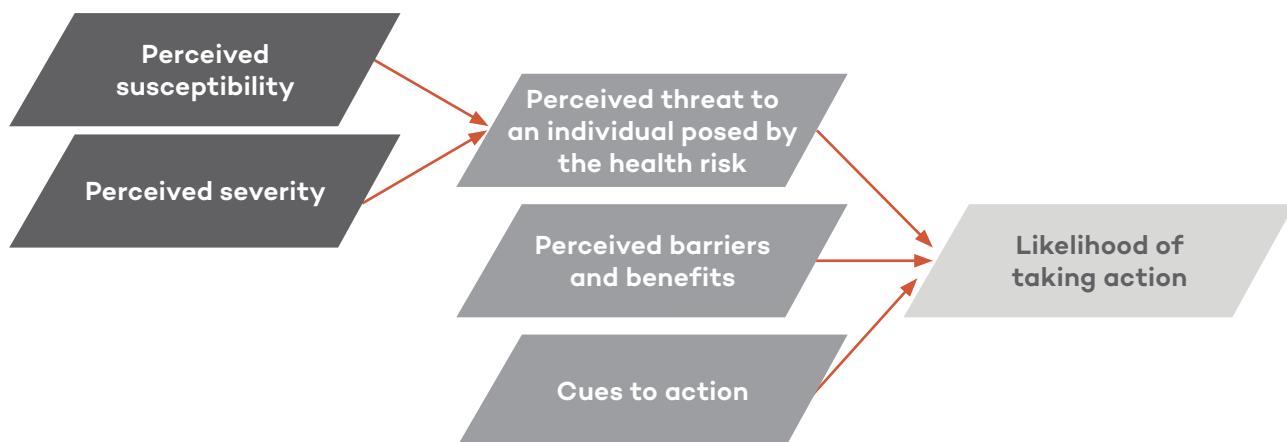


Figure 2.6 The health belief model

The health belief model (HBM) was created in the 1950s by social psychologists Irwin M. Rosenstock, Godfrey M. Hochbaum, S. Stephen Kegeles and Howard Leventhal to identify factors that would have an effect on whether a person would take action to avoid a threat to health. The concept explains that people are more likely to take preventative action if they believe they are at risk from the threat and if they feel the threat is severe enough to their health.

The HBM has four major concepts:

- **Perceived susceptibility** – Individuals will take action to prevent or to control ill health if they regard themselves as susceptible to the condition.
- **Perceived severity** – Individuals will take action if they believe that the condition will have potentially serious consequences for them.
- **Perceived benefits** – Individuals will take action if they believe that the course of action available to them will be beneficial in reducing their susceptibility to (or the severity of) the condition.
- **Perceived barriers** – Individuals will take action if they believe that the anticipated barriers to taking the action are outweighed by its benefits.

In 1988, Rosenstock et al. also added the concept of self-efficacy to the model, discussing that an individual also had to believe they were capable of taking the appropriate action, in order for the action to be taken.

### Practical example

Think of an illness that you have experienced and answer the questions below:

- Before developing the illness, had you ever thought you were likely to develop the illness? (Perceived susceptibility).
- Had you thought that the illness was severe with possible complications? (Perceived severity).
- Had you considered the benefits of getting treatment for the illness? (Perceived benefits).
- Had you thought of any problems with accessing treatment for the illness? (Perceived barriers).

## Self-determination theory

Self-determination theory (Deci and Ryan, 1985) is a combination of theories that provide a broad framework for the study of motivation and personality. The theory is concerned with the different types of motivation and the effects of intrinsic (internal) motivation compared to the effects of extrinsic (external) motivation. The theory explains the need to develop intrinsic motivators whilst acknowledging the impact of the environment in terms of social and cultural factors on the development of the self, motivation and behaviour.

Self-determination theory identifies three conditions necessary for the development of personal wellbeing, also known as **inherent growth characteristics**:

- **Autonomy** – An individual's need to feel they are in control of decisions made, therefore they have choice.
- **Competence** – An individual's need to feel they can carry out and successfully reach goals and targets.
- **Relatedness** – An individual's need to feel connected and related to society by having a purpose or being involved in something greater than themselves.



## Motivational interviewing

Motivational interviewing is a person-centred approach to behaviour change that can be described as 'a collaborative conversation style for strengthening a person's own motivation and commitment to change' (Miller and Rollnick, 2013).

One of the reasons that people do not make changes is that they are ambivalent; they can see both reasons for and reasons against changing. In motivational interviewing when someone makes statements that reflect this internal wrangling, it is called 'change talk' and 'sustain talk'. It has been demonstrated that a higher degree of change talk relative to sustain talk is a predictor of change, whereas a more even balance of the two is a predictor of not changing.

The techniques used in motivational interviewing to stimulate collaborative conversation are:

- Open questions.
- Affirmations.
- Reflections.
- Summaries.

# Other ways to support successful behaviour change

## Client-centred working and the core conditions

A starting point for encouraging clients to commit to long-term behaviour change is to build a positive working relationship. This starts during the initial consultation and develops as the relationship continues. Client-centred working puts the client at the heart of any relationship and consists of the core conditions of empathy, positive regard and congruence.

- **Empathy** – seeing things from the client's perspective without judgement. Judgement is always a reflection of the PT's opinion and perspective and as such is not client-centred.
- **Positive regard** – accepting, respecting and valuing the client as they are, without making judgements. All clients are autonomous adults who are fully capable of making the best decisions for them. This means clients should be allowed and expected to make their own informed choices.
- **Congruence** – being genuine and behaving in accordance with one's own values will demonstrate a consistency (congruence) that the client will be able to sense. People will often learn and copy behaviours that conform with and are accepted by their social or professional group. These behaviours may sometimes be incongruent to the person's own values. A balance between congruence and conformity must be found to ensure the PT can maintain a good rapport with the client whilst upholding their own values. From a client's perspective, a PT who shows empathy and positive regard can facilitate the discovery and development of their own personal congruence which in turn would increase confidence and self-efficacy.

## Social support

A client with a positive and encouraging social network (friends and family) is more likely to be able to sustain a behavioural change. A lack of support, or an unsupportive social network, can significantly reduce a client's potential for successful adherence to long-term behaviour change strategies.

For this reason it is an important factor for PTs to consider when programming and planning physical activity and exercise with a client. If a client has strong social networks and support, then it would be useful to discuss ways in which these support mechanisms can be integrated into a programme to increase the likelihood of success. In contrast, a PT could look for ways to develop new networks or strengthen existing ones (e.g. buddy system training, group PT sessions or group exercise sessions).

## Client education

Educating clients about the benefits of making lifestyle behaviour changes can be a powerful tool for maximising the chances of successful change. If a client fully understands the benefits of making a change, it's more likely the pros will outweigh the cons and this will increase the likelihood of long-term adherence.

The key to educating clients is to focus on benefits that are relevant and powerful for them. PTs tend to be naturally interested in health and fitness and as such they are open to learning and being educated about a wide range of related topics. Clients may not share the PT's enthusiasm for all things health and fitness, therefore the PT must target their education at developing knowledge in key areas of interest for the individual client.

### Example

If a client's most significant motivation for regularly taking part in PT is to improve their energy levels, they are unlikely to want to know about all the individual physiological benefits (e.g. increased mitochondria and increased capillaries). Overcomplicated explanations will detract from the overall message that regular adherence to exercise will increase energy levels as the body adapts to get fitter and work less hard to do the same tasks.

Once a client has fully engaged with the initial benefit, they may then seek additional information which can be related to the original, general, benefit-related goal. This would strengthen the message, but only if the timing were appropriate for the individual.



## Signposting

Signposting clients to other related services, products or sources of information will support lifestyle behaviour changes as they add value to the overall client experience. This may involve signposting to other types of session (e.g. group PT sessions, group exercise classes), other suitably qualified professionals (e.g. physiotherapists, dietitians) or informative resources (e.g. websites, articles) and support systems (e.g. national organisations, counselling services, forums).

A PT must be sure that any signposting to specific organisations or sources of information is checked prior to discussion with a client. This will ensure the PT works within their scope of practice and helps to maintain professionalism and the rapport, trust and relationship built up between the client and professional.

## Creating a positive environment

A positive environment can motivate and empower clients to achieve their desired goals. If a client feels comfortable in their surroundings they are more likely to be motivated to regularly attend and adhere to the activities planned in that environment. A PT should always consider the environment in which they are asking a client to exercise and endeavour to make it as inviting and comfortable as possible.

Environmental factors that can affect adherence and achievement of goals include:

- **Safety and perception of environment safety** – Have the environments been risk-assessed and appropriate safety measures been implemented? Does the environment feel and appear safe and well maintained?
- **Likeability and comfort** – Does the client like and feel comfortable exercising in this environment (e.g. water-based exercise is not appropriate for a client who has a fear of water)?
- **Temperature** – Is the temperature of the environment comfortable for the client? Extra consideration should be given to the individual's specific needs (e.g. a pregnant woman may want to adapt their training environment during the pregnancy as they may be more susceptible to overheating).
- **Barriers between PT and client** – Any perceived or real barriers that are formed between the client and the PT can reduce overall client comfort and enjoyment (e.g. a PT who sits behind a desk during consultations or stands behind equipment during sessions is creating barriers that will reduce client engagement and interaction). Consideration of client and PT positioning throughout consultations, discussions and sessions will significantly increase the positivity of the environment and enhance the PT's ability to deliver quality services to the client on an ongoing basis.

Careful planning and implementation of appropriate measures will help a PT ensure that the environment has a positive impact on a client's adherence to behaviour change.

## Performing regular reviews and reassessments

Whether a client is taking part in regular PT sessions or working out on their own, it is very important (for successful goal achievement and ongoing adherence) that a client engages in regular reviews and reassessments. These reviews and reassessments should be used to:

- Update client details and status (e.g. any new health or medical concerns, injuries, occupational changes).
- Identify progress against goals and targets.
- Identify other progressions or regressions.
- Identify any issues or particular likes and dislikes relating to the programme and exercises.
- Repeat assessment measures to enable accurate progression identification.
- Discuss and agree new goals and targets.
- Develop and agree programme adaptations and alterations.

Reviews and reassessments must be carried out in a client-focussed manner and the PT should utilise good communication skills that encourage as much client discussion as possible. It is essential that the client understands the process and fully engages with it or the information (quantity and quality) collected by the PT will not be as comprehensive. A lack of relevant information provided by the client will inevitably limit the PT's ability to develop and agree specific strategies to ensure the client successfully achieves their goals.

The PT must also make sure that every part of the review and reassessment process is valuable and meaningful to the client. They need to understand why each stage is being performed and clearly recognise the value. This will increase the likelihood that the client will:

- Provide accurate, detailed information that will be of use when adapting programmes.
- Perform to the best of their ability during assessments.
- Place value on the results.
- Engage with and adhere to the agreed SMART goals and actions which have been devised based on assessment results.

The PT should therefore be explaining, reinforcing and highlighting the benefits of each stage of the review process and how they relate to the client's individual needs, wants and goals.

The value of the assessments can also be demonstrated during programming and planning for the next period. If a client can understand how the information has been used to adapt the current programme, then they are more likely to place value on the previous discussions and assessments they have taken part in. This may improve client engagement during future reviews and reassessments.



#### **Key points for completing reviews and reassessments to maximise client engagement and understanding:**

- Ask open questions as much as possible to encourage client conversation.
- Gather information relevant to the previous programme adherence and performance (including likes and dislikes and things which have gone well or not gone so well).
- Discuss how effective the previous support, communication and motivational strategies have been and agree any adaptations for the next programme period.
- Clearly explain each stage of the review process in client-friendly language, so the client fully understands:
  - The benefits of regular reviews and reassessments.
  - What the expected outcome of adherence to the previous programme should be.
  - What the results of the reassessments (health and/or fitness) are expected to be, based on adherence to the previous programme.
  - How the repetition of assessments in a consistent manner enables progress to be accurately determined.
- Only conduct assessments which have value and meaning for the specific client.
- Discuss and agree new SMART goals and targets for the next programme period.
- Explain the changes expected in the next programme period (e.g. changes in measurements).
- Schedule the next review with the client.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- List the four techniques used in motivational interviewing (MI) and describe how they are used.
- In your own words, describe how to work in a client-focussed manner.
- Identify potential sources of social support a client may have available.
- Explain the process of signposting and give examples of when it may be necessary.
- Describe how to create a positive environment for a client.
- In your own words, explain the importance of regular reviews and reassessments.

# Section 3: Health screening and fitness assessment

PTs have a legal duty of care to minimise the risks of any exercise or activity programmes designed for a client. They also have a professional obligation to maximise the benefits and ensure that the client has the best chance of successfully achieving their goals. It is therefore essential that health screening and relevant fitness assessments form a part of initial consultations and ongoing reviews.

## Informed consent

It is a legal and ethical requirement that clients give informed consent prior to participation in any activity. Informed consent is a legal record that the client has been fully informed, understands the risks and benefits of participation and consents to participate.

The first time informed consent is sought from the client is often after the consultation when the client is being asked to sign to say they are happy to participate in fitness assessments or exercises. In actuality, informed consent should be an integral part of each stage of the client experience.

### KEY POINT

An informed consent form is a legal record that the client has been fully informed and understands the risks and benefits associated with participation. As such any informed consent form should be checked by legal professionals prior to use.

Although written informed consent must be requested at specific points of the process (prior to practical assessments or exercise participation), best practice would be to also gain informal informed consent prior to embarking on any new process. For example, before asking for specific medical history information, the PT should explain what they will be asking, why the information is relevant and required and how the information will be securely stored. At this stage the PT should gain informed consent to continue. If the client has any questions or concerns about giving private details they can then be addressed before any questions are asked. This will help to keep the client engaged in the process as well as ensuring ethical best practice.

It is an essential part of any client exercise experience (legally, ethically and motivationally) that they understand their participation is completely voluntary (not compulsory) and that they are given the opportunity to ask questions before making an informed decision.

When completing an informed consent form, any questions or concerns which have been addressed must be recorded. Once all information has been agreed, the PT and client sign and date the form.

## Health screening

All clients should be screened before they start an exercise programme to assess their readiness to exercise, health status and current activity and fitness levels.

Screening clients and acquiring informed consent are compulsory legal and ethical duties of care for PTs. Clients must initially be screened to ensure that they are safe to take part in physical activity or identify the need for referral to their GP for guidance prior to embarking on an exercise programme. A basic screening is likely to include completion of a standard PAR-Q (physical activity readiness questionnaire) and only consider medical conditions that are directly relevant to the client's ability to begin exercising safely.

Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
Do you feel pain in your chest when you do physical activity?
In the past month, have you had chest pain when you were not doing physical activity?
Do you lose your balance because of dizziness or do you ever lose consciousness?
Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity levels?
Is your doctor currently prescribing drugs (e.g. water pills) for your blood pressure or heart condition?
Do you know of any other reason why you should not do physical activity?

Figure 3.1 Basic PAR-Q questions

PTs should also be considering what information is important to facilitate the design of specific, safe and effective programmes that progress a client towards successful achievement of their goals. For this reason, a PT should consider performing a broader consultation which may take the form of a longer, client-focussed discussion (interview) and the types of information gathered could include:

- Medical history.
- Recent illnesses and injuries.
- Personal goals.
- Lifestyle factors (e.g. occupation, hobbies, diet and support networks).
- Physical activity and exercise history.
- Physical activity likes and dislikes.
- Motivators and barriers to regular physical activity adherence.
- Current fitness levels.
- Stage of readiness.

Table 3.1 details the types of information gathered during a consultation as well as the checks that can be made, methods of collection and interpretations based on the information gathered.

<b>Information</b>	<b>Collection method</b>	<b>Checks to make</b>	<b>Relevant interpretations</b>
Personal information and details.	Questionnaire.	Name, address, emergency contacts, age, gender, ethnicity, disabilities, language spoken, etc.	The information gathered will help to identify any resources a client may need (e.g. resources in other languages) and set the scene for the collection of more detailed information regarding exercise advice (e.g. older adults may need further questioning to identify age-related exercise adaptations).
Medical history, illnesses and injuries.	PAR-Q supported by additional questioning as part of the consultation.	Current medical conditions and medications. Relevant aspects of long-term medical history. Previous guidance given about contraindications and recommended activities (e.g. GP guidance).	Clients may need to be signposted to a GP prior to exercise. Clients may be completely contraindicated from performing exercise in the PT context (e.g. severe hypertension). Further specialist guidance may need to be sought via professional consultation, signposting or referral (e.g. exercise referral or pre and postnatal specialist).
Lifestyle factors. Physical activity and exercise history. Current fitness levels.	Questionnaire supported by questioning as part of the consultation.	Occupation, leisure activities, hobbies, activity levels, current and previous activity and exercise adherence. Diet, nutritional status, smoking and alcohol intake.	Lifestyle may influence the time a client has available for sessions and their preferred exercise environment. Additional risk factors that require signposting or referral may be highlighted (e.g. sedentary older adult who smokes and drinks heavily). Information gathered will begin to build a picture of the client's current status and their goals, wants and needs.

Information	Collection method	Checks to make	Relevant interpretations
Physical activity preferences.	Questionnaire supported by questioning as part of the consultation.	Likes and dislikes (e.g. exercise equipment or environment).	Information gathered develops the client's understanding so they can agree SMART goals and activities.
Motivators and barriers to regular physical activity adherence.		Levels of motivation and readiness, client commitment, determination and potential for long-term adherence.	Probing questions develop understanding of the client's motivators and barriers which will enable specific actions to maximise adherence potential and minimise dropout risk.
Stage of readiness.		Barriers to regular adherence. Support networks available.	Understanding of the stage of readiness will enable solutions to be stage-matched for maximal benefit.

Table 3.1 Consultation information summary

## Health screening measurements

There are a range of health screening measurements that can be used to identify any concerns or risk factors (additional to those reported in the initial interview part of the consultation). Health screening measurements include:

- Resting heart rate (RHR).
- Blood pressure (BP).
- Body composition (skinfold analysis and bioelectrical impedance).
- Body mass index (BMI).
- Waist measurements and waist-to-hip ratio.

A description of the protocols for each of the listed health screening measurements can be found in section 2 of the PT toolkit.

### Resting heart rate

Resting heart rate (RHR) is the amount of times the heart beats every minute at rest. The average resting heart rate is between 60 and 80 (Heyward and Gibson, 2014) and is measured in beats per minute (bpm).

An RHR of less than 60bpm is called bradycardia and may be the result of good aerobic fitness, hypothermia, low thyroid function or certain medications.

An RHR of more than 100bpm is called tachycardia and may be the result of stimulants like caffeine, excess stress, fever, poor aerobic fitness or certain medications. An RHR of 100bpm is a contraindication for exercise and should be signposted to a GP for clearance.

### Blood pressure

Blood pressure (BP) is a measure of the force that blood applies to the walls of the arteries as it flows through them.

BP is measured in millimetres of mercury (mmHg) and is expressed using two numerical readings. The optimal blood pressure reading is written as 120/80mmHg (one hundred and twenty over eighty). These two numbers represent the systolic and diastolic blood pressures respectively.

BP is usually taken by an electrical monitor, however a sphygmomanometer and stethoscope are still used in certain circumstances (e.g. medical assessments). Taking BP has become less common during consultations over the last few years as assessment in a fitness environment can provide varied results and limited accuracy. BP is also a common measurement which is taken during routine medical examinations. For this reason, a client may be able to give a more accurate report of their blood pressure than taking the test itself. If a client is not aware of their medically tested BP, taking the test in a consultation can provide valuable information to help stratify risk.

An excessively low (<100/60mmHg) or high (>140/90mmHg) blood pressure will mean that a client should seek medical guidance prior to participating in exercise. If there are no other causes for concern, a BP reading within normal parameters will indicate that exercise is recommended.

When performing the test, a PT must be aware that there are a wide variety of factors which can have an effect on BP. Table 3.2 details examples of factors that can increase blood pressure immediately and in the long term.

	<b>Acute (immediate) factors</b>	<b>Chronic (long-term) factors</b>
<b>Systolic</b>	Stress, anxiety or arousal. Physical activity/exertion. Food. Caffeine. Smoking. Illicit drugs.	Psychological stress/anxiety. Sedentary lifestyle/inactivity. Obesity. High dietary salt (Na) intake. Low dietary potassium (K) intake. Excessive alcohol intake. Certain medications/drugs.
<b>Diastolic</b>	Heavy weight training. Isometric exercise.	Psychological stress/anxiety. Sedentary lifestyle/inactivity. Obesity. High dietary salt (Na) intake. Low dietary potassium (K) intake. Excessive alcohol intake. Certain medications/drugs.

Table 3.2 Factors that increase blood pressure

### Body composition

Body composition is the term used to describe the percentage of fat, bone and muscle in the human body. The amount of fat in a body's composition is of most interest because it can be very helpful in judging health in addition to body weight. Since muscular tissue takes up less space in the body than fat tissue, body composition, as well as weight, determines how lean a person appears. Two people who share the same height and body weight may look completely different because they have different body compositions.

Recommended body fat percentages depend on age, gender and ethnicity, but it is important to understand that body fat percentages that are too low or too high carry increased risks to health.

In recent years, research has identified another key factor relating to body composition. Larger fat stores around the abdominals have been shown to increase the risk of certain health-related diseases, such as high blood pressure, coronary heart disease and type 2 diabetes. A waist (the distance measured around the body at the height of the belly button or at the narrowest place in the trunk) which is larger than the hips (the distance measured around the widest part of the hips) is an indicator that health is at risk (Visscher et al., 2001).

### Skinfold analysis

Skinfold measurement is one of the most recognised options for measuring body composition and is often quoted as being the 'gold standard' for measuring body fat percentage.

Although this assessment is widely used, it requires the tester to have substantial training and/or experience combined with quality, calibrated equipment to obtain accurate and reliable results. In addition, this test (requiring pinches of folds of skin) can be uncomfortable and embarrassing for some clients. The PT must therefore consider if this is the most appropriate test to carry out.

### Example

If this test is performed to allow the development of a specific outcome goal (e.g. to lose 2% body fat over 12 weeks), the PT must consider if this measurement is likely to demonstrate success in the best way possible. If a client is feeling overweight and looking to lose weight already, the test itself may further embarrass the client. If the results cannot be fully relied upon for accuracy and the client may stop engaging with the programme or review process as a consequence of embarrassment, then what is the purpose of the test?

### Bioelectrical impedance

Bioelectrical impedance is a method of estimating body fat percentage using an associated measurement (total body water). Bioelectrical impedance monitors are readily available in most fitness facilities and can be purchased for a reasonable cost in either professional or publicly accessible models. Bioelectrical impedance monitors pass a small current through the body and the body's resistance to the current is measured. Body fat provides an increased resistance because of the relatively low water content, so the monitor can predict the percentage of body fat from the speed at which the current is returned.

Bioelectrical impedance monitors can be useful for PTs as the testing is usually simple and non-invasive (e.g. the client has to hold the monitor handles) so it is less embarrassing or uncomfortable for clients than skinfold testing, as well as being quicker, more cost-effective and less technical for the PT. The results offered can only be considered an estimate because various assumptions are made about the human body that may or may not be true for the individual. Therefore this may be a useful tool for a PT to use when comparing individual client changes, however it may not provide results that can be compared across different clients.

### Bod pods

Bod pods were devised as clinical tools for measuring body composition using air displacement. They have since been introduced into some health and fitness facilities and it is not uncommon for specialist organisations to introduce a bod pod into a facility to provide temporary promotions to members and clients. Bod pods measure total body volume by calculating the amount of air displaced in the pod when the client is inside. The results of this air displacement are then used to estimate the proportion of body fat and lean mass in the client's body.

A PT who is required to supervise bod pod tests would need to undergo specific training so they understand the key protocols and factors which affect the results.

Key considerations for clients who are considering taking the bod pod test include:

- It is likely that they will be asked to take the test wearing a swimming costume and hat to ensure that clothing and hair cannot affect the accuracy of the reading.
- Excessive body hair can affect the results as it will affect the amount of air displaced during the test.

### Body mass index (BMI)

Body mass index (BMI) provides information about the amount of body weight within each square metre of the body and is measured using kilograms per metre squared ( $\text{kg}/\text{m}^2$ ).

As BMI uses weight only and does not consider body composition, it is not appropriate for measuring fat loss. However, it is useful as a quick method to determine body weight compared to national guidelines and as a potential factor for disease risk.

This measurement is particularly inaccurate for individuals who have a higher than normal amount of muscle mass. They will often be classified in overweight categories suggesting an increased risk, which is not correct if they are muscular and still lean. BMI should not be used as a means of monitoring changes in body composition.

### Waist measurement and waist-to-hip ratio

Waist measurement and the waist-to-hip ratio are particularly useful tools for the PT to use when considering risk stratification of clients. This is because the pattern of body fat distribution is recognised as an important predictor of the health risks of obesity.

The measurement of the waist and hips is taken by using a tape measure to wrap around the appropriate parts of the body. The issue with this is that the sites for measurement have not been standardised across the industry. In a practical PT environment, where clinical accuracy is not required or possible, the easiest positioning for the tape measure would be:

- Waist – the narrowest part of the abdominal region, midway between the ribs and pelvis.
- Hips – the widest part of the hip region, around the hinge of the hip.

Although this approximated approach would not enable the comparison of different clients, the PT is likely to maintain consistency when measuring each individual client as these positions are likely to be easy to replicate from assessment to reassessment.

## Risk stratification

Following the completion of health screening and measurements and the accumulation of the information gathered throughout the whole consultation process, the PT should be able to identify the client's risk level.

There are a wide range of risk stratification models for identifying what action would be best for individual clients who have particular risk factors (see PT toolkit section 1). For clients who fall into the moderate or high risk categories, the PT should consider whether referral to a medical professional, GP or other professional is most appropriate.

Those who fall into the low risk category can usually begin exercising, however if there are any particular concerns, the PT should proceed with caution and discuss a potential referral to ascertain whether this is required.

## Fitness assessments

The purpose of testing physical fitness is to establish a client's physical fitness profile. Each test allows the PT to assess a specific component of physical fitness and record the client's strengths and weaknesses. Data from specific tests is assessed against standard reference tables for each component. Current fitness baselines are then established and used to write a specific exercise programme.



Physical fitness tests include:

- Power:
  - Vertical jump (VJ).
  - Standing broad jump (SBJ).
- Cardiorespiratory:
  - Balke treadmill.
  - Multistage fitness test.
  - Cooper 1.5-mile run.
  - Cooper 3-mile walk.
  - Queens College step.
  - Other ergometer tests.
- Muscular strength and endurance:
  - Sit-up or curl-up.
  - Back extension.
  - Repetition maximum tests.
- Specific range of movement (ROM):
  - Soleus and gastrocnemius.
  - Hamstrings.
  - Quadriceps and hip flexors.
  - Adductors.
  - Pectoralis major.
  - Latissimus dorsi.

The protocols for a range of fitness tests can be found in section 3 of the PT toolkit.

## Postural assessments

Postural assessment is one of the simplest and most informative assessments that can be completed by a PT. A basic postural assessment can be done statically or dynamically and can even be carried out as the client walks around during sessions.

In order to carry out effective postural assessments, the PT must be able to identify any deviations from neutral posture so they can highlight any areas of dysfunction (tightness, over-activity, weakness or over-lengthened musculature).

Section 4 of the PT toolkit explains the posture points to look out for when performing a postural assessment.

Postural assessment should be carried out by viewing the client from a number of positions. Ideally, in order to get a clear view that is not skewed by perspective, these positions should be square onto the client's body (e.g. anterior view, lateral view, posterior view).

## Selecting the most appropriate tests

All assessments should be carried out based on the needs, goals and capabilities of the client. Some tests may be unsuitable or unsafe for clients (e.g. high-intensity cardiovascular tests for a sedentary client). Other tests may be inappropriate as there is no reason to complete them (e.g. a client who wishes to maintain their health may not require strength tests).

Consideration should also be given to the test order, especially in relation to tests which measure resting levels (e.g. resting heart rate and blood pressure). Resting measurements should be taken first, following a short period of relaxation or seated discussion (e.g. the consultation involves sitting in a relaxed, private area).



Figure 3.2 The VARTEC acronym

The top three points of Figure 3.2 (validity, accuracy and reliability) relate to the overall quality of the test and the quality of information it would provide. The bottom three points (time, equipment and cost) relate to the resources required to perform the test and whether the test would be practical and viable in the individual circumstances of the PT, client or facility.

The findings of the VARTEC analysis can then be used to decide whether the assessment or test selected is the most appropriate. A PT may decide to use a validated, recognised test or they may decide to design their own test based on the individual requirements of the client (e.g. if a client is preparing to complete a 5km fun run, a 5km test which assesses the time taken to run that distance may be most appropriate). Whichever approach is taken, the PT should ensure that the information provided by the assessment is meaningful and helps to inform the programming or highlight the actual achievements of the client.

Other factors that help to ensure the appropriate assessments and protocols are selected and used include:

- Recording the selected assessments and their protocols clearly and accurately (including any adaptations made for the individual) so that the tests can be recreated reliably at a later date.
- Always following a clear protocol and measurement procedure to record any distances/times accurately so any results can be compared from assessment to assessment.
- Evaluation of the information gathered to ascertain whether the test was meaningful following every assessment session (if the test was of little or no value, the PT should consider whether to reassess using this method).
- Continuous adaptation of the assessments completed to ensure maximum specificity to the client (e.g. if a client has completed a Cooper walk test for a few months but their fitness has now developed, the PT may want to change to performing the Cooper run test to elicit more applicable results).

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Review a health screening form and explain the importance of each question and the types of relevant information that may be revealed.
- Using sections 2, 3 and 4 of the PT toolkit, carry out a range of assessments and evaluate the testing protocols and results.
- Identify clients who would benefit from each test.
- Identify clients who would not benefit from each test.

# Section 4: Using technology to encourage positive health and fitness behaviours

The definition of technology is ‘the application of scientific knowledge for practical purposes’ (Oxford Dictionaries, ND). The health and fitness industry has embraced the development and usage of technology, both for performance and health benefits. Examples of uses of technology in health and fitness include:

- Monitoring the activity and status of an individual (e.g. heart rate monitors, activity monitors, blood pressure monitors, wearable technologies including watches and monitors embedded within clothing).
- Improving our understanding of the human body and performance (e.g. by tracking individuals in a team, which has improved our understanding of the mechanics and stresses placed on each individual. This means they can be trained more specifically and effectively).
- Comparing technique and performance over time (e.g. video analysis and comparison tools).
- Analysing athletic or sports performance (e.g. motion tracking and recording the miles covered by each player in a football match).
- Improving the performance and comfort of the participant (e.g. footwear designs to improve foot safety, comfort or mobility).
- Allowing sports participation in unnatural environments (e.g. virtual reality golf and artificial ski slopes).
- Improving surface quality by reducing impact and abnormal stresses (e.g. sprung floors in exercise studios and 4G pitches).
- Preventing or reducing injury (e.g. footwear technology to promote improved gait patterns).
- Promoting rehabilitation and recovery (e.g. proprioceptive technologies to promote holistic recovery of the nervous system as well as the muscular and skeletal systems).
- Prolonging careers of elite performers (e.g. by improving boxing glove and safety equipment design, boxers are more able to withstand the impacts and their careers can be prolonged).
- Promoting physical activity (e.g. motion-sensitive consoles, wearable technology or phone apps).
- Providing evidence of training completed (e.g. GPS trackers within phone apps and wearable technology that provide an accurate training diary).



Clients are choosing to incorporate technology into their exercise and physical activity regimes more and more, so it is essential for the PT to welcome this advance and integrate technology into their sessions.

PTs can use the information provided by new technology to:

- Compare reliable assessment data without having to take another test. For example, a heart rate monitor on a watch can provide a regular measurement of resting pulse before a client gets up in the morning. This should provide a comparably accurate result that can be easily monitored by the client and trainer.\*
- Demonstrate achievements in a manner that is familiar and of interest to the client (e.g. a phone app which triggers a message when targets are achieved).
- Encourage strong support networks and regular motivational interactions. For example, most applications will store or display information in an accessible format and access can be granted to other individuals as required. This allows the PT to set common goals for all clients in a group which can be monitored by the whole group. This could stimulate cooperation, support and competition, as required by the group, and allows the PT to easily monitor group engagement.
- Focus a client on their goals and the methods they have agreed in order to successfully achieve those goals. A range of social media and technological applications can be used to record client goals and programmes. These can be used to monitor adherence and success and they usually facilitate ongoing communication and interaction which can further motivate and provide support.
- Clearly show details of every exercise session (e.g. frequency, intensity, time, type) and allow analysis in graph or chart form which can be easier for a client and PT to interpret (e.g. many programmes provide analysis tools as part of the package; this can be used to great effect if the client is interested and motivated by these results).



The PT should ensure that any collection, storage or usage of data should comply with the Data Protection Act, 1998 as well as adhering to ethical and professional standards.

If a client allows access to a source of information that they manage, a PT must ensure that passwords and access details are kept confidential and secure.



\*Although new technologies can provide accurate results, the PT must consider the actual accuracy and reliability levels of the individual piece of technology – some are likely to provide a rough guide at best.

A critical evaluation of the piece of technology, any research carried out to test the technology and validations from industry experts can help to identify accuracy. If accuracy cannot be officially clarified then a PT can use their expertise to assess and analyse the results provided. If a piece of technology can provide a rough guide of status or performance and this is sufficient for the client then this may still be an appropriate piece of equipment to use.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Research health and fitness technologies and identify at least three you would find useful when working with clients as a PT.
- Evaluate each technology to highlight key points, uses and potential contraindications.

# References

- Active IQ. (2015). *Behaviour Change for Health and Wellbeing*. Huntingdon: Active IQ.
- Critical Appraisal Skills Programme. (ND). CASP Checklists [online]. Available at: <http://www.casp-uk.net/#!checklists/cb36> [Accessed 24 August 2016].
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, vol.125, pp.627 668.
- Heyward, V.H. and Gibson, A.L. (2014). *Advanced Fitness Assessment and Exercise Prescription*. 7th edition. Champaign, Illinois: Human Kinetics.
- Kerr, L., Wilkerson, S., Bandy, W.D. and Ishee, J. (1994). Reliability and Validity of Skinfold Measurements of Trained Versus Untrained Testers. *Isokinetics and Exercise Science Journal*, vol. 4 (4), pp.137-140.
- Kincaid, J.W. (2002). *Customer Relationship Management Getting it Right*. New Jersey: The Hewlett Packard Company, Professional books.
- Mason, P. and Butler, C.C. (2010). *Health Behavior Change*. 2nd edition. London: Churchill Livingstone, Elsevier.
- Michie, S. et al. (2011). The Behaviour Change Wheel: A new method for characterising and designing behaviour change interventions. *Implement Sci*. DOI: 10.1186/1748-5908-6-42. [Online] Available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096582/> [Accessed 23 August 2016].
- Michie, S. et al. (2014a). *ABC of Behaviour Change Theories*. London: Silverback Publishing.
- Michie, S. et al. (2014b). *The Behaviour Change Wheel: A Guide to Designing Interventions*. London: Silverback Publishing.
- Miller, W.R. and Rollnick, S. (2013). *Motivational Interviewing*. 3rd edition. New York: The Guilford Press.
- O'Rourke, J. and Collins, S. (2009). *Interpersonal Communication: Listening and Responding*. 2nd edition. Mason, OH: South-Western Cengage Learning.
- Ortiz, R. (2010). *The Active Listener*. Lulu Enterprises Inc.
- Oxford Dictionaries. (ND). [Online] Available at: <http://www.oxforddictionaries.com/> [Accessed 26 August 2016].
- Prochaska, J.O. and Diclemente, C.C. (1983). Stages of self-change of smoking: toward an integrative model of change. *Journal of Consultant Clinical Psychology*, vol. 51(3), pp.390-395.
- Prochaska J.O., Velicer W.F., Rossi J. S., et al. (1994). Stages of change and decisional balance for twelve problem behaviours. *Health Psychology*, vol. 13, pp.39-46.
- Prochaska, J.O. and Velicer, W.F. (1997). The transtheoretical model of health behaviour change. *American Journal of Health Promotion*, vol. 12(1), pp.38-48.
- Rosenstock, I.M. et al. (1988). Social Learning Theory and the Health Belief Model. *Health Education Behaviour*, vol. 15(2), pp.175-183.
- Visscher, T.L.S., Molarius, A., van der Kuip, D., Hofman, A. and Witteman, J.C.M. (2001). A comparison of body mass index, waist-hip ratio and waist circumference as predictors of all-cause mortality among the elderly: the Rotterdam study. *International Journal of Obesity and Related Metabolic Disorders*, vol. 25(11), pp.1730-1736.
- Weinberg, R.S. and Gould, D. (2015). *Foundations of Sport and Exercise Psychology*. 6th edition. Champaign, Illinois: Human Kinetics.
- World Health Organization. (2003). World Health Report 2002. Geneva: WHO.
- World Health Organization. (2010). Global Recommendations on Physical Activity for Health [online]. Available at: <http://www.who.int/dietphysicalactivity/publications/9789241599979/en/index.html> [Accessed 17 November 2014].



# Programme design and delivery for personal training

## Aim

To be able to devise safe and effective progressive personal training sessions, for a range of different clients, by working within their scope of practice and applying the principles of programme design.

## Learning outcomes

At the end of this unit, you will:

- Understand the principles of safe and effective personal training programme design.
- Understand the principles of periodisation and how they can be used effectively to meet client goals and needs.
- Know how to safely and effectively integrate alternative environments into personal training sessions.
- Know the considerations for planning and delivering group personal training sessions.
- Understand the scope and professional boundaries of personal training pre and postnatal women.
- Understand the scope and professional boundaries of personal training older adults.
- Be able to design safe and effective personal training programmes and session plans.
- Be able to provide a session introduction that prepares the client for exercise.
- Be able to instruct safe and effective exercise technique.
- Be able to monitor a client during exercise sessions.
- Be able to provide motivation and encouragement.
- Be able to monitor client progress and adapt the programme accordingly.
- Be able to review client progress and satisfaction.

# Introduction

Personal trainers (PTs), whether working in fitness facilities or other environments, will come into contact with many different types of people with different needs, wants and goals. This is why it's essential that PTs understand their scope of practice, so they not only design safe and effective programmes that progress clients towards their goals, but they also know when to refer clients to a more appropriate professional (e.g. pre and postnatal specialist, older adult specialist, medical professional, physiotherapist or sports therapist).

This unit will review the knowledge and skills required for a PT to safely and effectively design and deliver progressive exercise to a range of healthy adults, including individual and group training in traditional and alternative exercise environments.

# Section 1: The principles of programme design

## Exercise guidelines

Physical inactivity is the 4th leading risk factor for global mortality (World Health Organization, 2010) and it is responsible for 1 in 6 deaths in the UK (Public Health England (PHE), 2014). There is a clear evidence-based link between regular physical activity participation and a wide range of positive health outcomes, including:

- Improved cardiorespiratory health.
- Reduced risk of coronary heart disease (CHD).
- Reduced risk of stroke.
- Reduced risk of hypertension.
- Reduced risk and severity of respiratory conditions (e.g. asthma and chronic obstructive pulmonary disease (COPD)).
- Improved metabolic health.
- Reduced risk of developing type 2 diabetes and obesity.
- Improved musculoskeletal health.
- Reduced risk of osteoporosis.
- Reduced risk of certain cancers (e.g. breast and colon cancer).
- Improved functional health and reduced risk of falls.
- Improved mental health.
- Reduced risk of depression.

(World Health Organization, 2010; ACSM, 2011)

Increasing physical activity levels is therefore a key focus of both the World Health Organization (WHO) and healthcare organisations in each of its member states (e.g. Public Health England).

PTs can play a significant role in increasing physical activity levels in their local communities. Advocating regular participation and adherence, and encouraging client engagement, must be main concerns for any PT. Whenever working with a client, the first priority must be to facilitate the regular achievement of the minimum guidelines for physical activity for health and wellbeing (see Table 1.1).

### Minimum physical activity guidelines for apparently healthy adults (18-64 years)

To perform:

- At least 150 minutes of moderate-intensity aerobic physical activity per week OR
- 75 minutes of vigorous-intensity aerobic physical activity per week OR
- An equivalent combination of moderate- and vigorous-intensity activity per week.
- Muscular strength or endurance exercises, using all major muscles, on at least two occasions per week.

To attempt to minimise the amount of time spent sitting and being sedentary as much as possible.

### Considerations

- 30 minutes of moderate-intensity activity completed 5 days a week will ensure achievement of the 150-minute target.
- Aerobic activity should be performed in bouts of at least 10 minutes where possible (extremely deconditioned individuals will still benefit from shorter sessions, but they should build up to be able to complete at least 10 minutes of continuous aerobic activity).
- Untrained clients may achieve benefits from lower intensities and shorter duration sessions.
- Additional health benefits can be gained by increasing duration of activity to 300 minutes (moderate-intensity) or 150 minutes (vigorous-intensity).
- Beginners and previously sedentary individuals should begin to exercise at a moderate level and gradually progress to minimise the risk of increased musculoskeletal injury.

### Additional considerations for adults 65 years and above

- Exercises to enhance balance and reduce the risk of falls should be performed on at least three occasions per week.
- When health and medical considerations prevent the achievement of the minimum amounts of physical activity, individuals should be as active as abilities and conditions allow.

### Exercise recommendations to achieve specific goals

#### Increased endurance, hypertrophy, strength, power and neuromuscular efficiency

<b>Frequency</b>	<ul style="list-style-type: none"> <li>• Work each major muscle 2-3 days per week.</li> </ul>
<b>Intensity</b>	<p><b>Strength</b></p> <ul style="list-style-type: none"> <li>• Beginner to intermediate clients – 60-70% of 1 repetition maximum (1RM).</li> <li>• Experienced clients – ≥80% 1RM.</li> <li>• Older adults and the previously sedentary – 40-50% 1RM.</li> </ul> <p><b>Endurance</b></p> <ul style="list-style-type: none"> <li>• ≤50% 1RM.</li> </ul>
<b>Type</b>	<ul style="list-style-type: none"> <li>• A variety of resistance exercises using a range of equipment and/or body weight.</li> </ul>
<b>Repetitions (reps)</b>	<ul style="list-style-type: none"> <li>• 8-12 reps for most adults wanting to develop strength.</li> <li>• 10-15 reps may be beneficial for older adults and the previously sedentary.</li> <li>• 15-20 reps for most adults wanting to develop endurance.</li> </ul>
<b>Sets</b>	<ul style="list-style-type: none"> <li>• 2-4 sets for most adults.</li> <li>• 1 set can be effective for older adults and the previously sedentary.</li> </ul>
<b>Rest</b>	<ul style="list-style-type: none"> <li>• 2-3 minutes between sets.</li> <li>• ≥48 hours between sessions for a particular muscle group.</li> </ul>

#### Increased flexibility

<b>Frequency</b>	<ul style="list-style-type: none"> <li>• ≥2-3 days per week.</li> </ul>
<b>Intensity</b>	<ul style="list-style-type: none"> <li>• To the point of stretch, tightness and slight discomfort.</li> </ul>
<b>Type</b>	<ul style="list-style-type: none"> <li>• Static (active or passive), dynamic and advanced methods are each effective in their appropriate contexts.</li> </ul>
<b>Volume</b>	<ul style="list-style-type: none"> <li>• A target of 60 seconds of total stretching time for each muscle group stretched.</li> </ul>

Table 1.1 Physical activity and exercise guidelines (ACSM, 2011; WHO, 2010; ACSM, 2014a; PHE, 2014)

When working with beginners, or those who find exercise and activity adherence challenging, a PT must be prepared to facilitate activity that ensures the client at least meets the minimum requirements. This may mean balancing physiological adaptations and progressions with factors that increase the likelihood of adherence (e.g. motivators and enjoyment).

Once a client has built a strong exercise habit which enables them to meet the minimum guidelines for health, other physiological, aesthetic or performance goals can be introduced as required.

It is essential for a PT to remember that a client cannot progress and reach their exercise- and activity-related goals if they do not continue to take part in exercise and activity.

For those who have a strong exercise habit, setting SMART (specific, measurable, achievable, realistic/relevant and time-bound) goals and targets and applying the relevant training principles and variables to programmes will help to ensure progression.

There is an inverse relationship between the intensity and volume of training required to elicit different physiological benefits (cardiovascular and muscular). For example:

- A training programme designed to develop maximal strength would utilise a higher intensity and a lower volume.
- A programme designed to develop muscular endurance would utilise a lower intensity and higher volume.
- A programme to develop cardiovascular (CV) endurance would utilise a low-intensity approach and a long duration/high volume.
- A programme to develop maximal speed would utilise a high intensity and short duration/volume.

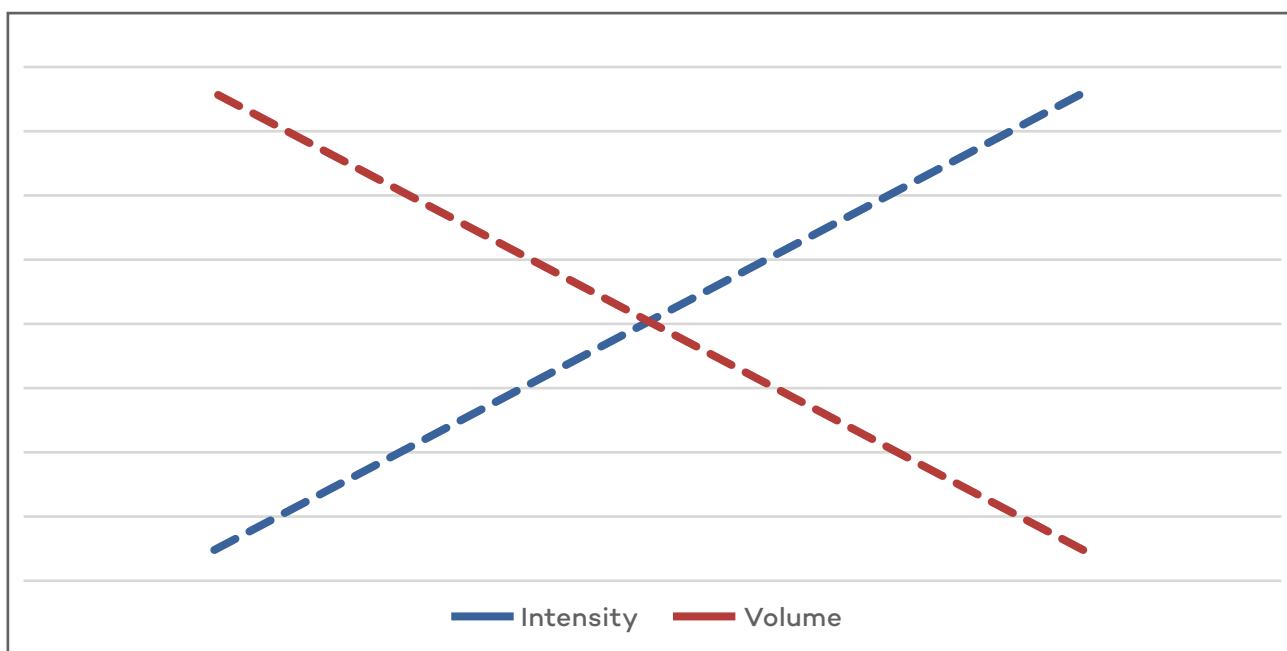


Figure 1.1 Inverse volume/intensity relationship

	Training goal		
	Strength	Hypertrophy	Endurance
<b>Intensity</b>	High.	Moderate.	Low.
<b>Load as % of 1RM</b>	>85%	67-85%	<67%
<b>Reps</b>	1-5	6-12	12-20
<b>Recovery</b>	3-5 minutes.	1-2 minutes.	0-60 seconds.
<b>Sets per exercise</b>	2-6	3-6	2-3 (1 set may be appropriate for a beginner or older adult).

Adapted from Baechle et al., 2000.

Table 1.2 Recommended reps and sets to achieve main training objectives

## Programming to minimise injury and optimise recovery

PHE (2014) recommends that individuals perform activity on a daily basis, although it is also important that sufficient rest is included in any progressive programme to minimise the risk of overtraining. Overtraining is essentially a reversal of any benefits of exercise, and it occurs when an individual does not rest and recover sufficiently.

Signs and symptoms of overtraining include:

- Reduced performance.
- Loss of coordination.
- Reduced ability to concentrate.
- Irritability, hypersensitivity and mood changes.
- Disrupted sleep patterns, lethargy and fatigue.
- Increased susceptibility to colds and illness.

As can be seen from the guidelines in Table 1.1, it is recommended that at least two days should be allowed between muscular strength, endurance or power training. Allowance for sufficient rest will optimise recovery and adaptation whilst minimising the risk of overtraining and injury.

PTs also need to consider specific weaknesses and injury risks presented by an individual client. By incorporating exercises that address weaknesses and risks whilst developing and progressing clients towards their goals, a PT can help to minimise the risk of future injury whilst maximising progression.

Including a range of specific functional skill-related exercises to increase balance, coordination, agility, speed, power and reaction time within programmes can help clients meet the demands of their daily lives. This would minimise the risk of injuries being caused by instinctive reactions to demands. For example, a client who takes part in multi-planar balance and agility training is more likely to be able to withstand the physical demands of changing direction when playing tennis, or even when manoeuvring around other people on a busy high street.

Ongoing subjective and objective evaluation and review of the client's programme, performance and progression can also help to maximise physiological adaptations whilst minimising the risk of injury. Reviewing a client's status before, during and after sessions may help the PT identify areas of individual risk.

### Example

A client is following a programme designed to achieve a perfect balance of exercise and rest, but during a review, they explain they are feeling lethargic and have a cold they can't shake off. The client is working on the tenth floor of an office building on Tuesdays and Fridays each week. The building's lift has broken down, so the client is having to walk up and down the stairs at least ten times each day they are in the office. The PT identifies that the client completes heavy legs sessions on Mondays and Thursdays. By readjusting the programme so the client performs one heavy legs session on a Saturday, or Sunday, the PT is able to reduce the risk of illness and injury and reverse the negative symptoms of overtraining that the client was experiencing.

## Training methods and techniques

When designing exercise programmes for individual clients it is essential that the methods selected are appropriate to progress the client towards their individual goals. There is a vast array of training methods that can be used to design programmes and more methods are being developed on a daily basis.

What is key, when considering the methods to use with a particular client, is whether they can perform the exercises with safe and effective technique. Progressions must be measured and controlled, and new methods, exercises and techniques introduced at a pace that is appropriate for the individual.

In order to plan and progress effectively, a PT needs to be able to evaluate the needs, wants, goals and abilities of the client in order to identify the best exercises, techniques and methods to address those needs, wants and goals in a safe and effective manner.

To evaluate methods and techniques effectively, a PT will need to understand the purpose, benefits, risks and requirements of each method. Some methods are extremely versatile and variables can be manipulated to adapt the benefits to suit certain goals, whilst other methods focus on the development of one component of fitness.

Due to the wide variety of methods available, it is impossible, in the context of this manual, to cover all the individual methods, variations, applications and adaptations that are commonly used to develop specific components of health and fitness. The following sections provide information on the foundation methods upon which many variations have been based and offer examples of their applications and adaptations.

## Resistance training methods

### Basic sets

Basic sets form the basis of most resistance workouts. They can be described as a group of a certain number of reps performed with a given weight a given number of times.

- **Single sets** – Beginners and previously sedentary older adults have been shown to benefit from performing a single set of 10-15 reps of a range of exercises. A basic single-set programme would usually take a whole-body approach, training all major muscle groups once.
- **Multiple sets** – Multiple sets of an exercise are performed with a given weight (e.g. 3 sets of 10 reps or 5 sets of 5 reps).

Basic sets can be easily altered to develop different types of fitness by manipulating the variables of each exercise or workout. For example, a workout with a low number of reps and a high number of sets would tend to develop hypertrophy and strength; the opposite would train muscular endurance. A workout including a large amount of isolated exercises would focus on **intramuscular** coordination (coordination of contractions within an individual muscle or group). In contrast, a workout including a large amount of compound exercises would focus on **intermuscular** coordination (coordination of contractions across muscle groups).

### Pyramids and wave loading

Pyramid training methods involve the manipulation of intensity and volume over the course of multiple sets of the same exercise. At its most basic, a pyramid involves increasing or decreasing the load as the reps decrease or increase respectively.

Pyramid training lends itself to the development of muscular strength (or hypertrophy), although if resistance exercises are replaced with CV options, it is possible to create a CV pyramid (using percentage of maximum heart rate (%MHR), rate of perceived exertion (RPE) or speed as the intensity variable and time as the volume variable).

There are four ways to perform a pyramid:

- **Ascending pyramid** – The first set is performed at a low intensity and the intensity of each successive set increases as the volume decreases.
- **Descending pyramid** – The first set is performed at a high intensity and the intensity of each successive set decreases as the volume increases.
- **Complete pyramids** – A combination of ascending and descending pyramids; the client builds and reduces intensity and volume to complete enough sets so that they both ascend and descend.
- **Skewed pyramids** – This type of pyramid is essentially an ascending pyramid with one final descending set completed at the end to maximise the effects.

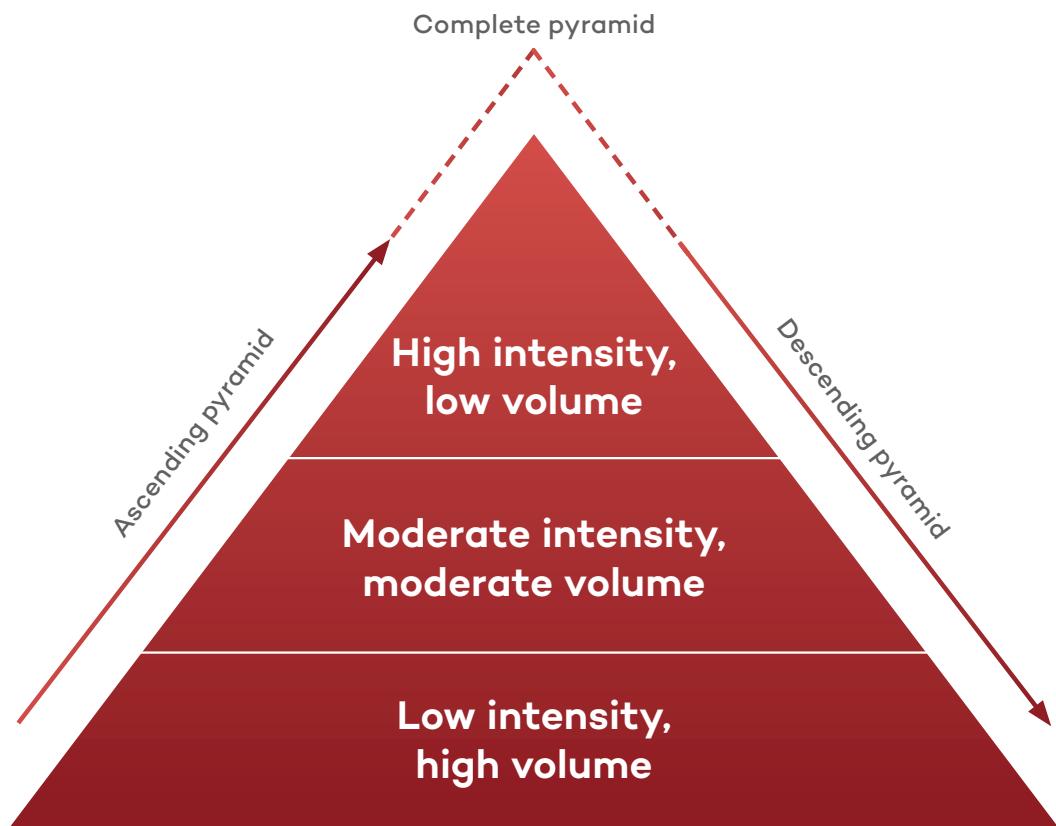


Figure 1.2 Pyramid training method

Wave loading is a method which includes two or three small complete pyramids. The first set begins at the lowest intensity and the next set is performed at an increased intensity. Each set after this then ascends and descends in turn, creating a wave pattern. Wave loading can be thought of as the resistance training equivalent of CV intervals.

Pyramids and wave loading are very intense methods of training and can often result in significant fatigue or even failure. As clients become fatigued there is a risk that technique will be affected, and this may increase the risk of injury. It should therefore be a key consideration of any PT when using this method that the client is:

- Experienced enough to recognise any negative effects on technique (or the method should be used during supervised PT sessions only).
- Supported and spotted sufficiently to ensure safety throughout.

### **Supersets**

Superset methods traditionally involve the performance of two different resistance exercises back-to-back with little or no rest inbetween. Supersets have also traditionally incorporated resistance exercises and have been designed to develop hypertrophy or muscular strength.

As fitness concepts have developed, so have supersets, and it is now common to see the incorporation of functional and CV exercises that are used to meet wider physiological and performance goals. In addition, where traditional supersets involved the completion of similar reps at similar intensities, more functional applications have seen the variables adapt to address the required goals. For example, if the first exercise in the superset is a strength exercise there may be 5 reps performed at 90% 1RM and the following muscular endurance exercise may require 15 reps at 60% 1RM. It may also be appropriate to have one exercise of the superset using reps and one that is timed.

There are many variations of traditional supersets that fall into the following subcategories:

#### **Antagonistic supersets**

Antagonistic supersets involve the completion of two exercises for opposing muscle groups back-to-back. For example, a press-up could be supersetted with a pull-up to work the pectorals and triceps followed by the latissimus dorsi and biceps.

This type of superset lends itself to resistance training as each opposing muscle group should be worked in a similar manner to maintain balance between exercises.

## Agonistic supersets

Agonistic supersets involve the completion of two exercises for the same muscle group back-to-back. For example, a press-up combined with a bench press.

This type of superset is extremely versatile and can be used to develop endurance, hypertrophy or strength. It can also be effective when looking to develop functional abilities (e.g. balance, coordination or power). For example, a bodyweight squat combined with a single-leg squat can help to develop strength, balance and endurance in one simple combination. In contrast, a heavy back squat combined with a jumping squat can help to develop strength and speed (strength x speed = power).

## Pre-exhaust and post-exhaust variations

Pre- and post-exhaust variations of the agonistic superset training method involve the fatiguing of key muscle groups before (or after) an exercise in an attempt to create increased overload in the targeted muscle.

**Pre-exhaust** – An isolated exercise is performed before a compound exercise (e.g. a pec flye is performed before a press-up).

**Post-exhaust** – A compound exercise is performed before an isolated exercise (e.g. a press-up is performed before a pec flye).

## Tri and giant set variations

Tri and giant sets are often considered advanced techniques as they require the completion of three (tri-sets) or four plus (giant sets) exercises that work the same muscle groups back-to-back. For example, a tri-set to work the latissimus dorsi muscle could include a bent-over row, a prone flye and a pull-up. A giant set could also include an additional cable row and/or lat pull-down.

The key to performing any of the superset variations is effective planning. In order to make sure that a client can perform the exercises back-to-back with as little rest as possible, the equipment must be prepared and ready for swift change-overs. If one piece of equipment is in one area of the gym and the other equipment is in another, it is unlikely that the client will be able to perform the exercises in this continuous manner.

It is also essential for a PT to consider the abilities of the client and whether they would be able to perform the latter exercises safely and effectively without technique being compromised. If there is a risk that technique may slip from set to set then the PT must be prepared to adapt their planning accordingly (e.g. reduce the complexity or intensity of the latter exercises).

## Drop sets

Drop sets are a method of hypertrophy or strength training designed to allow a client to continue a set past the point where failure would usually stop performance of any further reps. This method involves performing an exercise to failure, then removing a small percentage (5-20%) of the load (often with assistance) to allow the performance of another 2-3 reps. This 'drop' in load can be repeated up to three times.

This method is also known as 'strip sets' when performed with plate-loaded weights because the plates are stripped from the rack to 'drop' the load.

Key considerations for this training method include:

- The initial set must be performed to failure and the load must ensure that failure occurs within the appropriate rep range for strength or hypertrophy.
- The 'drop' in load must be sufficient to allow continuation but minimal enough to elicit failure again within the planned 2-3 reps.
- There should be no rest between reps for the whole of the drop set.
- This method of training is extremely demanding because it extends a set beyond normal concentric failure limits. This method should be used sparingly and with caution to ensure maximum progression combined with minimum risk of plateau, burnout or injury.

## Partial reps

Partial (or limited range of motion) reps can have useful applications at either end of the intensity scale for very different reasons:

- Bodybuilders who are attempting to maximise the size of their muscles often utilise partial reps to allow loading above what they could usually achieve when performing a full range of motion movement. This is due to the fact that a muscle can apply maximal force in its central range of motion, but as the muscle reaches its end of ranges, the force it can generate is reduced. An added (often accidental) consequence of this training method is that, if overused, or if the programme does not include appropriate flexibility exercises, the muscle will begin to adaptively shorten to the new functional range. This can significantly reduce range of motion over time.
- Clients who cannot perform an exercise with safe and effective technique due to mechanical or movement limitations can use partial reps to develop their technique and range of motion over time. This type of partial rep is often performed at an endurance intensity and rep range, and the focus of each set is to develop range over time.

Manipulation of range of motion is also often used to reduce the effects of momentum, increase the force required to overcome inertia, and change the force profile and time under tension. This can be used to increase the feelings of muscle fatigue, to introduce variety into an exercise and to prepare the body to respond to different muscular demands, therefore (in principle) maximising adaptation.

One commonly used method of performing partial reps is to break the full range of motion into several stages (usually three: the top range, bottom range and full range). This type of training is sometimes called a ‘matrix’. PTs will need to consider the volume of training included in one matrix. For every set, the client will have significantly increased the time under tension (volume) of training as they are having to perform three ranges per set (e.g. 7 reps of each range = 21 total reps). This means that a lighter load than normal should be used for each exercise and the focus is likely to be on developing muscular endurance rather than strength or hypertrophy.



## Forced reps

Forced reps are a type of resistance training where a client performs as many reps of an exercise as possible, and once they reach failure, a PT or spotter helps them lift the last 2-4 reps before terminating the set.

This training method is often used to develop hypertrophy or strength, with sets including high loads and low numbers of reps and only one or two additional forced reps. To ensure this method elicits maximum benefits, it is essential that the PT/spotter only provides minimal assistance for the ‘forced’ reps. If the PT/spotter is having to apply too much assistance then the load is too great or the set has been extended too far beyond failure.

## Negative reps

Negative reps are used to develop hypertrophy and strength and can be performed in one of two ways, both requiring the assistance of a PT/spotter.

The pure form of negative training is more high-risk and less commonly used. The client performs a warm-up set of an exercise before a supramaximal load is placed on the bar. Typically, a load of 105% is used, just above the lifter's 1RM. This means it is not possible for the lifter to raise the bar on their own and they depend on the spotter to help them perform the concentric phase of the lift.

The spotter then maintains controlled contact with the bar, because despite pushing as hard as possible, the weight will inevitably move through the lowering phase of the movement. Due to the supramaximal load, it is unlikely that this method will result in any more than three repetitions.

As the forces exerted are greater than the body is used to, the PT must be aware of the increased risk of injury and must ensure that safety measures are taken to prevent unnecessary risk.

The alternative application of negative reps is when they are used in combination with forced reps. In this combined approach, the client performs a set of an exercise until they reach failure. Once failure is achieved, the PT/spotter then assists the client with the concentric lifting phase only. The spotter/PT then maintains controlled contact with the bar, but provides no assistance during the eccentric phase of the exercise. This method of performing negative reps is safer, but the PT must still be aware and take action to minimise any negative outcomes caused by the increased risk relative to submaximal training methods.

### **Cluster sets**

Cluster sets (also known as ‘pause training’) is a method that is used to develop maximal performance. Clusters are often used to develop hypertrophy or maximal strength, however it is thought that these sets are most effective for developing power.

This method of training is designed to minimise loss of technique and performance during maximal sets by including short rests (pauses of up to 30 seconds) between reps. This means that a client can work at a higher intensity than they usually would for a traditional set.

## **Cardiovascular training methods**

### **Continuous training**

#### **Steady state**

Steady state training is the simplest form of CV training. It involves a client working at a steady low-to-moderate intensity (60-90% MHR) for 20-60 minutes.

This type of training is often used to introduce beginners to CV exercise as it can help to develop a foundation of aerobic endurance. This approach does need to be carefully considered, however, as 20 minutes on one piece of CV equipment can be boring and demotivating. In these circumstances it may be beneficial to consider including aerobic activities that are enjoyable for the client (e.g. walking in the park or cycling). This will ensure the benefits and motivators can be maximised and the likelihood of adherence increased.

#### **Long slow distance**

This method of training involves working for long periods of time (usually a minimum of 45-60 minutes) at a low aerobic intensity (less than 70% MHR). This type of training helps to develop a strong aerobic base whilst improving the body’s ability to utilise fat as an energy substrate.

This type of training requires a lot of time and patience, so it is best used with clients who are training for specific endurance performance reasons.

### **Tempo training**

Tempo training is most effectively used when preparing for an endurance event or race. It involves the client working at (or around) the lactate thresholds (OBLA and MLSS) or at a level which is at (or just above) race pace.

This method of training can either be steady state (e.g. a client completes a session which is slightly shorter in duration than an actual race at a slightly higher intensity) or it can include intervals (e.g. the intervals cycle above and below the threshold to apply stress and allow recovery of the system in a cyclical fashion).

Tempo sessions are designed to increase the maximal steady rate of the client so they can maintain their pace throughout the course of a race or event.

### **Interval training**

Interval training involves periods of work and recovery. There are two main types of intervals:

- **Aerobic intervals** involve working slightly above and below the onset of blood lactate accumulation level (OBLA) in long intervals of 3-5 minutes.
- **Anaerobic intervals** involve working at higher intensities than aerobic intervals (above OBLA and often above maximal lactate steady state (MLSS)) and recovering at lower intensities for longer periods.

The lengths of intervals are often described as ratios (e.g. 1:1 is a common work-to-rest ratio for an aerobic interval, whereas 1:3 is a common work-to-rest ratio for anaerobic intervals). The intensity of intervals can be described using MHR or RPE and can be strictly controlled (e.g. using assessments to accurately measure CV fitness and monitoring performance using heart rate monitors) or more loosely implemented (e.g. using RPE and feelings of comfort). The way an interval is planned and implemented should be appropriate to the individual client and their motivators and needs. For example, an elite athlete is likely to require strict control and monitoring, whereas a beginner may just

enjoy the variety offered by interval training and adapting their intervals based on how they feel during the session.

Table 1.3 provides some guidelines for suggested work-to-rest ratios when performing interval training sessions to focus on each of the energy systems.

Training emphasis	Work:Rest ratio
Aerobic.	1: $\frac{1}{2}$ -1:1
Lactate.	1:2-1:4
Creatine phosphate.	1:3-1:6

Table 1.3 Suggested work-to-rest ratio for interval training

Performing interval training with varying work-to-rest intervals can be beneficial for all levels of client (beginner to elite) as it varies the training stimulus. The differentiating factors would be the intensity and the duration of the work and rest intervals. For example, beginners would require a work interval with a lower intensity and rest intervals would be longer. Clients with a higher level of fitness could work at a higher intensity with shorter rest periods.

Intervals can also be manipulated to maximise the effects on performance. For example, a football midfielder who needs to be able to recover quickly during a match will benefit from lactate intervals which include rest periods that are at the lower end of the scale. In contrast, a defender tends to need to be able to perform maximal sprints on sporadic occasions. They could therefore benefit from intervals that include higher intensity work periods combined with longer rest periods.

The type of rest required to recover from each of the interval types will also be variable. Aerobic intervals are likely to include rest periods that are only slightly lower in intensity than the work period (e.g. 80% MHR work: 70% MHR active rest). Maximal intensity creatine phosphate intervals will include maximal work periods combined with periods of complete rest where no activity takes place at all.

The higher the intensity of the work interval, the lower the intensity of the rest interval.

Activity	Aerobic interval		Lactate interval		Creatine phosphate interval	
Number of work intervals	4		8		8	
Work interval	3 minutes.	75-80% MHR.	30 seconds.	85-90% MHR.	10 seconds.	95+% MHR.
Rest interval	3 minutes.	65-70% MHR.	90 seconds.	60-65% MHR.	50 seconds.	Complete rest.
Work:rest ratio	1:1		1:3		1:5	
Total workout time	24 minutes.		16 minutes.		8 minutes.	

Table 1.4 Example intervals

### High-intensity interval training

High-intensity interval training (HIIT) has become very popular over the last few years. This is mainly due to research (ACSM, 2014b) showing that this type of training can yield significant health benefits, including:

- Improved blood pressure and cardiovascular health.
- Increased insulin sensitivity.
- Improved lipid and cholesterol profiles.
- Effective fat loss, with associated maintenance of muscle mass.

HIIT training consists of high-intensity work intervals which are repeated in an ongoing cycle with rest (or active rest) periods. The measure of intensity for HIIT sessions is usually %MHR or RPE, although a range of CV, resistance and functional exercises can be used to achieve these targets.

Intervals are usually time-bound and can last from five seconds to minutes, depending on the session aims and objectives and client abilities. It is essential that rest periods are sufficient in length and differential intensity to ensure effective recovery and to allow the client to repeat the interval as many times as required with safe and effective technique. Sessions can last 20-60 minutes, depending on the goals and requirements of the individual.

HIIT training has been controversial in fitness forums because of its counterintuitive use for those with lifestyle-related conditions (e.g. obesity, type 2 diabetes or hypercholesterolaemia). It is true that performing exercises at high-to-maximal intensities is likely to increase the risk of negative outcomes (e.g. injury or cardiovascular incident). It is therefore the professional obligation of the PT to ensure the benefits outweigh the risks.

Much of the research on this type of training has been carried out in clinical environments with medical professionals on hand to deal with any medical emergencies quickly. A PT who is working in a fitness environment must be additionally cautious when using HIIT and should there be any concern, the appropriate actions should be taken. For example:

- If the client has a medical condition that is outside the remit of the PT, medical advice and guidance should be sought by the client before proceeding with this training method.
- If the client is apparently healthy but the PT has other concerns (e.g. the client is a sedentary beginner), then the intensity and/or time/volume of the high-intensity intervals must be limited to allow the client to perform the work safely, effectively and with proper technique.
- Rest intervals must be manipulated to maximise effectiveness and minimise negative outcomes, including potential drop out (e.g. DOMS could increase in those not used to this type of training so there may be a need to limit the frequency until familiarity is developed).

### **Tabata**

Tabata is a variation of HIIT which was first introduced by Dr Tabata in 1996. The method consists of 7-8 maximal intensity intervals of 20 seconds with a 10-second rest between each interval.

Tabata training has grown in popularity due to its short duration and reported physiological benefits (as described in HIIT above). Many types of exercise are now incorporated into Tabata sessions, some which would be considered resistance-focussed and some CV-focussed. However, the emphasis on time intervals and maximum effort means that this method has a significant effect on heart rate, irrespective of the individual exercises selected – as such, Tabata should be considered a CV-focussed training method which is a structured variation of HIIT. A PT who considers using Tabata should be mindful of the risks and take precautions similar to those described in the HIIT section above.

### **Fartlek training**

Fartlek is a Swedish term that means ‘speed play’. It is a type of interval training which has a less rigid structure than traditional intervals. This does not mean that fartlek training is unplanned. A fartlek session will still have planned aims and objectives and it may also have planned intervals (although it can be modified during the session in response to a client’s performance).

Examples of fartlek training include:

- A fun, unstructured cardiovascular session held in a park. Intervals are planned around natural obstacles and features. For example, a client may be required to sprint up and walk down each hill for the first half of the session and then do the opposite for the remaining half of the session.
- A planned, highly structured session designed to help a tennis player respond to the unknown demands of a match. For example, the intervals may include very high intensity multi-planar plyometrics and agility drills. The rest intervals may also vary, involving some short and some longer intervals.

## **Versatile training methods**

### **Circuits**

Circuits can be described as a series of exercises performed consecutively with little or no rest inbetween. This method of training has traditionally been used for muscular endurance development, however circuits are now used for many reasons and in many circumstances. This is due to the versatility of the training method. For example, a combination circuit could easily include both CV and resistance exercises.

A circuit training approach can be very accessible to beginners and those who are not familiar or comfortable with more complex methods. Circuits also work well with small groups of clients as each client can either perform a different exercise at the same time, or they can all perform the same exercise together (depending on the training environment and equipment available). For example, each client in the group performs a different resistance exercise for the first stage, then the CV exercise planned for stage two of the circuit is performed as a group.

Circuit training can be:

- Vertically loaded – each exercise is performed one after another until the first set is complete, then the second set is completed.
- Horizontally loaded – each exercise is performed for all sets before moving onto the next exercise.
- Timed – each exercise is performed for a specified time period (e.g. 30 seconds).
- Repetition-focussed – each exercise is performed for a specific amount of reps (e.g. 15 reps).

### ***Free running and calisthenics***

Free running and calisthenics have become very popular in recent years.

**Free running** is an inclusive form of Parkour which was developed in the early 2000s. It can be described as a fluid form of running combined with acrobatics that is used to traverse around a particular environment (usually an urban environment).

**Calisthenics** are exercises which usually involve little or no equipment and focus on developing various components of fitness (usually strength and hypertrophy) using bodyweight and natural and urban structures.

Both of these training methods are extremely functional which means they can be manipulated to focus on the development of different components of fitness. Although popular, both these methods of training can be considered technical. It may be possible to incorporate certain basic techniques into a general PT session, however in order to minimise risk, it is essential that a PT is fully trained and familiar with the specific techniques and principles before using them with a client.

### ***Functional training***

Functional training develops a client's ability to cope with the movement demands of their own lifestyle. One example of a functional exercise could be a bodyweight squat performed at a controlled but momentum-building pace which helps a health-related client rise from their chair effectively. Alternatively, a functional exercise for a rugby player could be an explosive, quick, repetitive frontal plane hop which develops the performance of complex dodging movements for competitive matches.

Both of these examples can be defined as functional, but they are unlikely to be functional for the same clients. For example, if the health-related client were to perform the frontal plane hop at the same pace and intensity as the elite rugby player, this exercise is likely to actually reduce function as their ability to maintain good technique would be compromised by the excessive intensity. In contrast, exercises that would challenge the health-related client would be unlikely to improve the rugby player's ability to cope with the imposed demands of an elite rugby match.

The key focus for functional exercises is to train movement patterns and not muscles. A PT should be analysing the functional demands of a client's life in order to identify:

- Movement patterns that are common and important to the client.
- Movement patterns that can be used to balance an imbalance or strengthen a weakness.
- The speed, force, intensity, direction and frequency of common and important movements.

From these findings, the PT can design a progressive programme to improve their client's functional ability.

### ***Functional exercise complexes***

Daily functions rarely utilise isolated, single joint, single muscle group movements.

Even filling a kettle involves the stabilisation of the lower body and core as the upper body rotates to lift the kettle. There is also likely to be some lower body rotation whilst the upper body stabilises the weight (kettle) so the kettle can be filled with water.

Most sporting movements also require muscle activity to stabilise and produce movement at a number of joints simultaneously. For example, a professional footballer who is attempting to perform agile, powerful movements to dodge opposing players will need the upper body, core and lower body musculature to help drive propulsion, change direction, balance and deflect the opposition.

This does not mean that all functional exercises must always involve multiple joints. It may be that a PT will initially include single joint movements which can then be combined to progress to more complex, compound exercises. For example, a client may initially only be able to coordinate sufficiently to effectively perform one or two movement patterns in a complex, but after regular training they may be able to seamlessly coordinate many movements together.

### Example

Squat +



Med ball front raise =



Squat to front raise = Volleyball dig



### Example

Squat +



Bent over row =



Squat to row = Lifting suitcases



### **Multi-planar movements**

Most traditional resistance machines and exercises work predominantly in the sagittal plane (e.g. leg press, chest press and seated row).

Life does not tend to occur in just one plane of motion – it occurs in multiple planes in ever-changing combinations. In order to make exercises functional, a PT must begin to incorporate multiple planes into client programmes.

Because training has previously been dominated by the sagittal plane, even well-trained clients can demonstrate significant weakness when beginning to work in the frontal and transverse planes of motion. A PT must take care to introduce multi-planar exercises into a programme at an appropriate pace and intensity so the client can control each movement whilst progressing safely.

Examples of multi-planar movements include:

### Multi-planar lunges

*Sagittal plane*



*Frontal plane*



*Transverse plane*



### Woodchops

*Cable woodchop*



*Single-leg medicine ball woodchop*



*Reverse cable woodchop*



*Squat with medicine ball reverse woodchop*



## Working at various speeds and intensities

Daily function, whether based around performing daily activities or training for an event or sport, will include working at a range of different speeds and intensities. These functional demands can be addressed by incorporating controlled variety into programmes.

## Flexibility techniques

Flexibility is a combination of passive range of motion and active mobility and it is a key component of fitness that can have a direct effect on all other types of fitness. Any lack of flexibility can affect posture, length-tension relationships and force production and this can in turn impair function and performance.

Adaptive shortening is a key concept to understand when planning flexibility training. Soft tissues have a tendency to adapt to the demands placed upon them. For example, if a muscle is held in a shortened position for a long period of time (e.g. when the hip flexors are shortened by long periods of sitting), it will adaptively shorten. This will also occur as a consequence of training, especially training which does not utilise the full range of motion around a joint.

For this reason, flexibility exercises should be performed at least two to three times per week and before and after a workout.

There are different methods of stretching that can be used to train flexibility. Some methods are designed to maintain, whilst others are designed to develop flexibility and range of motion.

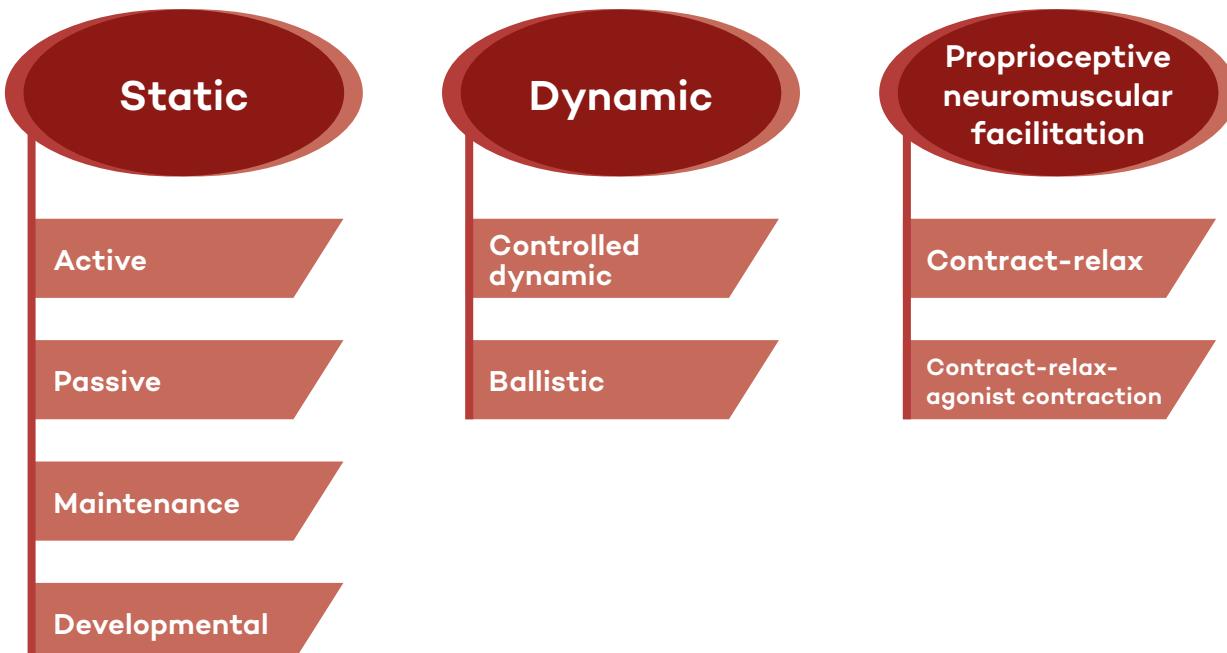


Figure 1.3 Types of stretching



Muscles are thought to have an optimal **length-tension relationship**. This is the relationship between the length of a muscle and the force that fibres can produce at that length.

When a muscle fibre is stretched or shortened, the overlap of actin and myosin is affected. If there is too much or too little overlap it limits the amount of force a contraction of the fibre can produce.

When a muscle is in an optimal position with an optimal length-tension relationship, there will be an optimal overlap of actin and myosin and therefore a maximal force can be produced.


**POINT OF  
INTEREST**

A simple way to work out how to stretch a particular muscle:

Look at the concentric action(s) of a muscle – the reversal of this action will create an effective stretch. For example, the concentric action of the quadriceps is to flex the hip and extend the knee. A quadriceps stretch involves extending the hip and flexing the knee.

Stretches can be performed individually or, to add interest and enjoyment, most stretches can be adapted to utilise partner assistance or support.

Whichever method is selected when programming for a client, the key to effective goal achievement is technique. For example, if the aim is to stretch the hamstrings but as the client flexes at the hip they excessively bend the knee, the hamstring will not be fully stretched.

Key technique points to consider when stretching:

- Ensure that the movement is aiming to move the origin and insertion of a muscle away from one another.
- Do not move into stretches too quickly or the stretch reflex will apply a counteractive contraction. Move into a stretch in a slow and controlled manner to get the best effects.
- Stretches should take the muscle(s) to the point of mild tension only. Overstretching a muscle will again invoke the stretch reflex that applies a counteractive contraction.
- All soft tissue structures can be affected by stretching (muscles, tendons and ligaments).
  - Muscles and tendons will both stretch when lengthened during a normal stretch.
  - Ligaments can be stretched when the joint is opened. This is important to note because if inappropriate forces are applied during stretches, the joint can be weakened.

### **Static stretching**

Static stretches are held without moving for a period of time.

- **Active stretching** – The body part is moved into position and is actively held in a static position using the surrounding musculature (e.g. imagine pulling the toes up so the foot is in dorsiflexion and holding it there).
- **Passive stretching** – The body part is moved into position and held there using a supporting structure such as the floor, a wall, another limb or a partner (e.g. leaning against a wall when performing a pectoral wall stretch).
- **Maintenance stretching** – These are short stretches that are held for 10-15 seconds. Maintenance stretches are designed to maintain the length of soft tissue structures.
- **Developmental stretching** – These stretches are held for a longer period of time and the range of motion should be developed over the course of the stretch. This type of stretch desensitises the muscle spindles because as the tension increases, autogenic inhibition is initiated and the muscle relaxes. This facilitates a small increment in range of motion which can be capitalised upon by taking the stretch further. Developmental stretches should last a total of 60 seconds and 2-4 reps should be carried out in this time (2 x 30-second reps are thought to be most beneficial for the majority of healthy adults, whereas older adults may benefit from 1 rep of 60 seconds).

Static stretches are usually recommended during stand-alone flexibility sessions or during cool-downs, although they may be beneficial for some clients in other circumstances.

## Something extra

It is often quoted that static stretching should not be used in a warm-up (particularly developmental stretching) because it limits performance. Research has shown that long periods of static stretching can inhibit muscle performance and this is thought to be because of the desensitisation of the muscle spindles and the consequential inhibition of the stretch-shortening cycle. For this reason, dynamic stretches are often a more appropriate option for those who wish to perform maximally in their upcoming session.

However, there may be times when a PT will want to develop range of motion or desensitise muscle spindles prior to a workout. For example, a client who has a poor range of motion around a joint may benefit from performing static stretches after a warm-up to help them perform an upcoming exercise with better technique. Beginner clients with poor motor skills may not be able to perform the dynamic movements and as such they too may benefit from static warm-up stretches.

If choosing to use static stretches in a warm-up, a PT must consider the effect on heart rate, tissue temperature, etc.

In general circumstances, a dynamic stretching protocol is probably the best option for a warm-up as it develops the ability to use full range of motion whilst continuing to develop other warm-up benefits. When using static stretches in a warm-up, a PT must be clear about the reasons for these choices and ensure that the warm-up is adapted to counteract the cooling-down effects that will inevitably occur.

## **Dynamic stretching**

Dynamic stretching can be described as controlled movement through full joint ranges of motion so that soft tissues are dynamically moved into stretch positions. Dynamic stretches are effective during warm-ups as they combine flexibility training with continuation of the warm-up and pulse-raising activities.

It is essential that dynamic stretches are performed in a controlled manner and with good technique as it is easy for the effects of stretching to be lost during movements that are too quick or complex. For example, a walking lunge aims to stretch the hip flexors and an upper body rotation aims to stretch the obliques. If a client does not have the motor skills to perform both movements together, when performing a lunge with rotation they are likely to reduce both movements and the stretch will be lost.

## **Ballistic stretching**

Ballistic stretching is a form of dynamic stretching which involves the use of momentum to develop flexibility. This type of stretching was thought to be contraindicated for many years due to the increased risk of injury from the explosive bouncing movements.

Ballistic approaches have now begun to reappear (mainly in elite sporting contexts) as they can be used to mimic and prepare a client for specific explosive movements required in an upcoming activity.

For clients who are not likely to be performing extreme end of range movements in an explosive manner, ballistic stretches are still not recommended as the risks outweigh any potential benefits.

For clients who are going to perform extreme end of range movements in an explosive manner in an upcoming workout or event (e.g. martial arts movements), ballistic stretches could be incorporated into a warm-up. It is essential that a PT uses caution when including ballistic stretches and considers the following:

- Whether there are any other alternatives that may be more beneficial and present less risk. Use ballistic stretches as a last resort and only with strong justification.
- Ensure the client has been fully assessed and reviewed to confirm that this is the best protocol for them.
- Ensure the client is fully aware of the benefits, risks and reasons for the inclusion of this type of stretching and that specific informed consent has been given.
- Ensure the client is fully warmed up before ballistic stretches are performed. It would be wise to include ballistic stretches at the end of a warm-up, after the more controlled dynamic movements have been performed.

### **Proprioceptive neuromuscular facilitation (PNF) stretching**

PNF stretching is a type of assisted stretching which manipulates underlying neuromuscular principles (autogenic inhibition and the inverse stretch reflex) to maximise the effects of a stretch. There are two main types of PNF stretching:

- Contract-relax (also known as PIR or post-isometric relaxation).
- Contract-relax-agonist contraction.

Section 7 of the PT toolkit details the protocol for contract-relax stretching (CR) and contract-relax-agonist contraction stretching (CRAC).

PNF stretching poses increased risk as extra pressure is being applied and ranges of motion are likely to be more extreme than when performing other types of stretching. For this reason, PNF stretching should only be applied to thoroughly warm muscles and by an experienced practitioner.

This type of stretching is completely contraindicated for anyone with weakened, unstable or loose joints (e.g. pregnant women or clients with arthritic conditions) as the risks outweigh the benefits. The PT must also be mindful of technique and joint position at all times.

## **Training variables, progression and regression**

Many different types of fitness can be developed by including a variety of exercises and manipulating variables. The latter can be done by progressing and regressing exercises; this must be considered as a sliding scale or continuum. Small changes in exercise variables, such as lever length and range of motion, can be instrumental in progressing clients towards their goals, even if the client does not notice any changes in the exercise itself.

In most circumstances and when considering each variable in isolation it is easy to identify whether a variable will progress or regress an exercise. For example, increased volume, complexity or lever length and reduced familiarity or rest will create a clear progression. PT toolkit section 5 shows a basic overview of how variables can progress or regress exercises in isolation.

In other circumstances, a PT must consider the abilities of the client, the type of exercise, the other variables that have changed as a consequence of the adaptation and the aims of the exercise and programme in order to identify whether an adaptation progresses or regresses an exercise.

For example:

- It is often considered a progression if range of motion is increased from partial to full. However, a partial range of motion may mean that an increased load is applied which progresses the exercise. When performing a partial range of motion exercise, there is also less opportunity for momentum development so the pace of the exercise may slow, but the combined effect would create a progression.
- Introducing multiple planes of motion into an exercise is often thought of as a progression. When considering this adaptation from a neuromuscular point of view, the complexity has progressed and the exercise is being performed in unfamiliar and weaker planes, but when considering the adaptation from an intensity perspective, multi-planar movements often regress the exercise.
- Speed is an interesting variable; when considered in isolation, an increase in speed requires more force which is a progression. However, an increase in speed is often accompanied by an increase in momentum which would reduce the force required (regression) and increase neuromuscular demand (progression).

A PT should consider the client's goals and ability levels (strengths and weaknesses in relation to each component of fitness) to select the most appropriate exercise, progression or regression for the individual. By also considering the client's preferences in relation to the equipment and environment, a PT can design a programme which not only progresses a client safely and effectively towards their goals, but also increases the likelihood of adherence and success.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- In your own words, explain the recommended exercise guidelines for healthy adults.
- In your own words, describe ways that programmes can be designed to:
  - Minimise injury risk.
  - Optimise recovery.
  - Maximise adaptation.
- Identify training methods and techniques that can be used to develop:
  - Muscular endurance.
  - Hypertrophy.
  - Maximal strength.
  - Cardiovascular fitness.
  - Function.
  - Flexibility.
- For each method or technique identified in the previous question, describe the training protocol.
- Select four exercises. Create a progression/regression continuum for each exercise, considering how it can be progressed and regressed using a range of variables for a range of client goals.
- Observe the exercise technique of friends and family or watch exercise videos online to identify ways to refine technique and improve alignment.

# Section 2: Periodisation

Programme periodisation is defined as: 'The logical and systematic sequencing of training factors in an integrative fashion in order to optimise specific training outcomes at pre-determined time points' (Bompa and Haff, 2009).

## Principles of periodisation

The basic principle of periodisation is to break long-term programming into separate blocks of training. Each block is designed to progress a client towards a specific goal and elicit a specific adaptive response. These blocks are called **phases** or **cycles**.

A periodised programme can be a strictly controlled structure that aims to improve elite competitive sporting performance. In this form, the periodised plan could last a year or more. For example, an athlete who is working towards peak performance at a World Cup or at the Olympics could follow a periodised plan which lasts four years.

Periodised plans can also be useful tools when working with general fitness and health-related clients as they can help to minimise the risk of plateau or exhaustion whilst maximising progression, as well as add variety into a programme to encourage adherence and enjoyment.

## General adaptation syndrome (GAS)

Selye's general adaptation syndrome theory (1984) was initially developed to explain how we cope with life in general, however it has since been used to explain how we respond to and cope with the stresses placed on the body during exercise (Baechle et al., 2000; Bompa and Haff, 2009). This theory also explains why periodisation and variation are necessary within progressive programmes.

GAS – Adaptive responses to a new stimulus/stressor

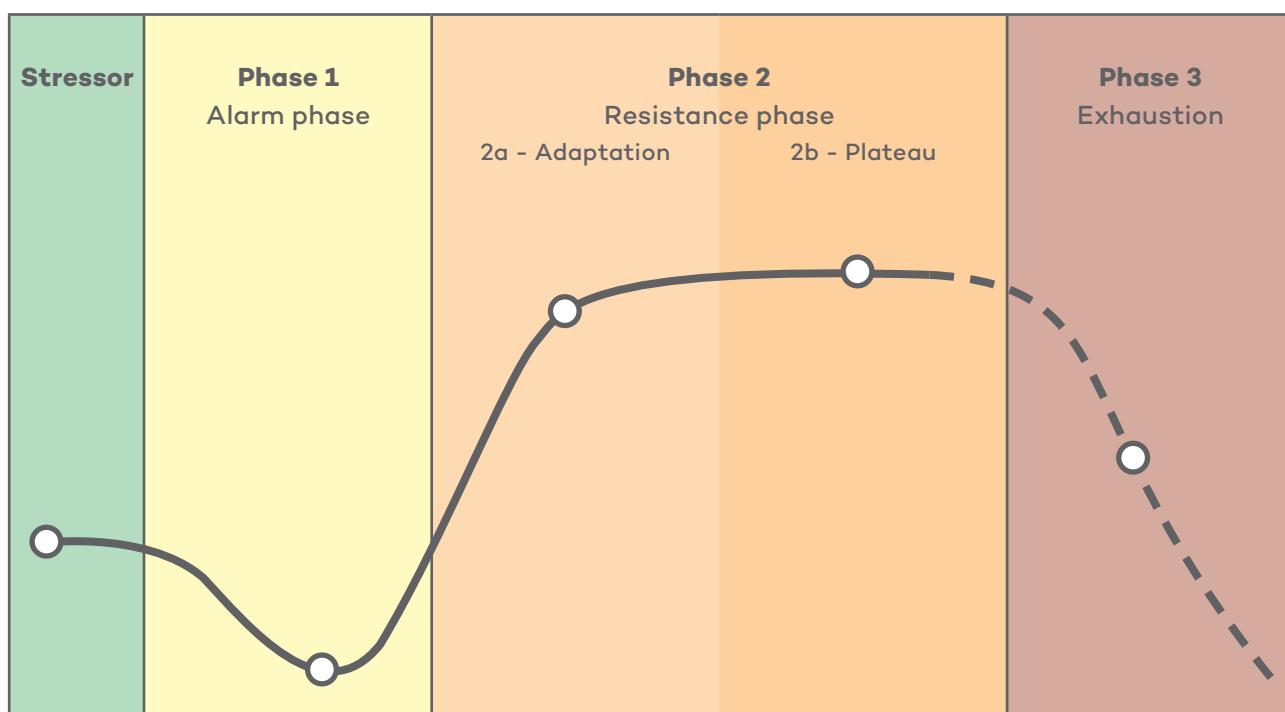


Figure 2.1 General adaptation systems

When a new training stimulus is introduced, the body initially goes into a type of shock (phase 1 – alarm phase) which leads to a decrease in performance. The alarm phase can last from several days to several weeks. During this phase the client may experience increased fatigue, muscle soreness and stiffness, and reduced coordination and performance.

The body will then begin to adapt to the new stimuli and enter the resistance phase. The first part of this phase (phase 2a – adaptation phase) involves significant change as the body makes a range of physiological adaptations in response to the demands being placed upon it (e.g. cardiovascular, respiratory and neuromuscular adaptations).

These adaptations result in an increase in function and performance and the client may feel that the current training is becoming significantly easier and the progression will be noticeable.

After a period of regular exposure to the same stimulus, the rate of adaptation will slow and eventually stop. This is an indication that the client has begun to plateau (phase 2b).

Should exposure to the same stimulus continue past this point, the body will enter the exhaustion phase (phase 3) and performance will deteriorate. This phase can also result in symptoms of overtraining, sickness or injury.

The key aim of any periodised progressive programme is to maximise time in the adaptation phase whilst minimising time in plateau and avoiding exhaustion.

For this reason, continuous linear progression is not advised – an effective periodised programme should schedule regular cycles of rest and recovery. If the body is allowed even brief periods of recuperation at the end of each training phase, it will be primed to receive and adapt to the next progressive training stimulus.

Plans should also include various challenging stimuli to ensure that the body is being presented with sufficient new stress to initiate the alarm phase and begin the adaptation cycle once more. Insufficient new stimuli would lead to a lack of progress as the body does not need to adapt to new demands. In a general fitness context, this situation is more common than overtraining.

## Supercompensation

Where GAS explains the body's long-term response to exercise, the concept of supercompensation explains the acute, short-term response to exercise. This concept should also be considered when planning periodised progressive programmes.

Supercompensation can be described as the process that the body goes through in order to progress from workout to workout. There are four phases of supercompensation (see Figure 2.2):

- **Phase 1:** This phase lasts 1-2 hours post-workout and is characterised by fatigue.
- **Phase 2:** This phase lasts 1-2 days post-workout and is when the physiological recovery and repair take place. Delayed onset muscle soreness (DOMS) might be experienced.
- **Phase 3:** This phase lasts 1-3 days and is when supercompensation occurs and the body adapts to a higher level. DOMS, if experienced, will fade and should be gone altogether by the end of this phase. Phase 3 can be characterised by an increase in energy levels, positive and confident feelings and optimistic outlooks. This is the optimal time to apply another stimulus; if a new stimulus is applied the client returns to phase 1, having capitalised on the increases gained during supercompensation.
- **Phase 4:** This phase lasts 3-7 days. If no further stimulus has been applied, any progressions made during the supercompensation phase (phase 3) are gradually lost.

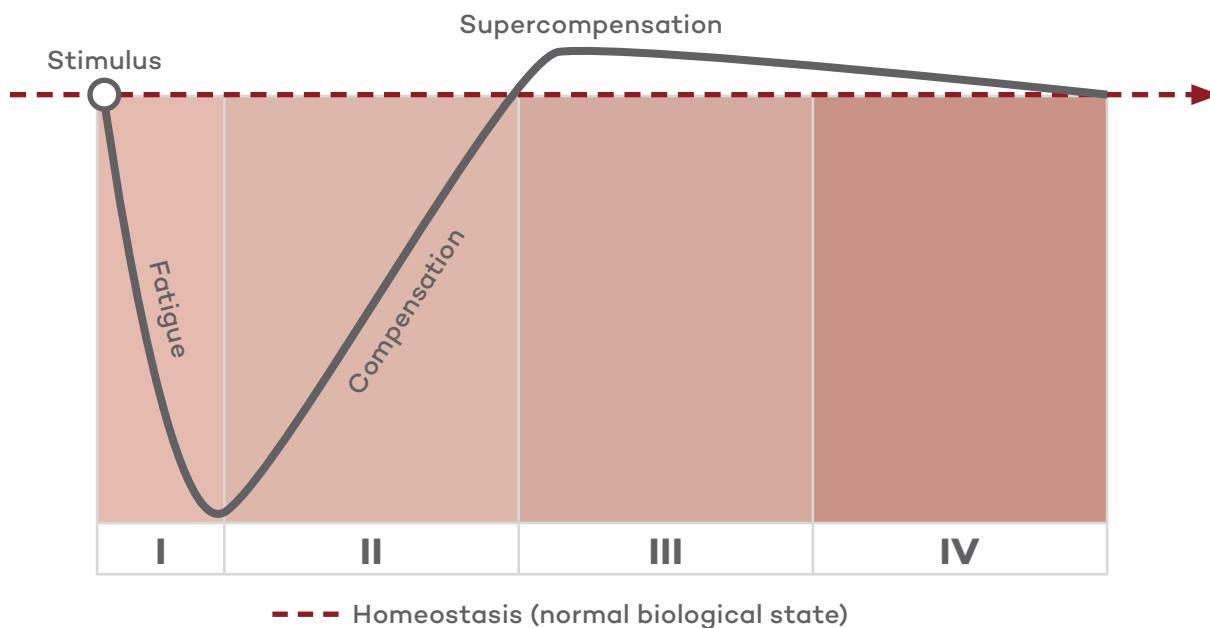


Figure 2.2 The four phases of supercompensation

In order to maximise the effects of the supercompensation phase, there are three key considerations:

- The stimulus must be sufficient to cause fatigue and induce an adaptation (overload).
- The recovery time frame must be sufficient to allow adaptation.
- The individual's nutritional intake must be sufficient to support the training and recovery processes.

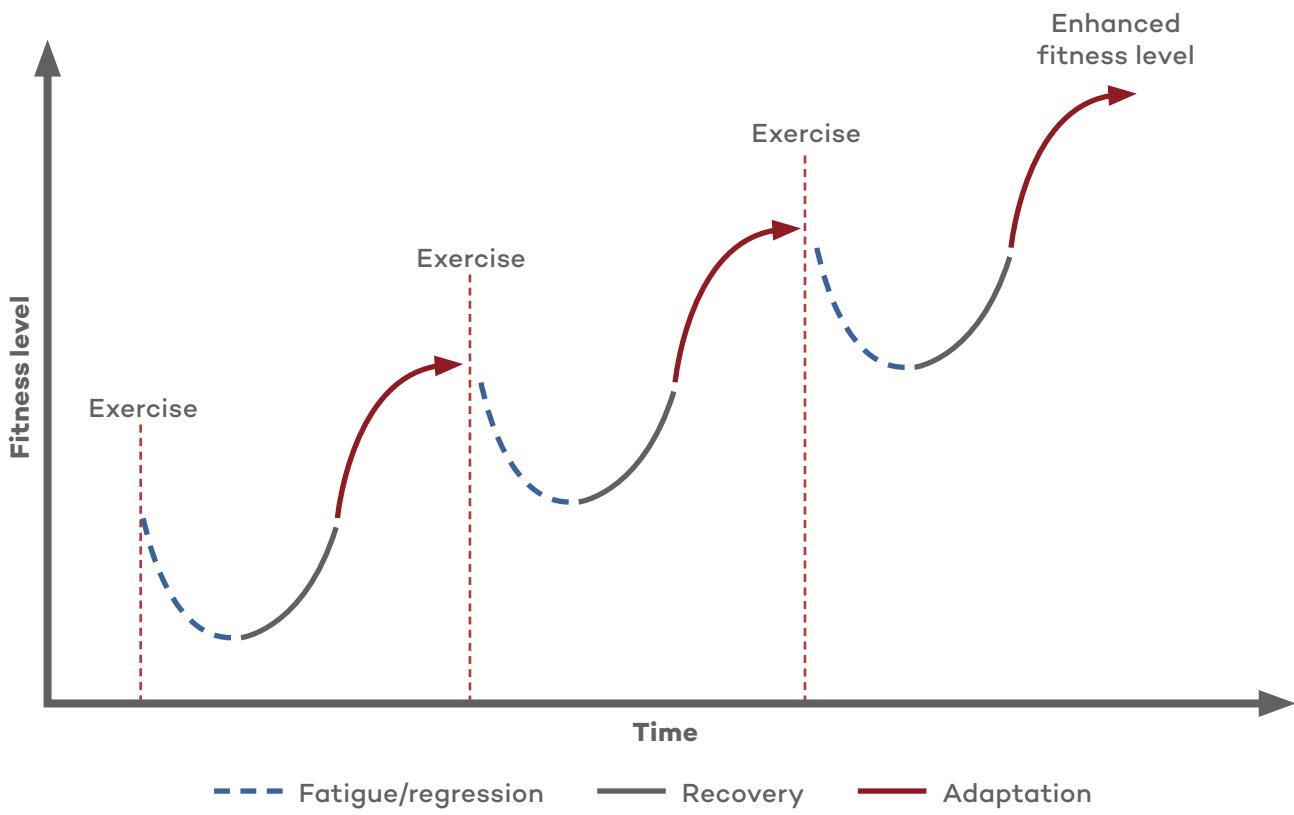


Figure 2.3 Maximising adaptation using supercompensation

## Stages of learning

When preparing periodised programmes, consideration must be given to the skill required to progress towards a specific goal. Each new movement or skill must be effectively learnt to ensure that performance is safe and effective using proper technique.

Whether training for health-related, sport or competitive reasons, there will be a benefit to being able to perform certain movements on instinct with proper technique. For example, a client who is a competitive rower will need to be able to continue rowing whilst making slight, instinctive adjustments based on the unpredictable forces that affect the boat during a race. In contrast, an adult who just wants to improve their fitness for life will need to be able to respond instinctively when unpredictable things happen. For example, if a tin falls out of a cupboard, a client will need the skill to be able to instinctively catch it without injuring their back or twisting their knee. Training movement patterns can help to prepare the body for those times when we have to perform a movement on instinct.

Fitts and Posner (1967) proposed that there are three stages of learning (see Figure 2.4). When initially learning a new movement, the actions are slow as thought has to go into their performance. This is called the **cognitive stage**.

Once a movement has been practised, performance becomes more fluid and the brain begins to be able to carry out some parts of the movement subconsciously. This is the **associative stage**.

After a movement has been repeated many times, it is often performed so fluidly and consistently that it becomes second nature. This is evidence that the brain is beginning to perform these movements automatically and is known as the **autonomous stage**.

The further through the stages of learning a movement has passed, the easier it will be to complete. In fact, it is thought that movements that are consistently repeated will leave a 'movement memory'; this means that if the movement is repeated after a long break, it will be easily recalled and performed because the pattern familiarity still remains.

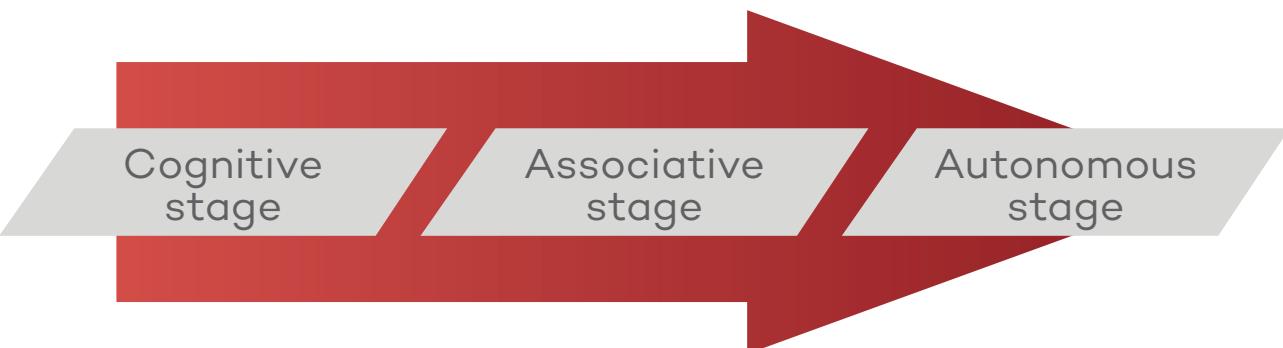


Figure 2.4 The three stages of learning

A PT can support these stages of learning by taking them into consideration when progressing exercises and periodising programmes. In addition to increasing complexity, speed and intensity, a PT can directly challenge motor learning in a controlled manner.

When a movement is new to a client, they will be in the cognitive stage of learning, so the PT should allow the client to perform movements in a controlled manner. Time and clear teaching points should be provided so the client can correct and improve their technique; this will ensure that any movement memory is more accurate when recalled in future.

Once the movement has become familiar, the PT can begin to challenge the client by increasing the complexity, intensity and speed of the pattern. The PT should still be providing feedback in the form of teaching points to improve technique, but they should also be looking for the client to improve their own technique without external input. This will raise the client's internal awareness of their own technique and reinforce any movement memory.

Finally, the PT can begin to challenge the client's motor control in more uncontrolled ways. During normal activities of daily living and sporting contexts the body will be challenged by the requirement to move in unexpected ways. For example, if an item is dropped, the instinct is to try to catch it. If the movement pattern has been embedded via the use of functional movements (e.g. multi-planar hop to reach) the client is much more likely to carry out this instinctive action with accurate technique. This may mean that the action is inherently safer as the body is primed to move quickly but effectively.

## Macro, meso and microcycles

The **macrocycle** is the largest division of a periodised programme. A macrocycle is generally an expression of the overall training objective, so it can last anywhere from 12 weeks to 4 years or more.

A macrocycle is then broken down into smaller **mesocycles** which can last from several weeks to several months, depending on the goal and the individual client. For example, one mesocycle might target the development of strength, the next might focus on the development of speed and the third might integrate strength and speed to focus on power. The achievements of all the mesocycles added together should result in the achievement of the overall macrocycle goal.

**Microcycles** are the smallest cycles of a periodised programme and they typically last one week. These short-term training cycles consist of weekly progressions as well as day-to-day intensity and volume manipulations (e.g. in week one a client might perform two low-intensity endurance sessions and one speed session; in week four they may have progressed to one low-intensity, one medium-intensity and one speed session per week). If the client performs the sessions planned in each microcycle, they should achieve the overall mesocycle goal.

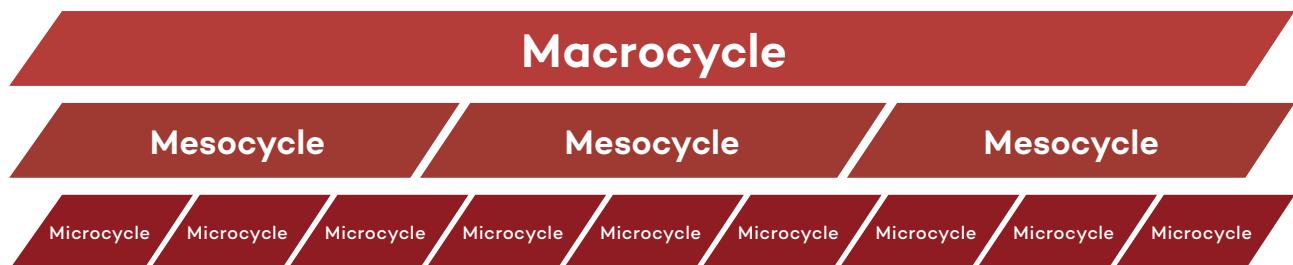


Figure 2.5 Macro, meso and microcycles

## Types of periodisation

### Linear loading

Basic linear loading is a simple form of progression and involves the predictable, linear development of volume and intensity over a period of time. Linear loading is likely to focus on one type of progression (e.g. increased strength) for the whole training period and sessions within each microcycle are likely to be very similar.

This type of periodisation is often used by gym instructors or written into a programme by a PT for a client to perform three times per week for four to six weeks followed by a programme review.

Component of fitness	Mesocycle 1	Mesocycle 2	Mesocycle 3	Mesocycle 4
CV.	10 minutes at 60% MHR.	15 minutes at 60% MHR.	15 minutes at 60% MHR.	15 minutes at 70% MHR.
Resistance.	2 x 15 reps at 65% 1RM.	2 x 15 reps at 65% 1RM (change two exercises for alternatives).	3 x 15 reps at 65% 1RM.	3 x 15 reps at 65% 1RM (introduce two new exercises).

Table 2.1 Examples of linear loading for a general gym user

As shown by the example in Table 2.1, a PT can use a number of variables to try to limit plateau (e.g. the introduction of unfamiliar exercises). When using this linear approach, particularly with beginners, the PT must balance progression and overload against the risks that increase if progression is introduced too quickly.

In its pure form, linear loading cannot be used for long periods of time. This is because it is likely to move a client towards plateau and exhaustion and the training stimuli are likely to be too similar to stimulate sufficient alarm and adaptation on an ongoing basis. However, the simplicity of linear loading makes it useful in the short term, especially for beginners and previously sedentary individuals who are likely to require less stimulation to achieve alarm and adaptation. These types of progression also work well for less confident clients who are going to be working on their own, as they tend to involve a lot of repetition of the same exercises.

### Step loading

Step loading is a simple combination of linear loading periods and recovery periods. Step loading usually occurs over the course of a mesocycle, with three progressive microcycles and the fourth microcycle for recovery (Figure 2.6). The next mesocycle then continues from the end point of the previous mesocycle. This results in a progression which can be characterised by the phrase 'three steps forward and one step back'.

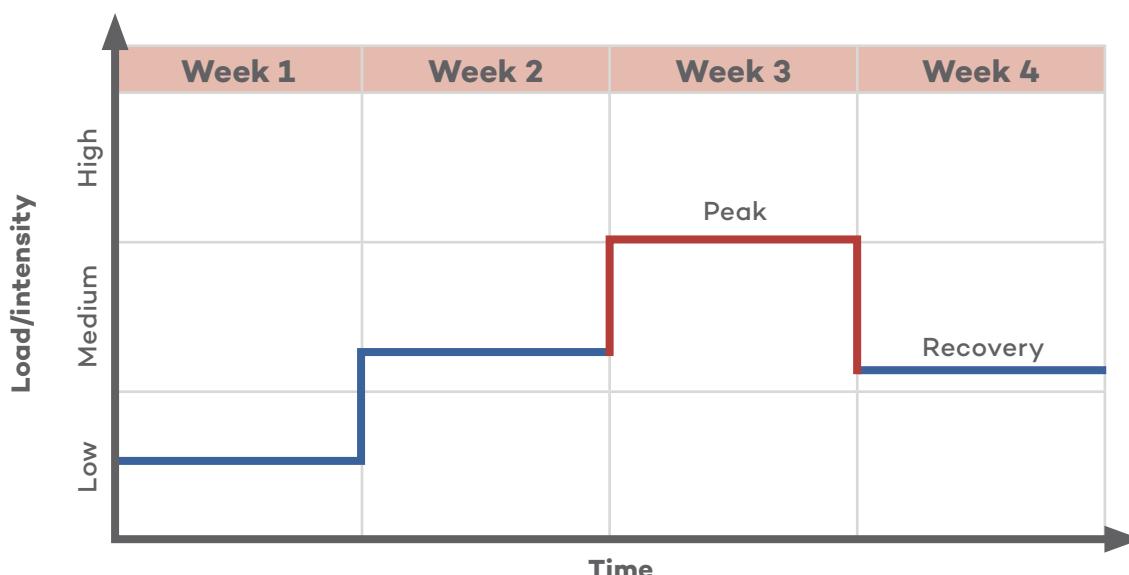


Figure 2.6 Example of step loading

## Non-linear loading

Non-linear loading involves the incorporation of different workouts at different points in each micro and mesocycle. For example, a client could complete one strength session, one power session and one endurance session per week.

The advantages of this type of periodisation include:

- High variability and unpredictability that stimulate alarm and adaptation.
- Many components of fitness and skill can be addressed within one cycle.
- Active recovery can be built into the programme by manipulating the variables.

Non-linear loading might not be suitable for beginners or those who are going to be training on their own and do not have a large repertoire and understanding of exercises. Even if a client is taking part in regular PT sessions, this might not be an appropriate method for some as the time required to effectively demonstrate, instruct and correct technique for all the unfamiliar exercises could limit the actual performance of exercises that would stimulate adaptation.

### *Split routines*

Split routines involve using sessions that train different muscle groups on different occasions throughout the week (microcycle). These routines are a commonly used form of non-linear loading, although they are often applied in a linear way which can limit progression (e.g. when the exercises always remain the same but the load increases week on week).

Split routines are usually used for hypertrophy and strength gains when the volume of training means that sufficient recovery cannot be incorporated into the programme if a whole-body approach is taken.

Routines can be split in a range of ways, but the key to using this form of training successfully is to remember that each split must be considered to have its own supercompensation cycle (e.g. if the upper body is being trained on a Monday, it should be trained again before the effects of supercompensation are lost). This means that each body part should really be trained at least twice per week. If this frequency cannot be achieved, the PT should consider whether a whole-body approach would be more beneficial.

## Block periodisation

Block loading can be described as periods of training which concentrate on one type of training, component of fitness or skill.

There are many ways to design block periodisation programmes which can be used for competitive athletes and general exercisers alike. Depending on the goals of the client, the blocks (mesocycles) can be variable lengths and can focus on different types of skill and fitness.

Block periodisation phase	Exercise intensity	Phase duration	Phase characteristics
Accumulation.	50-70% 1RM.	2-6 weeks.	A high volume of training performed at a moderate intensity using general movements and exercises.
Transmutation.	75-90% 1RM.	2-4 weeks.	A moderate volume of training performed at a moderate to high intensity using movements and exercises specific to the client's function/sport.
Realisation.	>90% 1RM.	2-4 weeks.	A low volume of training performed at a high/maximal intensity using highly specialised movements.
Recovery.	<50% 1RM.	1 week.	General recovery activities to recuperate from the high intensities of the realisation phase.

Table 2.2 A competitive example of block periodisation (Lorenz and Morrison, 2015)

## Applying the principles of periodisation

Although there are a number of distinct types of periodisation that lend themselves to different types of client, progressive programmes are most likely to use a combination approach. This is because the periodisation design must:

- Reflect the needs of the individual client.
- Overload the body sufficiently to create adaptation but not so much that it leads to overtraining.
- Take into account the actual progression of a client (e.g. a plan must be monitored and evaluated, and future plans adapted as a consequence of findings).

### Competition phasing

Clients who are aiming to progress towards optimal performance in an event or competition should move through three distinct phases of training. Each phase usually forms a mesocycle, although the length will vary depending on the sport/activity and frequency of event/competition. This type of phasing may actually form microcycles or even just an underlying goal of training.

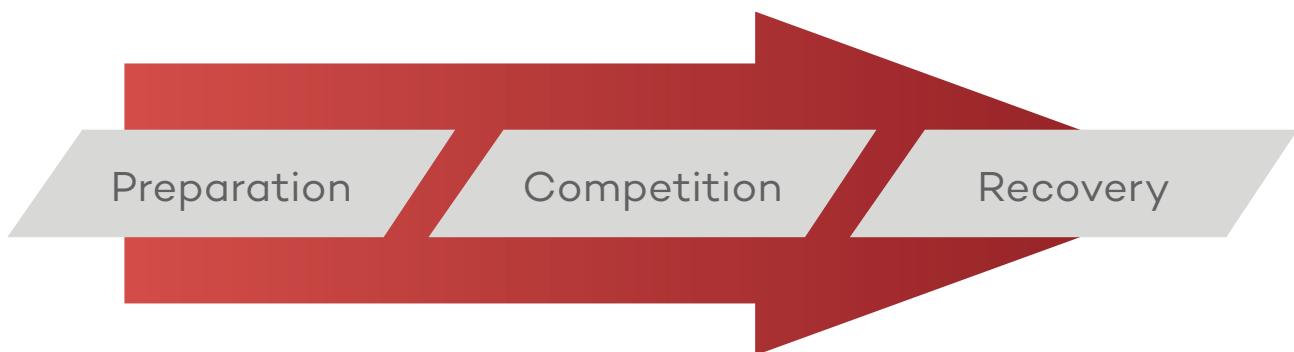


Figure 2.7 Competition phasing (Dick, 2014)

Whatever the selected structure is, this type of phasing has one ultimate goal: the achievement of peak performance at the time of competition. This might be achieving a certain placing (e.g. winning or reaching the semi-finals) or it might be time- or distance-related (e.g. to complete the marathon in under 4 hours or to throw the javelin more than 40 metres).

The preparation phase is likely to require the most detailed planning as this will be where adaptation and progression will be most important. How this phase is broken into meso or microcycles will be very specific to the individual, the training aims and the particular competition or event.

Figure 2.8 shows some examples of how this phase can be periodised to prepare a client for their ultimate competition.



Figure 2.8 Examples of preparation phase mesocycles

Clients may enter the competition phase once per year for a few months (competitive season) or they may compete at specific intervals throughout the year (e.g. every three months). Depending on the type of event/competition, clients may be required to compete frequently during the competition phase, or just once. This pattern must be considered by the PT when preparing the periodised plan.

For example, footballers will play over 20 matches in a 6-to-8-month period. They need to be prepared to play once or more every week. They may also need to be flexible enough to recover or prepare mid-season, for example if an individual isn't getting much match play or is injured. In contrast, a triathlete might compete once every 2-3 months.

The periodised plan for the footballer is likely to involve three basic mesocycles for the year, including a clear preparation period (pre-season training), a competition period (the season) and a recovery period (post-season break) (see the example in Table 2.3).

The triathlete might require a more complex periodised programme, cycling through preparation, competition and recovery in one target-oriented mesocycle (see the example in Table 2.4).

<b>Macrocycle/long-term goal(s):</b>	<b>Mesocycle 1/medium-term goal(s):</b>	<b>Mesocycle 2/medium-term goal(s):</b>	<b>Mesocycle 3/medium-term goal(s):</b>
<b>Team goal:</b> To complete the football season in the top five places of the league. <b>Individual goal:</b> To be the first selection for my position for at least 70% of the league matches.	<b>Preparation phase:</b> <ul style="list-style-type: none"> <li>To be able to increase CV endurance (<math>\text{VO}_2</math> max by 5%) and speed (reduce 20m sprint time by 1 second).</li> <li>To be able to recover from 90% MHR to 70% MHR within 90 seconds.</li> </ul>	<b>Competition phase:</b> <ul style="list-style-type: none"> <li>To take part in all training sessions between matches.</li> <li>To be selected to start 70% of matches.</li> </ul>	<b>Recovery phase:</b> <ul style="list-style-type: none"> <li>Rest and recover.</li> </ul>
<b>Microcycles:</b> 12 individual microcycles split into 3 4-week blocks: <ul style="list-style-type: none"> <li>Block 1: To increase CV endurance (<math>\text{VO}_2</math> max by 5%).</li> <li>Block 2: To increase speed (reduce 20m sprint time by 1 second) and improve recovery (from 90% MHR to 70% MHR within 90 seconds).</li> <li>Block 3: To integrate the new skills to allow application on the pitch during match play.</li> </ul>	<b>Microcycles:</b> 32 individual microcycles of 1 week in length. Each microcycle includes*: <ul style="list-style-type: none"> <li>1 low-intensity recovery session following a match.</li> <li>2 fitness training sessions focussed on balance, coordination, agility and speed.</li> <li>1 tactical training session focussed on match play and team tactics.</li> </ul>	<b>Microcycles:</b> 3 microcycles: <ul style="list-style-type: none"> <li>Microcycle 1 (3 weeks) - complete rest.</li> <li>Microcycle 2 (2 weeks) - recreational activity (5 sessions per week of 45 minutes of low-intensity recreational activity, e.g. swimming, light jogging, cycling).</li> <li>Microcycle 3 (3 weeks) - 3 corrective exercise sessions (e.g. postural, balance and coordination training) per week and 2 recreational activity sessions.</li> </ul>	*Microcycle structure must be variable depending on the amount of match play involved (e.g. more match play = increased low-intensity and recovery sessions, less match play = increased fitness and tactical sessions).

Table 2.3 Example of a periodised programme for a competitive footballer

<b>Macrocycle/long-term goal(s):</b> <ul style="list-style-type: none"> <li>To qualify for next year's regional triathlon championships.</li> <li>To reduce total triathlon time by 10 minutes for next year's regional championships (7 minute reduction in cycle time, 3 minute reduction in run time).</li> </ul>	<b>Mesocycle 1 – Preparation (12 weeks)</b> <ul style="list-style-type: none"> <li>To reduce cycle time by 3 minutes.</li> <li>To maintain run and swim times.</li> </ul>	<b>Mesocycle 2 – Competition (1 week)</b> <ul style="list-style-type: none"> <li>To come in the top 20 competitors for the regional qualification competition.</li> <li>To knock 3 minutes off racing cycle time.</li> </ul>	<b>Mesocycle 3 – Recovery (2 weeks)</b> <ul style="list-style-type: none"> <li>To recover from the competition.</li> </ul>	<b>Mesocycle 4 – Preparation (36 weeks)</b> <ul style="list-style-type: none"> <li>To reduce cycle time by another 4 minutes.</li> <li>To reduce run time by 3 minutes.</li> <li>To maintain swim pace.</li> </ul>	<b>Mesocycle 4 – Competition (1 week)</b> <ul style="list-style-type: none"> <li>To complete the regional championships in 10 minutes less than 2016.</li> </ul>
<b>Microcycles:</b> 12 individual microcycles (1 week long). Each microcycle to include: <ul style="list-style-type: none"> <li>1 run session.</li> <li>1 swim session.</li> <li>3 cycle sessions (1 endurance, 1 lactate interval and 1 creatine phosphate interval).</li> </ul> Session duration and intensity are adapted to maximise progression and minimise overtraining.	<b>Microcycles:</b> 1 week – taper training to competition. <ul style="list-style-type: none"> <li>1 week corrective, postural exercise.</li> <li>1 week odd and even weeks</li> </ul>	<b>Microcycles:</b> 1 week complete rest (recreational activity only). <ul style="list-style-type: none"> <li>1 week corrective, postural exercise.</li> <li>1 week (odd and even weeks)</li> </ul>	<b>Microcycles 9-16:</b> 1 run and swim (steady state), 1 cycle and swim (steady state), 1 run (lactate intervals), 1 cycle (creatine phosphate intervals), 1 mixed. <ul style="list-style-type: none"> <li>Odd weeks: 5 sessions per week. 1 swim, 2 runs (1 interval, 1 LSD), 1 cycle (interval), 1 mixed.</li> <li>Even weeks: As above but 2 cycle sessions and 1 run.</li> </ul>	<b>Microcycles 17-24:</b> 1 tempo interval run, 1 steady tempo cycle and 1 steady tempo swim, 2 mixed sessions (1 low-intensity, 1 moderate-intensity). <ul style="list-style-type: none"> <li>Odd weeks: 5 sessions per week. 1 swim, 2 runs (1 interval, 1 LSD), 1 cycle (interval), 1 mixed.</li> <li>Even weeks: As above but 2 cycle sessions and 1 run.</li> </ul>	<b>Microcycles 25-34:</b> 1 LSD, 2 aerobic intervals, 2 lactate intervals per week. <ul style="list-style-type: none"> <li>Alternate cycle, swim, run.</li> </ul> <b>Microcycles 35-36:</b> Taper.

Table 2.4 Example of a periodised programme for a competitive triathlete

## Periodisation using progression pyramids

Periodisation does not need to be complex. For clients who are looking to achieve general progressions, a periodised plan can simply be used to maximise adaptation and minimise plateau and exhaustion.

Simply adding different exercises or adapting basic training variables can help to minimise plateau by imposing variable demands. Maximising adaptation, however, can be more challenging and doing this (even simply) requires some structure and planning.

Basic periodisation strategies often utilise pyramids to provide simple ways to progress clients who have various health-related, general fitness goals (e.g. increased strength, hypertrophy or endurance).

Using a progression pyramid involves considering the components of fitness required to achieve a goal and fitting them into a logical structure. Each programme should begin at the bottom of the pyramid and aim to form a strong foundation from which the client can work. As the periods progress up the pyramid they become more intense, complex or specific to the goals. Progressive pyramids usually utilise principles similar to block periodisation, although they can also utilise linear and non-linear principles, depending on the client, their goals and the type of pyramid.

Figure 2.9 shows one of the most common progression pyramids. More examples can be found in section 5 of the PT toolkit.

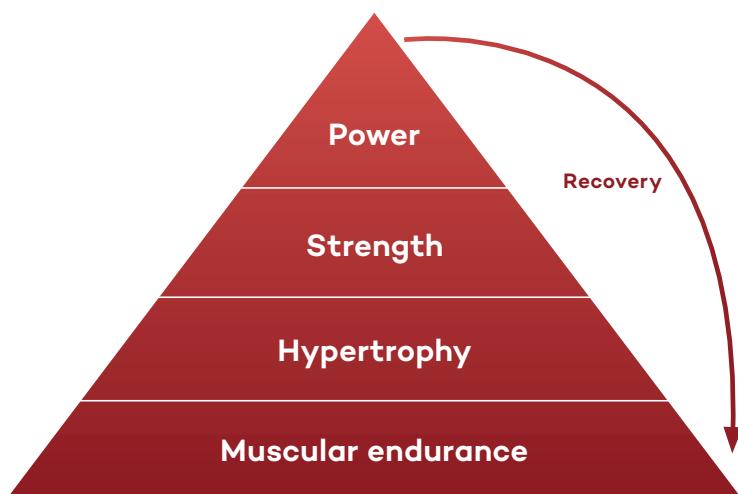


Figure 2.9 Basic resistance training pyramid

The key consideration when working with progression pyramids is that a client does not just work their way up the pyramid and once at the top, perpetually perform exercises that fall into the top category. Once at the top of the pyramid, the client should either return to the bottom (with progressed exercises incorporated into their programme) or they should embark upon another strategy for progression (e.g. a different pyramid or a different form of phasing).

If the last part of the programme is very intense, a period of recovery should be included prior to the introduction of the next phase of training. Recovery periods could take the form of complete or active rest and the duration of the period could be variable (usually one to four weeks).

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- In your own words, explain each of the following principles of periodisation:
  - General adaptation syndrome.
  - Supercompensation.
  - Stages of learning.
- Draw a diagram to explain how periodised programmes are broken down into macro, meso and microcycles.
- Evaluate each of the types of periodisation and example methods of application to identify the following:
  - Advantages.
  - Disadvantages.
  - Clients who would benefit and not benefit from using this type of periodisation.
  - Reasons for your answers.
- Write a progressive periodised plan for each of the following clients (ask a family member or friend to give specific client histories and aims or use made-up scenarios):
  - A health-related client.
  - A general fitness client.
  - A client working towards an event or competition.
  - A client working to develop strength or hypertrophy.

# Section 3: Alternative environments

PTs are required to work in a wide variety of environments, including:

Indoor:

- Gyms.
- Fitness studios.
- Sports halls.
- Client homes.

Outdoor:

- Parks.
- Sports pitches.
- Green gyms.
- Trim trails.

Each environment has benefits and disadvantages, and the PT must be able to consider these in order to safely and effectively deliver exercises to a range of clients in the most suitable environment.

For example:

- Gyms have a wide variety of equipment for the PT to use. The equipment is likely to be maintained and there will be procedures in place to ensure 'duty of care' is effectively applied. However, some clients feel uncomfortable or intimidated in a gym environment and some just don't enjoy training in gyms.
- Parks may offer a fun, stimulating and varied environment for some clients, particularly those who enjoy the outdoors. Working in these environments will need additional planning and preparation because safety, equipment transportation and facility usage (e.g. toilets) will need to be assessed, and measures and processes implemented, to ensure a safe and effective session.

## Health and safety in outdoor fitness training environments

In order to maintain the health and safety of participants, other outdoor environment users, other instructors and the PT, appropriate policies and procedures must be in place and followed. When developing and implementing policies and procedures, the following legislation, regulations and codes of practice should be considered:

- Health and Safety at Work etc. Act (1974).
- Management of Health and Safety at Work Regulations (1999).
- Manual Handling Operations Regulations (1992).
- ukactive Outdoor Code of Practice.

Appropriate planning and preparation are key to maintaining the health and safety of all parties involved in an outdoor environment. If a PT is working in an outdoor environment as part of an organisation, they should be trained in the appropriate operational procedures to ensure that these are followed throughout each session. Key organisational documents used to ensure that safe working practices are followed at all times include:

### Normal operating procedures (NOPs)

- Processes to follow during times of normal service.

### Emergency action plans (EAPs)

- Processes to follow during any kind of emergency (e.g. fire, accident, illness or extreme weather conditions).

### Risk assessments

- A process of evaluating risks in an environment to be able to identify measures to minimise harm.
- NOPs and EAPs will be developed using the information gathered during risk assessment.

### Client screening and PAR-Qs

- This may involve health screening, previous activity history and lifestyle, fitness and movement assessments.

### Accident report forms

- These forms should be filled in following an incident or accident.
- Serious incidents and accidents may require reporting under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR), 2013.

PTs who work in an independent capacity are not required to have these procedures written and structured in the same way, but in order to make sure clients enjoy the safest and most effective sessions possible, they still need to have a safe and structured way of working. For this reason, they need to perform risk assessments, develop procedures to follow in times of normal service and emergencies, complete client screening and record all accidents and incidents. These measures and procedures still exist for a self-employed PT, they just might not be in the same structured format.

## Risk assessment

Whether formal or informal, risk assessments should be carried out on all equipment and all environments. This will help to identify the hazards posed by a particular session, the harm it may cause and measures which can be implemented to minimise the risk of harm. The recommended process of risk assessment includes the following five steps:

**1**

Identify the hazards.

**2**

Decide who might be harmed and how.

**3**

Evaluate the risks and decide on precautions.

**4**

Record and implement the findings.

**5**

Review the assessment and update regularly and when conditions change.

Hazard identification, as the first step in the process, is essential. A PT must consider anything which may cause harm. Table 3.1 gives examples of outdoor hazards and potential precautions that can be taken to reduce the risk of harm.

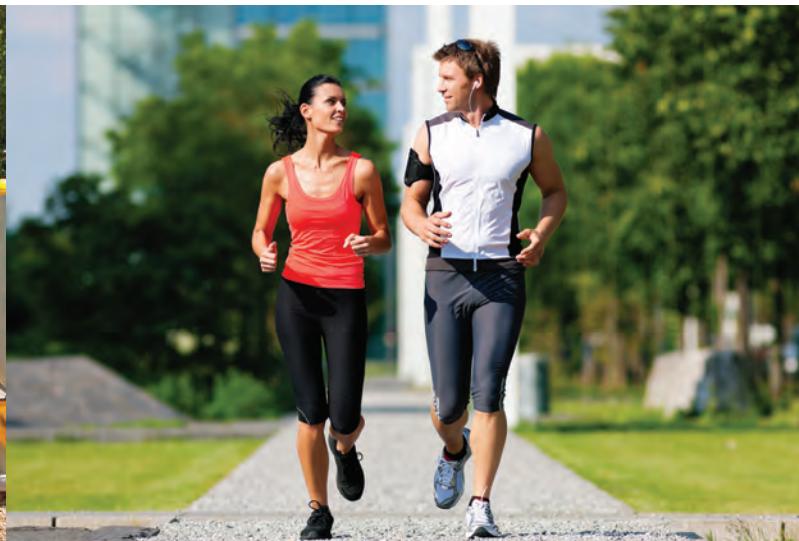
Hazard	Risk	Precautions
Slippery road surface after rain.	Injury caused by slips and/or falls.	<ul style="list-style-type: none"> <li>Client and PT have footwear appropriate for outdoor conditions.</li> <li>Alternative environments are available for sessions when weather conditions are unsafe.</li> <li>PT is a first aider or a first aider is available close by.</li> <li>First aid kit is available and stocked.</li> <li>Emergency services are easily contactable.</li> </ul>
Tree-lined walkways and paths.	Injury caused by falling or fallen branches.	<ul style="list-style-type: none"> <li>Alternative routes are taken when it is windy.</li> <li>PT is a first aider or a first aider is available close by.</li> <li>First aid kit is available and stocked.</li> <li>Emergency services are easily contactable.</li> </ul>
Broken equipment/unsafe natural features.	Injury caused by unsafe equipment/features.	<ul style="list-style-type: none"> <li>Equipment/features are assessed for safety prior to every session.</li> <li>Any equipment/feature deemed to be unsafe is not used and alternatives are ready.</li> </ul>
Participant and public behaviour.	Aggressive, violent behaviour.	<ul style="list-style-type: none"> <li>The PT has access to an emergency phone.</li> <li>Emergency services are programmed into mobile phone on speed dial.</li> <li>A family member/friend/colleague has details of the location of each session and knows what action to take should an incident occur.</li> </ul>

Table 3.1 Examples of outdoor hazards, risks and potential precautions

## Planning outdoor exercise programmes

Many outdoor sessions focus on the use of bodyweight exercises for muscular strength and endurance work. This is often because exercise equipment can be heavy and difficult to transport to various locations.

To get the most out of the session and the outdoors, the PT should consider using light, portable equipment as well as looking for ways to use the environment in their sessions. Environments might have been specially designed and incorporate outdoor gym equipment or the instructor might need to adapt to their surroundings so they can use a range of existing structures (e.g. benches, trees or steps).





With the proper planning, preparation and resources, a PT can utilise the outdoors in a wide variety of ways using a wide range of methods. It is possible to plan a safe, effective and progressive periodised programme in an outdoor environment, focussing on the development of any component of fitness. In order to achieve strength and hypertrophy goals in an outdoor environment, training methods such as calisthenics are often used. Traditional gym-based methods would be difficult to instruct outside because of the dependence on heavy weights and equipment.

When preparing an outdoor exercise programme, a PT must be adaptable and able to adjust plans to their specific surroundings. For example, if a PT works in two different outdoor environments, they are likely to find completely different resources in each location. One might have great toilet facilities, a wide variety of natural features, green gym equipment and safe, maintained designated pathways. This might enable the safe delivery of all training methods and exercises in the PT's repertoire. In contrast, another location could consist of a muddy field and a couple of park benches.

In order to work effectively in the outdoors, a PT must be able to move between these types of environment with ease.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Write a list of alternative environments in your local area (other than the gym or studio) where personal training could take place, including:
  - Indoor environments.
  - Outdoor environments.
- Explain the benefits and disadvantages of each environment.
- Make a list of the legal and regulatory requirements relevant to a PT working:
  - In an organisation.
  - On a self-employed basis.
- Perform a risk assessment on one local environment that could be used for personal training and identify:
  - Hazards.
  - Risks.
  - Precautions to manage or minimise the risk of harm.
- Consider the local environment that has been risk assessed:
  - Describe training systems, methods of training and a range of suitable exercises.
  - Prepare a periodised progressive programme for a particular client who has specific aims and goals (ask a family member or friend for a specific client history and aims or use a made-up scenario).
  - Plan an outdoor session to fit into the planned periodised programme.

# Section 4: Group personal training

Providing group personal training can broaden a PT's target market and can be attractive to clients who:

- Would like to benefit from personal training but have limited funds available for individual sessions.
- Find working out on their own a challenge.
- Enjoy the social and group aspects of fitness.
- Want to exercise with friends or family members.
- Would benefit from the additional motivation and support that can be offered in a group situation.

Family members, spouses, partners and friends can become a support network to help clients motivate themselves to make and maintain behavioural and lifestyle changes. If they also take part in personal training together, these psychological and behavioural benefits can be further maximised.

When planning and developing group training sessions, it is important to remember that group personal training should not be considered the same as 1:1 training, nor is it the same as group exercise classes. Clients who participate in group personal training should receive periodised, progressive programmes that address individual goals in a group situation. A PT must therefore be able to balance group and individualised observation, instruction, motivation and support in a session which ensures that all clients are challenged and progressed in a safe and effective manner.

Plans for group personal training should include at least one progression and one regression for each exercise selected. No matter how similar (in terms of fitness, ability and experience) a group are, there are bound to be differences between each client. By planning progressions and regressions, a PT can welcome diversity and still ensure that all members of the group are challenged in a safe and appropriate way.

Timed circuits work well when delivering group personal training. This type of session allows the PT to control the group and ensure no members are waiting around for others. A circuit can include exercises that generally improve all components of fitness, but a PT can also include exercises to specifically address individual goals. These exercises could be performed by the whole group or the PT could plan stations where each client performs their own specific exercise.

When instructing circuits, a PT must ensure that they can clearly observe, instruct and motivate all clients effectively throughout the session. This means that the PT must consider where each piece of equipment is and where each activity will be carried out. They must also consider how they will support each individual client in the group – too much focus on one client will limit interaction with the others. For example, if one client is performing a resistance exercise in one part of a gym and another is performing a different exercise in another area, the personal training experience will be lost.

Creating competition when working in groups can either be detrimental or hugely advantageous to group dynamic, cohesion and rapport. Some clients won't appreciate competitive activities, whilst others will thrive and push themselves to achieve their best. The PT must get to know the group and ensure that incorporating competition into a session is going to benefit all members. If competition will be detrimental for even one client, it should be avoided or carefully controlled so it does not have a negative impact. If it can be implemented appropriately, however, it can be a useful and effective tool to motivate maximal participation in the session, ongoing adherence, motivation and enjoyment.

Structuring a group session so that clients work in pairs can also be a useful tool to build cooperation, motivation and social enjoyment. Partner training can be easily incorporated into group training sessions and a wide variety of training methods work well using partners. For example:

- **Partner-assisted static stretching** – With clear and effective instruction, partners can be used to passively ease a part of the body into stretch positions. Great care and effective communication between the partners are required to ensure that inappropriate pressure is not applied to the joints and the muscles are not overstretched.
- **Partner-assisted dynamic stretching** – Dynamic flexibility movements can challenge a client's balance and coordination. Careful positioning of group members can allow partners to support one another simultaneously (see Figure 4.1).

- Partner-assisted PNF stretching** – Partners can be used to apply the counterforce resistance during PNF stretches. This type of partner work must only be used with appropriate clients as there are increased risks due to the complexity of the techniques. Before including this type of partner work in a group session, the PT must first be sure that the clients fully understand the techniques required and have the motor skills and movement awareness to perform (or assist) the stretch. It is also important that the PT closely observes each pairing and corrects technique effectively. Should the PT be in any doubt that the clients can safely perform either role in the pairing, another form of stretching should be selected.
- Supersets** – Including exercises performed back-to-back allows the members of the pair to perform a different exercise in the superset at the same time. Once they have both performed both exercises in the set, they will also rest together. This keeps the group together and nurtures cooperation or competition as required. Tri and giant sets can also be used in larger group circumstances when individual clients are able to perform these high-volume methods.
- Spotting partnerships** – When training a group of people who are looking to develop hypertrophy or strength, it can be beneficial to use one member of a pair as the spotter whilst the other one performs the exercise. This can free up the PT to move around, observe and instruct more effectively so they can correct and motivate as required. This method can also help to develop good client spotting so that these skills can be used outside of personal training sessions. This method of partner training naturally combines strength or hypertrophy exercises with rest periods. Before using spotting partnerships, the PT must first ensure that all clients are fully trained in safe and effective spotting technique. If there is any doubt in a client's confidence or ability in relation to spotting, another form of training should be selected.

In addition to planning the main component, the warm-up and cool-down components must also be planned effectively. It may take longer to warm up or cool down a group. Clients may take longer to set up and instruct, even if they are healthy, experienced clients.

This is because there are likely to be more demonstrations, explanations and discussions compared to one-to-one training. This must be taken into account when planning. Clients who may need longer warm-ups and cool-downs (e.g. an older, previously sedentary client) should also be accounted for. Group warm-ups and cool-downs should always accommodate all clients' individual requirements, so if one client requires a longer warm-up, the whole group should perform a longer warm-up. This avoids singling anyone out and maintains group cohesion.



Figure 4.1 Partner-assisted dynamic hip swings



Figure 4.2 An example superset

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Review a range of training methods and techniques to identify methods that would work well in group personal training sessions.
- Write a list of benefits and challenges of delivering group sessions.
- Explain how to apply safe session structure to group sessions.
- Plan a group personal training session that includes partner-assisted activities.
- Prepare a detailed teaching plan for the planned group training session, including explanations for exercise set-up, teaching points and other considerations.

# Section 5: Special populations

In order to work with any special population group (e.g. pre and postnatal women, older adults) on a regular and long-term basis, the PT should seek additional training and qualifications. If a PT does not hold these specialist qualifications, they are still likely to be approached by clients who fit into these population groups. It is therefore essential that PTs have basic knowledge covering the key considerations for each of these groups so they understand their professional boundaries and when to refer.

## Pre and postnatal women

Guidance from the Royal College of Obstetricians and Gynaecologists (RCOG) (2006) states that 'all women should be encouraged to participate in aerobic and strength-conditioning exercise as part of a healthy lifestyle during their pregnancy' and that 'reasonable goals of aerobic conditioning in pregnancy should be to maintain a good fitness level throughout pregnancy without trying to reach peak fitness level or train for athletic performance'.

### The benefits of exercise

The benefits of exercise during pregnancy include:

- Maintenance of general fitness levels.
- Maintenance of a healthy weight.
- Improved circulation.
- Improved coordination and body awareness.
- Improved psychological wellbeing.
- Reduced fatigue.
- Reduced swelling.
- Improved sleep patterns.
- Reduced stress.
- Preparation for labour and postnatal recovery.

### Exercise contraindications

Before beginning an exercise programme, a pre or postnatal woman should be screened. This is required for all clients, but the screening form is likely to include additional questions and information requests that allow a PT to gather details relevant to the pregnancy. The 'PARmed-X for Pregnancy' developed by the Canadian Society for Exercise Physiology (CSEP) is the recognised health screening form for pre and postnatal women. Organisations may have their own version of this form, but the questions and information gathered are likely to be similar.

Staying active and exercising at an appropriate intensity will generally be recommended for healthy pregnant women, but there are some conditions which will contraindicate exercise unless under the direct supervision of a medical professional. These include:

- Multiple foetuses (e.g. twins).
- Heart or lung diseases and conditions.
- Persistent bleeding.
- Pre-eclampsia or pregnancy-induced hypertension.
- Severe pregnancy complications.
- Heavy smoking.
- Poorly controlled existing conditions (e.g. diabetes, thyroid disorders or seizures).
- Extremely sedentary lifestyle.
- Extreme obesity ( $>40$  BMI).
- Anaemia.

## Exercise and activity recommendations

The aim of exercise programmes during pregnancy should be to minimise loss of balance, and any exercise selected should ensure the avoidance of foetal damage (RCOG, 2006).

Women who already take part in regular exercise can continue to train, although each individual needs to be very aware of their body, health and pregnancy. As such they should adapt the frequency, intensity, time and type (FITT principles) of exercise to how they are feeling and how the pregnancy is progressing. Pregnant women must be guided to follow any medical advice, and caution is always the best approach.

Previously sedentary women who are healthy and experiencing a normal pregnancy are also advised to become active and may look to begin exercising. Any exercise programme they begin to follow during the pregnancy period should be measured and cautiously implemented to minimise risk and maximise the benefits. Progression in line with the FITT principles would be minimal and the aim would be to form a positive and healthy exercise habit that meets the RCOG physical activity and exercise guidelines so they can begin to progress further postnatally:

- Beginners should start with 15 minutes of low-intensity aerobic steady state exercise 3 times per week.
- Exercise duration should be progressed gradually to 30 minutes of low-intensity steady state exercise 4 times per week.
- Exercise with a risk of falling or abdominal trauma should be avoided.

Other key recommendations for exercising during pregnancy include:

- Warm-ups and cool-downs should be lengthened to develop intensity more gradually (5-10 minutes) and can be included in the recommended durations (e.g. a beginner could do a gradual warm-up of 5 minutes, a steady state walk for 5 minutes and a cool-down of 5 minutes to meet the minimum recommendations).
- Static stretches should be maintenance (10-15 seconds) only and range of motion should be controlled as hormone release (relaxin) can increase joint laxity and the risk of overstretching.
- Posture adaptations which develop as the foetus grows can affect flexibility, balance and coordination, so exercises should always be stable, controlled and performed with good technique.
- Exercising in the supine position after 16 weeks is not recommended as the inferior vena cava can be compressed by the uterus which can lead to dizziness or numbness in the extremities.
- Prone lying positions can be uncomfortable throughout pregnancy as pressure is increased on the abdominal area and posture is affected.
- Prolonged motionless standing is not recommended as it can increase isometric muscle contractions that can cause increases in blood pressure.
- Heavy, uncontrolled, isometric or prolonged resistance work, particularly above the head, is not advised as this can affect blood pressure and can increase the risk of dizziness, loss of balance, falls and high blood pressure.
- Hip abduction, adduction, internal or external rotation can apply increased pressure to an unstable pelvic and hip region so these movements should be avoided, especially when working against a resistance.
- Uncontrolled balance exercises should be avoided due to the increased risk of joint instability and falls.
- Loaded forward flexion and uncontrolled twisting are not advised as adaptations and weaknesses in the abdominal and back musculature could increase the risk of low back pain or injury when performing this movement pattern.
- Rapid changes in direction or position are not advised due to the reduction in coordination, balance and postural awareness and the consequential increased risk of falls.
- Core exercises should be controlled and focus more on postural stability (without introducing long isometric holds), mobility and the pelvic floor.

Prenatal women should be reassured that exercise participation does not increase the risk of complications (RCOG, 2006).

Postnatal women who experienced an uncomplicated pregnancy and birth can begin to take part in low-intensity physical activity almost immediately. Examples of this include gentle walking and range of motion exercises. Pelvic floor exercises are also highly recommended for the immediate postnatal period to help the recovery of the pelvic floor. As this is so important, midwives commonly give postnatal women written guidance on pelvic floor exercises within a few hours of the baby being born.

Women who experienced a complicated pregnancy or birth (e.g. caesarean section) should only become physically active again once they have permission from their medical professional. This is likely to be after their first medical check-up (six to eight weeks) at the earliest.

Physical activity can progress to exercise once the client is ready and it is recommended by their medical professional. Any exercise performed in the postnatal period should be progressed slowly and the introduction of impact should be gradual and measured. The aim of programming in the postnatal period should be to gradually return the body to pre-pregnancy function.

Postnatal women should be reassured that moderate exercise does not affect breast milk quality or quantity (RCOG, 2006).

A PT with no specialist pre and postnatal qualifications can encourage pre and postnatal clients to take part in general physical activity for health, but if a client wishes to take part in regular personal training, they should be referred to a qualified specialist instructor.

The length of the postnatal period varies from person to person – some women recover very quickly and are able to return to full function within a few months, whereas others experience postnatal symptoms for a couple of years. This can make it difficult for a PT with no specialist qualifications to know when they can safely begin to train a client. In the best circumstances where a client has recovered fully from pregnancy and experienced no pregnancy or birth complications, it may be possible to consider a woman out of the postnatal period following their medical check-up at six to eight weeks. In other circumstances a woman may require much longer to return to full function.

Although exact timescales for the postnatal period are difficult to identify, a PT should always be cautious when working with pre and postnatal women. Following these guidelines will help to ensure safety and appropriate programming:

- A PT with no further specialist qualifications should not begin to work with a postnatal woman until medical guidance permits exercise (at least six to eight weeks).
- A PT should consider a client to be in the postnatal period for as long as postnatal symptoms are being reported and until she has stopped breastfeeding (hormones are still being released at increased levels and their effects will still be present, e.g. joint laxity).
- If a client reports postnatal symptoms, they should be referred to a qualified pre and postnatal specialist instructor.
- High-impact twisting, ballistic and aggressive movements should be avoided for at least six months (or until the client has stopped breastfeeding) because the hormone relaxin can affect joint laxity and stability.
- Impact should only be introduced when the pelvic floor is strong enough and progression should be very gradual. Further stress placed on the pelvic floor during the recovery period can increase the risk of stress incontinence (urine leakage when abdominal pressure increases, e.g. when coughing or jumping).

It is important for PTs to stay within their scope of practice; if they feel that a client has impaired stability, balance, posture or function as a result of a recent pregnancy, they should always refer them to a medical professional or suitably qualified specialist.

## Warning signs to stop exercise

PTs must be aware of the warning signs to ensure they guide prenatal women to seek immediate medical advice if necessary, even if they are exercising alone in the facility rather than directly with the PT. These warning signs are:

- Excessive shortness of breath.
- Chest pain or palpitations.
- Dizziness or fainting.
- Abdominal, uterine, back or pubic pain or contractions.
- Bleeding or leakage of amniotic fluid.
- Excessive fatigue.
- Reduced foetal movement.
- Shortness of breath before exertion.
- Headache.
- Muscle weakness.
- Calf pain or swelling.

## Older adults

An older adult is someone over the age of 65 (WHO, ND). When considering whether to train a client or refer them to a qualified older adult specialist instructor, although it is important to consider their chronological age, it is also important to consider their physiological age.

- Chronological age – how old the client is in years.
- Physiological, biological and functional age – how the body is functioning or how many signs of old age the client is reporting (e.g. high blood pressure or osteoarthritis).

The physiological age of a client must be considered because it is common to see clients who are displaying one or more significant signs of ageing at a much younger age. If a client who is less than 65 displays significant signs of ageing and wants to take part in personal training, it may still be advisable to seek guidance from a qualified older adult specialist. They can then help to determine if specialist training or medical guidance is required.

### The effects of ageing

As we age the systems of the body tend to degenerate. The pace of degeneration depends on multiple factors including physical activity, lifestyle and nutritional choices.

Ageing influences the formation of bone as osteoclast (cells which break down old bone) activity increases and osteoblast (cells which build bone) activity decreases. As a consequence, bone mass will start to decrease.

**Osteopenia** is considered to be the precursor to osteoporosis and is a condition where bone mineral density is lower than normal.

**Osteoporosis** is a disease characterised by low bone mass and deterioration of bone tissue leading to enhanced bone fragility and a subsequent increase in the risk of fracture. Osteoporosis occurs in both males and females but is more common in females.

Ageing affects the soft tissues in the following ways:

- Connective tissue (ligaments, tendons and muscle) elasticity is reduced as elastin fibres that facilitate stretch are replaced with collagen fibres.
- Ligaments thicken.
- Cartilage incurs damage caused by wear and tear.
- Synovial membranes are less active and synovial fluid becomes more viscous (thicker).
- Joints become stiff.
- Increased risk of osteoarthritis caused by joint wear and tear.
- Sarcopenia (loss of muscle mass).
- Loss of fast twitch muscle fibres and proportional increase in slow twitch fibres.

The result of these changes is gradual degeneration of the joints which can cause discomfort, pain, limitations in joint range of motion and reduced functional ability. With ageing there can be a significant reduction in function as the body's ability to develop power and momentum is limited. Many senior older adults (>70 years) find it difficult to stand from a seated position as a consequence of the loss of fast twitch fibres.

The nervous system becomes less efficient as ageing progresses: nervous pathways are lost and receptors become desensitised or non-functional. This can lead to:

- A gradual loss of memory recall.
- An increase in the size and a reduction in the number of motor units, which will lead to a loss of fine motor control.
- A reduction in the ability to balance and coordinate.
- A reduction or even loss of the senses (vision, hearing, taste, smell, sensation, proprioception and special awareness).

The result of nervous system degeneration can be increased disorientation, clumsiness and risk of falls.

The soft tissues of the respiratory system – which includes the diaphragm, intercostals, alveoli and respiratory tract – are affected in the same way as the rest of the body. The loss of elasticity in the alveoli causes a reduction in surface area and, consequently, in the efficiency of gaseous exchange. The brain's sensitivity to blood gas changes,

resulting in further limitation of the respiratory system. This is why older adults' respiratory systems respond less well to the variable demands placed upon them than those in younger people.

The cardiovascular system is affected in a similar manner to the respiratory system. Blood vessels become less elastic and capillaries are lost, reducing the potential for gaseous exchange. Atherosclerosis (plaque build-up in the arteries) also becomes more common as age increases.

## Medical conditions commonly associated with old age

As systems degenerate (either as a consequence of the ageing body or an increasingly sedentary lifestyle), there is a significant increase in the risk of some age-related medical conditions. These include:

- Low back pain.
- Arthritis (e.g. osteoarthritis, rheumatoid arthritis and gout).
- Osteoporosis.
- Hypertension (high blood pressure).
- Angina (a temporary blockage of a coronary artery which is often managed with medication).
- Myocardial infarction (heart attack caused by a complete blockage of a coronary artery).
- Atherosclerosis.
- Asthma (restricted airflow triggered by hyperreactivity to an allergen or environmental substance).
- Chronic obstructive pulmonary disorder (COPD) (progressive, irreversible damage to the lungs and respiratory system).
- Metabolic conditions such as obesity and type 2 diabetes (reduced insulin production or reduced insulin sensitivity).
- Neurological conditions, e.g. stroke (blockage of blood flow to the brain) and transient ischaemic attacks (often called a 'mini stroke').\*
- Alzheimer's disease and dementia which are characterised by a loss of function and memory, deterioration of language, and problems with perception or judgement.

\*It is important to be aware of the signs of a stroke and react quickly in the event of a suspected stroke as urgent medical treatment can significantly reduce the extent of long-term damage to the brain. The acronym FAST is used to identify the signs (see Figure 5.1).



Figure 5.1 FAST signs of stroke

It is important for a PT to work within their scope of practice, so if a client reports any of these medical conditions it is essential that they are advised to seek medical guidance and exercise programming should be referred to a suitably qualified specialist.

# The effects of exercise and recommendations for older adult exercise participation

It is widely recognised that many age-related changes can be counteracted by participation in regular physical activity or exercise. For example:

- Resistance training has been shown to reduce the effects of ageing on the neuromuscular systems.
- Regular weight-bearing exercise helps to maintain skeletal bone mass.
- Exercise will contribute to stronger muscles and improved balance and agility which can all help to prevent falls.
- Exercise can increase feelings of wellbeing and confidence, and improve opportunities for social interaction, which will have significant psychological benefits.

For these reasons, it is highly recommended that older adults continue to be as active as possible for as long as possible. Physical activity guidelines for older adults include:

- Perform exercise to enhance balance and reduce the risk of falls at least three times per week.
- Be as active as abilities and conditions allow when health and medical considerations prevent the achievement of the minimum amount of physical activity (150 minutes of moderate-intensity activity per week).

Prior to participation, all clients should be pre-screened. A healthy older adult between the ages of 50 and 65 can be reasonably accommodated in a regular exercise session with appropriate adaptations to meet specific age-related needs (see Table 5.1).

Older adults aged over 65 (or between 50 and 64 with health conditions and concerns) would need to be signposted to a medical professional (e.g. GP) for advice and may require referral to a qualified specialist instructor.

Component	Adaptation
Warm-up and preparation.	<ul style="list-style-type: none"> <li>• Use a longer, more gradual warm-up (around 15 minutes).</li> <li>• Use more mobility exercises.</li> <li>• Build the range of motion of mobility exercises gradually. For example, begin with small shoulder circles before increasing the shoulder ROM and progressing to arm circles.</li> <li>• Use slower, controlled movements.</li> <li>• Focus on posture, alignment and correct technique.</li> </ul>
Cardiovascular training.	<ul style="list-style-type: none"> <li>• Build intensity more gradually.</li> <li>• Lower the working intensity.</li> <li>• Use less impact.</li> <li>• Use less complex movements.</li> <li>• Use a longer, more gradual cool-down.</li> <li>• Emphasise correct technique.</li> <li>• Layer information (in stages rather than all at once).</li> </ul>
Muscular training.	<ul style="list-style-type: none"> <li>• Use less resistance and shorter leverage for some exercises.</li> <li>• Use fewer repetitions and sets, and more rest.</li> <li>• Use more stable and balanced positions.</li> <li>• Allow transition time to get down and up from the floor.</li> <li>• Use a slower pace.</li> <li>• Use more time to change exercises/positions.</li> <li>• Emphasise correct technique.</li> <li>• Supine lying may be contraindicated (osteoporosis); extreme spinal flexion (i.e. full or half curl-ups from supine) may be contraindicated – consider other alternatives.</li> <li>• Strengthen postural muscles, pelvic floor muscles and around potential fracture sites for osteoporosis (wrist, hip and spine).</li> </ul>
Cool-down and closing.	<ul style="list-style-type: none"> <li>• Use a longer duration.</li> <li>• Perhaps use more stretches for specific muscles.</li> <li>• Use more stable positions.</li> <li>• Use a smaller range of motion.</li> </ul>

Table 5.1 Exercise adaptations for older adults

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- Explain the benefits of physical activity for pre and postnatal women.
- Explain the benefits of exercise for older adults.
- Describe exercise contraindications and safety considerations for pre and postnatal women who would like to exercise.
- Describe exercise contraindications and safety considerations for older adults who would like to exercise.
- Using the guidelines in this manual, create a list of exercises that would be suitable and a list that would be unsuitable for pre and postnatal women. In your own words, explain your reasons for the selections made.
- Using the guidelines in this manual, create a list of exercises that would be suitable and a list that would be unsuitable for older adults. In your own words, explain your reasons for the selections made.
- Describe the risks of exercise for pre and postnatal women.
- Describe the risks of exercise for older adults.
- Describe ways the identified risks can be managed.

# References

- ACSM. (2011). Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal and Neuromotor Fitness in Apparently Healthy Adults: Guidance for Prescribing Exercise. *Medicine and Science in Sports and Exercise*. DOI: 10.1249/MSS.0b013e318213fefb.
- ACSM. (2014a). *Guidelines for Exercise Testing and Prescription*. 9th edition. Philadelphia, PA: Wolters Kluwer/Lippincott Williams and Wilkins.
- ACSM. (2014b). 'Information on High Intensity Interval Training' [online]. Available at <https://www.acsm.org/docs/brochures/high-intensity-interval-training.pdf> [Accessed 27 July 2016].
- Baechle, T., Earle, R. and Wathen, D. (2000). *Essentials of Strength Training and Conditioning*. 2nd edition. Champaign, IL: Human Kinetics.
- Bompa, T.O. and Haff, G.G. (2009). *Periodization: Theory and Methodology of Training*. 5th edition. Champaign, IL: Human Kinetics.
- Canadian Society for Exercise Physiology. (ND). 'PARmed-X for Pregnancy' [online]. Available at <http://www.csep.ca/view.asp?ccid=517> [Accessed 4 August 2016].
- Canadian Society for Exercise Physiology. (ND). 'PAR-Q & You' [online]. Available at <http://www.csep.ca/view.asp?ccid=517> [Accessed 4 August 2016].
- Canadian Society for Exercise Physiology. (ND). 'PAR-Q+' [online]. Available at <http://www.csep.ca/view.asp?ccid=517> [Accessed 4 August 2016].
- Crossley, J. (2006). *Personal Training: Theory and Practice*. London: Routledge.
- Daniels, J. (2013). *Daniels' Running Formula*. 3rd edition. Champaign, IL: Human Kinetics.
- Dick, F.W. (2014). *Sports Training Principles*. 6th edition. London: Bloomsbury.
- Fitts, P.M. and Posner, M.I. (1967). *Human Performance*. Belmont, CA: Brooks/Cole Pub. Co.
- Handrakis, J.P. et al. (2010). Static stretching does not impair performance in active middle-aged adults. *Journal of Strength and Conditioning Research*, vol. 24(3), pp.825-826.
- Kokkonen, J. et al. (2010). Early-Phase Resistance Training Strength Gains in Novice Lifters are Enhanced by Doing Static Stretching. *Journal of Strength and Conditioning Research*, vol. 24(2), pp.502-507.
- Levinger, I. et al. (2015). What doesn't kill you makes you fitter: A systematic review of high-intensity interval exercise for patients with cardiovascular and metabolic diseases. *Clinical Medical Insights: Cardiology*, vol. 9, pp.53-63.
- Lorenz, D. and Morrison, S. (2015). Current Concepts in Periodization of Strength and Conditioning for the Sports Physical Therapist. *International Journal of Sport and Physical Therapy*, vol. 10(6), pp.734-747.
- McMillian, D.J. et al. (2006). Dynamic vs. Static-Stretching Warm up: The Effect on Power and Agility Performance. *Journal of Strength and Conditioning Research*, vol. 20(3), pp.492-499.
- Murphy, J.C. et al. (2010). Effect of Single Set Dynamic and Static Stretching Exercise on Jump Height in College Age Recreational Athletes. *International Journal of Exercise Science*, vol. 3(4), pp.214-224.
- Muscolino, J.E. (2010). *Kinesiology: The Skeletal System and Muscle Function*. 2nd edition. Missouri: Mosby.
- Nelson, A.G., Kokkonen, J. and Arnall, D.A. (2005). Acute Muscle Stretching Inhibits Muscle Strength Endurance Performance. *Journal of Strength and Conditioning Research*, vol. 19(2), pp.338-343.
- Public Health England. (2014). 'Everybody Active, Every Day: an evidence-based approach to physical activity' [online]. Available at <https://www.gov.uk/government/publications/everybody-active-every-day-a-framework-to-embed-physical-activity-into-daily-life> [Accessed 22 July 2016].
- Richards, J. (2008). *Biomechanics in Clinic and Research*. Philadelphia: Churchill Livingstone, Elsevier.

- Royal College of Obstetricians and Gynaecologists. (2006). 'Exercise in Pregnancy (Statement No. 4)' [online]. Available at <https://www.rcog.org.uk/en/guidelines-research-services/guidelines/exercise-in-pregnancy-statement-no.4/> [Accessed 4 August 2016].
- Selye, H. (1984). *The Stress of Life*. New York: McGraw-Hill.
- Solomon, E.P., Schmidt, R.R. and Adragna, P.J. (1990). *Human Anatomy and Physiology*. 2nd edition. Florida, USA: Saunders College Publishing.
- Tabata, I. et al. (1996). Effects of Moderate-Intensity Endurance and High-Intensity Intermittent Training on Anaerobic capacity and VO<sub>2</sub> max. *Medicine and Science in Sports and Exercise*, vol. 28 (10), pp.1327-1330.
- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*. 12th edition. New Jersey: John Wiley & Sons.
- Ukactive. (2014). 'Outdoor Code of Practice' [online]. Available at: <http://www.ukactive.com/membership/raising-standards/ukactive-outdoor-code-of-practice> [Accessed 2 August 2016].
- Waugh, A. and Grant, A. (2014). *Anatomy and Physiology in Health and Illness*. 11th edition. Philadelphia: Churchill Livingstone, Elsevier.
- World Health Organization. (2010). 'Global Recommendations on Physical Activity and Health' [online]. Available at: <http://www.who.int/dietphysicalactivity/publications/9789241599979/en/> [Accessed 22 July 2016].
- Wulf, G. (2007). *Attention and Motor Skill Learning*. Champaign, IL: Human Kinetics.

# Professionalism and business acumen for personal trainers

## Aim

To understand the legal, professional, operational and business-related knowledge and skills essential to personal trainers working in a self-employed capacity or as part of a larger organisation.

## Learning outcomes

At the end of this unit, you will:

- Understand the legal and professional requirements for personal training.
- Understand health and safety in the workplace.
- Understand the requirements of a self-employed individual.
- Understand the legal and professional requirements for the management of personal information and records.
- Understand marketing techniques and tactics.
- Understand how to close a sale.
- Understand how to set budgets and manage finances in a personal training business.
- Understand how to monitor and interpret business data from a range of current information technology (IT) applications.
- Understand how information technology (IT) applications are used to support effective business planning and delivery.
- Understand the professional and personal importance of continuing professional development (CPD).
- Be able to plan and strategise to develop a successful personal training business.

# Introduction

It is important for the personal trainer to understand the legal and professional requirements for personal training. A thorough understanding will ensure that work is conducted in accordance with legal, professional and ethical codes of practice.

It is also important for the personal trainer (PT) to develop a strong business acumen which involves a thorough understanding of how a business operates, what will drive it forward and what you can do to influence/facilitate that drive. The development of an intuitive and applicable understanding of personal training as a business will improve the trainer's ability to make good judgements and quick decisions whilst using their initiative in the competition with other personal trainers.

# Section 1: The legal and professional requirements of personal training

There are a variety of different legal requirements that the personal trainer (PT) has to abide by. The PT's primary responsibility is to maintain the health, safety and welfare of their clients at all times. Failure to do this is likely to result in injury and possible legal action being taken against the organisation or the individual.

It is also important that the PT works within acceptable ethical and professional standards. Failure to do so will be detrimental to the industry, the business, the PT's reputation and could even result in exclusion from professional association memberships.

## The Equality Act in relation to personal training

There are various characteristics that people have in common (similarities) and some that make them different to others (differences). These characteristics include age, gender, race, ethnic origin, religion and beliefs, disability (physical or mental), sexual orientation, socioeconomic status, ability, levels of confidence, employment status, language spoken, education background, body shape and type, activity and fitness levels. People have the right to be valued and treated with equal respect and importance regardless of differences.

Some characteristics are protected by legislation to ensure that people do not experience prejudice, discrimination, harassment or bullying when using services. The characteristics which are currently protected under the Equality Act 2010 include:



- Gender.
- Marriage or civil partnership.
- Pregnancy and maternity leave.
- Sexual orientation.
- Gender reassignment.
- Disability.
- Race.
- Colour.
- Ethnic background.
- Nationality.
- Religion or belief.
- Age.

The Equality Act 2010 incorporates the Sex Discrimination Act 1975, Race Relations Act 1976 (as amended by the Race Relations Amendment Act 2000), the Disability Discrimination Act 1995, the Sexual Orientations Regulations 2003 and the Religion or Belief Regulations 2003.

PTs are required to operate within the legal framework of equality when providing services. They must ensure that all clients and prospective clients are treated equally, fairly and with the highest standards of customer care, irrespective of differences.

## The personal trainer's scope of practice

Scope of practice is a way of describing what an individual is trained and competent to do. It is essential that PTs always work within their scope of practice to ensure they work safely and effectively in the best interests of their clients. Scope of practice is defined by the knowledge, skills and qualifications which provide evidence of competence.

A PT with no further specialist qualifications should:

- Work with apparently healthy adults to collect and analyse relevant information to be able to design and implement safe and effective exercise programmes.
- When necessary, and within the limits of their knowledge and competence, adapt a general session to accommodate the needs of special population clients, including:
  - Young people (14-16-year-olds).
  - Disabled people.
  - Older people (50+).
  - Pre and postnatal women.
- Seek advice from, or refer to, other appropriate professionals (e.g. fitness or medical) if a client's needs fall outside the specific scope of practice of the PT.
- Provide information and guidance on healthy eating.
- Act as a positive role model for all clients.
- Proactively interact and develop positive relationships with clients in order to facilitate client retention.
- Keep up to date with health and fitness industry developments.
- Always be aware and work within their professional role boundaries.
- Always work within legal and professional standards.

A PT should not:

- Work with specialist population clients on a regular basis unless they have additional specialist knowledge, skills and recognised qualifications.
- Plan or deliver exercises or disciplines that they are not trained/qualified to instruct (e.g. should not 'cover' an ETM class or a spinning class if they do not hold the appropriate certificates).
- Provide prescriptive nutritional advice or develop bespoke dietary plans for clients.

(REPs, 2009)

## The role of a personal trainer

The role of a PT includes:

- Gathering and analysing relevant information from their clients to plan individualised programmes that achieve specific client goals and objectives. This includes fitness assessments to establish client fitness and skill level.
- Identifying and agreeing short-, medium- and long-term goals. This includes reviewing and adapting goals to ensure clients' needs are being met and, where required, the client is referred to a more appropriate professional.
- Providing programming and delivery of sessions that effectively apply the principles of exercise (including supervised and non-supervised sessions).
- Ensuring health and safety whilst working in a variety of environments, such as gyms, client homes, outdoors or in offices.



- Providing accurate information on the principles of healthy eating and weight management.
- Promoting healthy activities and related strategies to motivate clients to adhere to an active, healthy lifestyle and ultimately promote lasting health behaviour change.
- Seeking advice from other appropriate professionals if there are any objectives, physical activities or risks that fall outside their professional boundaries or that they do not feel competent to deal with. This might involve referral to an appropriate person.
- Maintaining client records and client confidentiality.

(REPs, 2009)

## Importance of professionalism for the personal trainer

Professional associations (e.g. Register of Exercise Professionals (REPs) and Chartered Institute for the Management of Sport and Physical Activity (CIMSPA)) have established industry standards of conduct for PTs. The PT should maintain high standards of ethical and professional conduct when providing services in fitness instruction.

Adhering to these standards is important in order to:

- Uphold the reputation of the profession.
- Encourage more engagement in physical activity and exercise.
- Generate repeat and new business.
- Gain and maintain entry on professional association registers.

### Standards expected of a personal trainer

The standards expected of a PT are split into five key areas (see Table 1.1).

1. Ensure that clients are dealt with in an open and transparent manner, maintaining a high standard of professional conduct at all times, demonstrating: <ul style="list-style-type: none"><li>• Respect for individual difference and diversity.</li><li>• Good practice in challenging discrimination and unfairness.</li><li>• Discretion in dealing with confidential client disclosures.</li></ul>
2. Develop and maintain a relationship with clients based on openness, honesty, mutual trust and respect and responsibly demonstrate: <ul style="list-style-type: none"><li>• That clients' needs are of key focus and priority, planning appropriate training programmes that take client welfare and best interests into account.</li><li>• Clear communication with clients, colleagues and medical practitioners, ensuring honesty, accuracy and cooperation when seeking agreements and avoiding misrepresentation or any conflict of interest arising between clients and own professional obligations.</li><li>• Integrity and recognition of the trust placed in PTs, ensuring that professional behaviour is always appropriate.</li></ul>
3. Conduct self in an appropriate manner at all times and responsibly demonstrate: <ul style="list-style-type: none"><li>• High standards of professional conduct appropriate to the client groups worked with and the image and expectations relevant to a PT and associated exercise and fitness organisations.</li><li>• An understanding of the legal, ethical and operational responsibilities when dealing with the public and an awareness of the need for honesty, accuracy and integrity when working in the public domain.</li><li>• A duty of care to maintain the safety of self, clients and other professionals and colleagues by following safe practices in the working environment and to be able to deal with all reasonably foreseeable accidents and emergencies.</li></ul>
4. Commit to the attainment of appropriate qualifications and continuing professional development to responsibly demonstrate: <ul style="list-style-type: none"><li>• An interest in seeking further knowledge to continuously improve professional skills to maintain a quality service (e.g. reflecting on own practice, identifying developmental needs and undertaking relevant activities).</li><li>• A willingness to be accountable for professional decisions and actions, to welcome feedback and evaluations of work and recognise when it is appropriate to refer to another professional.</li><li>• A personal responsibility to maintain own effectiveness and confine self to work within own scope of practice.</li></ul>

5. Maintain a safe exercise environment for all clients at all times and demonstrate:
- A responsible attitude to the care and safety of client participants within the training environment and in planned activities, ensuring that both are appropriate to the needs of the clients.
  - An appropriate awareness of group sizes to maintain client to instructor ratios to ensure that client safety is maintained at all times.
  - A systematic preparation of clients prior to activity to ensure safety.

Table 1.1 Standards expected of a PT (adapted from the Code of Ethical Conduct, REPs, 2011)

## Consequences of not following legal and professional requirements

The consequences for the PT of not following legal and professional requirements are many, and they can affect the employer, employee and/or the self-employed. Consequences range from possible legal action, discipline from professional organisations, poor reflection on the industry, damage to reputation and loss of business.



Figure 1.1 Consequences of non-compliance with legal and professional requirements

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- In your own words, summarise the requirements of the Equality Act 2010 in relation to personal training.
- Name the characteristics protected by law under the Equality Act 2010.
- Give examples of factors outside the PT's scope of practice.
- Make a list of the standards expected of a PT.
- Give examples of the consequences of the PT not following:
  - Legal requirements.
  - Professional requirements.

# Section 2: Health and safety in the workplace

## Responsibilities for health and safety in the workplace

Employers, employees and the self-employed have responsibilities under both the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999 to themselves and members of the public.

### POINT OF INTEREST

**The Health and Safety at Work etc. Act 1974** (also referred to as HSWA, the HSW Act, the 1974 Act or HASAWA) is the primary piece of legislation covering occupational health and safety in Great Britain. The Health and Safety Executive, with local authorities (and other enforcing authorities), is responsible for enforcing the Act and a number of other Acts and Statutory Instruments relevant to the working environment.

**Management of Health and Safety at Work Regulations 1999.** The Regulations were introduced to reinforce the Health and Safety at Work etc. Act 1974. The MHSWR place duties on employers and employees including those who are clients, designers, principal contractors or other contractors.

Health and Safety Executive, 2016

## Responsibilities of the employer

It is the employer's duty to protect the health, safety and welfare of their employees and other people who might be affected by their business, e.g. customers, suppliers and the general public. This means making sure that workers and others are protected from anything that may cause harm, effectively controlling any risks to injury or health that could arise in the workplace.

All employers, whatever the size of the organisation, must:

- Make the workplace safe.
- Maintain a safe and healthy workplace with the necessary facilities.
- Ensure that visitors and members of the public are not put at unnecessary risk.
- Assess risks and put in place procedures to manage these risks to an acceptable level.
- Provide a health and safety policy statement when employing five or more people.
- Become familiar with the contents of the health and safety policy and the parts for which they are responsible.
- Provide information, instruction, training and supervision.
- Prevent risks to health.
- Promote a culture of health and safety by ensuring that staff are fully briefed and trained in health, safety, security and welfare procedures and are constantly alert to hazards.
- Monitor staff behaviour and ensure that procedures are being followed.
- Protect, and encourage others to protect, confidential information.
- Provide the equipment needed for work and ensure it is maintained.
- Ensure that plant and machinery are safe to use, and that safe working practices are set up and followed.



- Make sure that all materials are handled, stored and used safely.
- Tell employees about any potential hazards from the work they do or chemicals and other substances used by the organisation and give them information, instructions, training and supervision as needed.
- Deal with substances such as chemicals safely.
- Make sure that ventilation, temperature, lighting and toilet, washing and rest facilities all meet health, safety and welfare requirements.
- Prevent or control exposure to substances that may damage employee health.
- Take precautions against the risks caused by flammable or explosive hazards, electrical equipment, noise and radiation.
- Avoid potentially dangerous work involving manual handling, and if it can't be avoided, take precautions to reduce the risk of injury.
- Provide protective clothing or equipment free of charge if risks can't be removed or adequately controlled by any other means.
- Ensure that the right warning signs are provided and looked after.
- Provide adequate first aid facilities.
- Report certain accidents, injuries, diseases and dangerous occurrences to either the Health and Safety Executive (HSE) or the local authority, depending on the type of business.
- Monitor and review the effectiveness of policies and procedures on an ongoing basis and improve them when necessary.
- Have health and safety policies and procedures, normal operating procedures (NOPs) and emergency action plans (EAPs).

## Responsibilities of the employee

Employees have health and safety duties as well as employers. These include the responsibility to take care of their own health and safety and that of others who may be affected by their actions at work. For good safety management it is essential for the employee to cooperate with employers and co-workers to help everyone meet legal requirements.

The most important responsibilities as an employee are:

- To take reasonable care of own health and safety.
- If possible, avoid wearing jewellery or loose clothing when operating machinery.
- Have long hair tied up/tucked out of the way (it could get caught in machinery).
- To take reasonable care not to put other people (fellow employees and customers) at risk by what they do or don't do in the course of their work.
- To cooperate with their employer, making sure they get proper training and understand and follow the company's health and safety policies.
- Not to interfere with or misuse anything that's been provided for their health, safety or welfare.
- To report any injuries, strains or illnesses they suffer as a result of doing their job (the employer may need to change the way they work).
- To tell the employer if something happens that might affect their ability to work (e.g. becoming pregnant or suffering an injury). The employer has a legal responsibility for their health and safety. They may need to suspend employees while they find a solution to the problem. Employees will normally be paid if this happens.
- Tell the employer if they're taking medication that may lead to drowsiness if driving or operating machinery. The employer should temporarily move the employee to another job if they have one available.
- If the employee has reasonable concerns about their safety, they can stop work and leave the work area without being disciplined.
- The employee must inform the employer about any health and safety concerns.



## Responsibilities of the self-employed person

The self-employed have responsibilities under both the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999 if their work activity poses a potential risk to the health and safety of other workers or members of the public.

The self-employed PT must assess the risks to their own health and safety at work and the people they work with. Examples of risks for the PT may include the working environment, equipment and screening of clients. Risk assessments must be conducted to identify, prioritise and put in place appropriate and sensible control measures.

## Duty of care

Duty of care can be defined as the moral or legal obligation to exercise a reasonable level of care to ensure the safety or wellbeing of others. A 'reasonable' level of care is considered to be when individuals have, to the best of their knowledge and ability, taken all precautions to minimise risk. Negligence is failing to exercise a reasonable level of care, and a negligent act can be intentional or unintentional.

Everyone is entitled to work in environments where risks to their health and safety are properly controlled. Under health and safety law, the primary responsibility for this is down to employers, although all professional individuals also have a duty of care and any specific queries or concerns relating to health and safety in the workplace must be reported to the employer.

For PTs, duty of care means they must ensure the health and safety of:

- Themselves.
- Other staff and professionals.
- Clients, e.g. appropriate programme design, screening, safe environment.
- Special populations (within their scope of practice).

## Duty of care in relation to special population groups

There are certain groups for whom the personal trainer has a particular duty of care:

Group	Duty of care	What would constitute an act of negligence and breach duty of care?
Special population groups.	If the PT is planning to work with a special population group on a long-term basis, additional specialist training and qualifications are required.	Working without the appropriate specialist qualifications. Acting/advertising as a specialist instructor. Instructing clients from specialist groups (one-to-one or in groups) on a regular basis. Planning progressive, long-term programmes for clients from specialist groups.
Clients with medical conditions.	Screening of clients is an essential priority and all clients must be screened before they can exercise.  Clients who answer 'yes' to PAR-Q questions must talk with their GP and be given clearance before they start becoming more physically active. Activities must then be suitably and personally modified by the instructor.	Failure to screen clients. Failure to refer clients. Failure to modify exercises as appropriate once clearance has been gained.
Vulnerable adults.	If the PT is working with a vulnerable adult, a chaperone should be present at all times.	Working with a vulnerable adult without a chaperone.

Table 2.1 Personal trainer's duty of care (adapted from the occupational descriptors for the PT, REPs, 2009)

## Consequences of not following legal requirements

Individuals who fail to follow current health and safety legislation may be made liable for any incidents/accidents that occur.

If the duty of care/service is put into question, it might end up in a court of law and any relevant documentation can be used as evidence either for or against. A court will consider two things: what the current standard working practices are within the industry and the chain of responsibility to highlight areas of failure (negligence). An example of negligence might involve not screening a participant prior to exercise who has known exercise contraindications, e.g. diabetes or coronary heart disease.

By knowing and following current health and safety legislation, employers and employees will protect themselves from legal action.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Which two pieces of health and safety legislation cover a PT's responsibilities?
- Summarise the responsibilities in the workplace for the:
  - Employer.
  - Personal trainer, as an employee and self-employed professional.
- Make a list of the specific things that the PT can do to ensure duty of care is upheld.
- Consider what would be classed as a breach of duty of care when working with:
  - Clients.
  - Special populations.

# Section 3: Requirements of being self-employed

## Requirements for the self-employed in the UK

If a personal trainer decides to start working for themselves, they will be classed as self-employed or a sole-trader. There are certain legal requirements for the self-employed in the UK which include:

- Registration with HM Revenue and Customs (HMRC).
- Keeping accurate business records.
- Completing tax returns and paying income tax.

### Registration

The self-employed PT must register with the HMRC to make sure that they pay the correct income tax and national insurance. Registration must take place as soon as possible after starting the business and at the latest this should be by the 5th October in the second year of business.

### Business records

The self-employed PT must keep detailed records of their business income and outgoings. This may take the form of formal and structured income and expenditure accounts, or it may be a more informal list of payments into and out of the business.

Whichever format is selected, it is essential that these records are maintained accurately and that they are kept for a period of five years so they can be made available for HMRC audit if required.

### Business expenses

The self-employed PT will have various business running costs. Some of these costs can be deducted to work out taxable profit as long as they're valid and allowable expenses incurred for the running of the business. This does not include money or items for personal use.

Allowable expenses include:

- Office costs.
- Travel costs.
- Clothing expenses, e.g. uniforms.
- Staffing costs.
- Things you buy to sell on, e.g. stock.
- Financial costs, e.g. insurance, bank charges.
- Business premises costs, e.g. heating, lighting, business rates.
- Advertising or marketing, e.g. website costs.

Valid expenses are a recognised part of running a small business and are deducted from any accounts. Tax payments are calculated based on net profit.



## Tax and the self-employed

Self-assessment is the system HMRC uses to collect income tax. The self-employed must complete a self-assessment tax return showing earnings for the tax year (between 5th April one year and 4th April the next). This is done once a year and must be submitted by 31st January or a penalty fine is imposed.

### Paying income tax

The self-employed PT will pay tax each year in two payments on 31st January and 31st July, unless:

- The last self-assessment tax bill was less than £1,000.
- If they have already paid more than 80% of all the tax they owe.

## Insurance requirements for the self-employed

The self-employed personal trainer will need to consider the insurance they need for their business. There are lots of different types of business insurance and they will need to find out what cover is needed and the best policies to fit their needs. Types of insurance to consider include:

- Professional indemnity.
- Public liability.
- Personal accident/sickness.
- Motor insurance.
- Cyber and data risk insurance.
- Home business insurance.

### Public and professional liability

Professional indemnity insurance is essential for those who offer services or advice to clients, such as personal trainers. This type of insurance will pay out if the client suffers financial loss, e.g. time off work due to an injury or accident that occurs whilst undertaking personal training sessions. Although we like to think this will never happen to us and take all steps to reduce risk, injuries and accidents do happen.

Public liability insurance will protect the PT business against the cost of settling or defending a claim from a client or member of the public for injury or damage to property. This can also apply if damage is done to a client's property during a home visit.

### Personal accident/sickness insurance

It is important for the self-employed personal trainer to consider the implications if they are unable to work due to injury or illness. Personal accident/sickness insurance will protect against income loss and can offer a real lifeline if a PT is unable to work.

### Motor insurance

Motor insurance is often overlooked when setting up a PT business. However, it is important that the personal trainer is appropriately insured if using their car for business purposes. Business use includes travelling to and from place(s) of work as well as the transportation of equipment (a standard motor policy tends to cover the vehicle for social, domestic and pleasure use only). If the PT is travelling to different locations to meet clients, they are unlikely to be insured without the additional cover.

### Carrying equipment

The personal trainer must make sure that they understand the conditions for carrying equipment as this may not be automatically covered by their insurance and there are likely to be a number of exclusions. The insurer is unlikely to pay out for equipment stolen if the car was left unlocked or unattended. It is essential to check with the insurer to make sure that everything is covered, and although this may result in an increased premium, it will help the PT cope with the financial implications of an incident. The insurer may also insist that additional measures are taken before they will cover equipment in the car, e.g. extra security.

## Cyber and data risk insurance

Cyberspace is full of harmful viruses and unscrupulous hackers. A PT will store client records and use emails at the very least, and is therefore vulnerable to cyber-attack. The amount of cover that is needed will depend on how much IT infrastructure there is, e.g. how much would it cost to repair if it all went down? Consideration is also needed for the consequences if clients' personal data is stolen. The PT would be liable for that unauthorised collection and the client can sue for compensation. It would therefore be prudent in today's technological society to invest in this type of insurance.

## Home business insurance

The PT should not assume that essential business equipment such as their computer, printer and mobile phone are automatically covered under their home policy. PTs should inform their home insurers if they are running their business from home as additional cover may be needed; failure to do so could invalidate their home policy if a claim is made. It is likely a lot of money will have been invested in business equipment, and it is worth paying an additional premium to safeguard business fundamentals. Cover can be obtained for accidental damage or if the items are lost or stolen.

## Demands of running a successful personal training business

Working as a personal trainer is very rewarding, but the demands of running a successful personal training business are not to be underestimated. Personal training is demanding in terms of time and energy. The PT is likely to work hard both physically and mentally, working long days, weekends and anti-social hours.

### Time management

On any given day, the personal trainer may be meeting with several clients while also trying to focus on their own professional development, fitness and home life. They are also at the mercy of their clients' schedules, which often means having to be flexible, e.g. changing appointments to fit with clients' needs. It is no surprise, then, that many PTs struggle with time management. It is important that the PT has strategies in place to maximise daily productivity and to organise and maintain a better work/life balance. There are many things the PT can do to effectively manage their time:

- Prioritise:** Prioritisation is a skill that will create calmness and space so that attention can be paid to the things that matter. Prioritising ensures that time is allocated where it is most needed and will be most wisely spent.
- Plan, schedule and set goals:** Planning is important as it draws attention to what can realistically be achieved in the time available. Extra time should be added for the 'unexpected'. Planning is essential to keep on track and accomplish goals.
- Avoid interruptions:** Interruptions can steal the time needed to achieve goals. Sometimes assertiveness and the ability to say no is needed, but other interruptions may not be as easy to overcome. It is useful to keep a log of interruptions for a week in order to highlight factors that are robbing time. Action should then be taken to avoid, manage or schedule interruptions into the work day so that adequate time is available to address daily workload.



### POINT OF INTEREST

Overtraining will eventually result in injury or illness and therefore influence the PT's ability to work.

## Motivation and retention of clients

Motivation and retention of clients is an ongoing challenge for the PT. Client retention starts with delivering sessions that meet or exceed a client's expectations, along with building a strong professional relationship and ensuring that all clients feel valued. The personal trainer has to ensure that this relationship is maintained and that sessions are creative, challenging and appropriate to each client's changing needs and requirements. This is essential to keep motivation and retention levels high.

## Differentiation of business from the competition

The PT market is extremely competitive, and to be successful it is important for the business to be set apart from the sea of competition, e.g. what makes the personal trainer unique? Consideration should be given to what the personal trainer can do to set themselves apart from the rest. This may be offering additional services, further training or establishing expertise, e.g. writing blogs. There are many innovative ways to make a PT business different, but this is an ongoing challenge and requires effort, creativity and commitment.

## Physical demands

Keeping in shape is a fundamental component of being a PT. It goes without saying that PTs will have a difficult time motivating others if they are not in shape themselves. However, PTs frequently suffer from overtraining and injury due to the demands of the role. It is crucial that a PT takes action to recognise the signs of overtraining and has strategies in place to reduce the risk, such as:

- Limit the amount of sessions delivered or implement strategies to reduce the physical impact of each session.
- Choose light weights when teaching/demonstrating.
- Ensure demonstrations maintain body balance (e.g. try to avoid always demonstrating unilateral exercises using the same side of the body).
- Plan rest days, get enough sleep and pay attention to proper nutrition.
- Do not ignore the signs/symptoms of overtraining.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Explain what responsibilities you will have if you become a self-employed PT.
- For how long should business records be kept?
- Make a list of examples of allowable business expenses.
- Explain the types of insurance that a self-employed PT may need.
- What is the difference between public and professional liability insurance?
- Why is cyber and data risk insurance important?
- List the demands of running a successful PT business.
- What strategies can be used to manage time more efficiently?
- What strategies can be used to motivate and retain clients?
- List examples of features that could differentiate one PT from another.
- How could you reduce the physical demands of being a personal trainer?

# Section 4: Legal and professional requirements for the management of personal information and records

## Data Protection Act 1998

The Data Protection Act 1998 applies to personal records held on a computer or in hard copy files and covers anything that is done to or with personal data, including how it is:

- Collected.
- Used.
- Stored.
- Disclosed (and who to).
- Disposed of/destroyed (and when).

A PT will need to collect, store and use client information in order to meet client needs and expectations. The personal trainer needs to comply with the Data Protection Act by adhering to the data protection principles.



There are seven key principles of the Data Protection Act 1998.

### **Principle 1: Data must be fairly and lawfully processed.**

This means the PT must:

- Have legitimate grounds for collecting and using personal data.
- Not use the data in ways that have unjustified adverse effects on the individuals concerned.
- Be transparent about how they intend to use data and give individual appropriate privacy notices when collecting personal data.
- Handle people's personal data only in ways they would reasonably expect.
- Make sure they do not do anything unlawful with the data.

### **Principle 2: Data must be processed for limited purposes.**

This means the PT must:

- Be clear from the outset about why they are collecting personal data and what they intend to do with it.
- Comply with the Act's fair processing requirements – including the duty to give privacy notices to individuals when collecting their personal data.
- Ensure that if they wish to use or disclose the personal data for any purpose that is additional to or different from the originally specified purpose, the new use or disclosure is fair.

### **Principle 3: Data must be adequate, relevant and not excessive.**

This means the PT must:

- Hold personal data about an individual that is sufficient for the purpose they are holding it for in relation to that individual.
- Not hold more information than they need for that purpose.

**Principle 4: Data must be accurate.**

This means the PT must:

- Take reasonable steps to ensure the accuracy of any personal data obtained.
- Ensure the source of any personal data is clear.
- Carefully consider any challenges to the accuracy of information and consider whether it is necessary to update the information.

**Principle 5: Data must not be kept for longer than necessary.**

This means the PT must:

- Review the length of time they keep personal data.
- Consider the purpose(s) they hold information for in deciding whether (and how long) to retain it.
- Securely delete information that is no longer needed for this purpose.
- Update, archive or securely delete out-of-date information.

**Principle 6: Data must be processed in accordance with individuals' rights.**

This means that individuals have the right to:

- Access a copy of their personal data records.
- Object to processing that is likely to cause damage or distress.
- Prevent processing for direct marketing.
- Object to decisions being taken by automated means.
- Have inaccurate personal data rectified, blocked, erased or destroyed.
- Claim compensation for damages caused by a breach of the Act.

**Principle 7: Data must be kept securely.**

This means the PT must:

- Design and organise security to fit the nature of the personal data they hold, and consider the consequences of a data breach.
- Be clear about who in the organisation is responsible for ensuring information security.
- Ensure they have the right physical and technical security, backed up by robust policies and procedures.
- Be ready to respond to any breach of security swiftly and effectively.

## Accurate and confidential record keeping

Maintaining accurate records is an important part of the PT's role. Record keeping is an important tool to establish and maintain client history. This will include information such as lifestyle, body composition, exercise programme and progress. Records should be continually updated with accuracy to clearly show the client's journey, and will act as a benchmark to measure progress. Records are also important as a motivational tool to reassure clients that what they are doing is yielding the required results or as a tool to identify what is not working.

**CONFIDENTIAL**

It is essential that records are accurate, objective and kept up to date so that the personal trainer can assess progress and modify/adapt as appropriate to meet clients' ongoing and often changing needs. Records should be accurate to ensure accountability and professional responsibility.

Ensure that records are maintained confidentially, e.g. not left lying around the gym. They must be filed securely when not in use. Maintaining confidentiality is a fundamental part of professionalism and compliance with the Data Protection Act.

## Data and information technology (IT) applications

UK data protection laws have remained fairly static over the last 20 years; the existing UK Data Protection Act dates from 1998. Yet the digital and technological landscape has changed dramatically in this time, and more and more businesses are improving productivity and efficiency by using digital technologies. Cybercrime is also on the rise and can result in disruption, financial loss and theft of intellectual property.

The personal trainer will most likely sell and advertise their services online and will store clients' details and personal data, and therefore they have a responsibility to protect against the possibility of data breach. The most common types of breach are viruses, malicious software which can steal personal information, e.g. spyware/malware, and impersonation of a business/organisation through email scams and websites.

The UK government has stressed the importance of cyber security, and has committed to investing heavily to ensure the UK is a safe place to do business online.

There is a wide range of free guidance and training on the internet which shows how to protect against cybercrime. The impact of cybercrime can be substantial and result in repair costs, loss of revenue and reputational damage as well as the legal implications for the personal trainer if clients' personal data is stolen.



The personal trainer has a legal obligation to protect clients' personal data.

## Consequences of breaching the Data Protection Act

The consequences of breaching the Data Protection Act include:

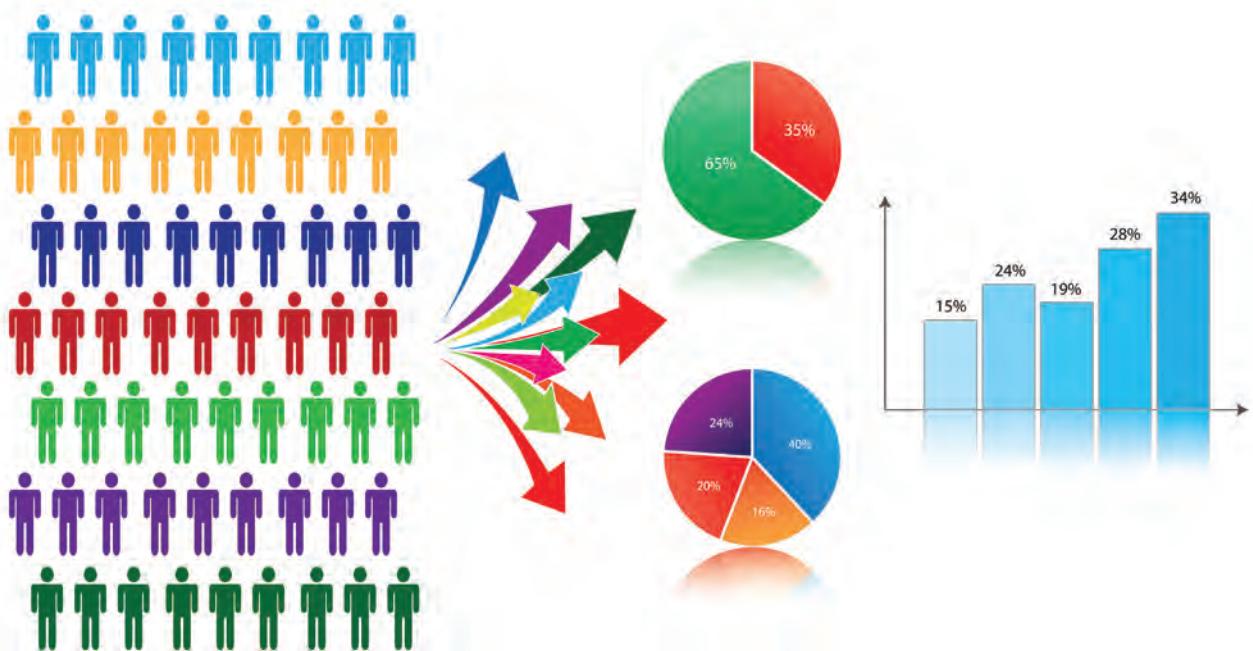
- Legal action.
- Loss of business.
- Bad reputation.
- Financial costs.
- Exclusion from professional associations.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- In your own words, explain the Data Protection Act and what this means for the PT.
- Explain why client records must be accurate.
- Make a list of the different types of cybercrime that may affect a PT and their business. Consider what you could do to reduce this risk.
- Explain the consequences of not following legal and professional requirements and give examples.

# Section 5: Marketing techniques and tactics



The Chartered Institute of Marketing (2016) defines marketing as: 'The management process responsible for identifying, anticipating and satisfying customer requirements profitably'.

So, put simply, marketing is about finding out:

- What potential customers need or want.
- The size of the existing or potential market.
- Customers' expectations.
- Potential competitors – their strengths, weaknesses and position in the marketplace.
- Appropriate pricing structures for the products or services on offer.

In conjunction with the information-gathering aspects, marketing also requires involvement in the following activities:

- Effective communication – all internal and external customers must receive accurate and valuable information about the products or services (if no one knows about the key characteristics of the offerings then generating sales will be challenging).
- Product or service development – to ensure the offerings add value to customers and meet their needs, wants and expectations.
- Product or service delivery – to ensure that offerings reach the consumer efficiently.
- Valuable exchange – customers must be prepared to pay for the product or service and they must believe that they are receiving value for their purchase. In general, the overall role of marketing in business is to maximise the profitability of a product, service or brand. Often the overall aim is forgotten during the execution of any marketing strategy. If the focus of a marketing strategy is diverted away from profitability and towards maximising sales, then the costs of creating those sales can wipe out any profit.

For example

A company produces high-quality, high-cost marketing literature which drives an additional 100 sales, making an additional £1,000 income.

Each brochure costs £2 to produce and they give out 10 for every 1 sale generated.

Income = £1,000

Cost = £2 x 1,000 = £2,000

The business actually lost £1,000.

## Role of marketing in a personal training business

Ultimately, the role of marketing for a personal training business is to maximise profitability. In order to do this, a number of factors must be investigated and processes put into action (see Figure 5.1).

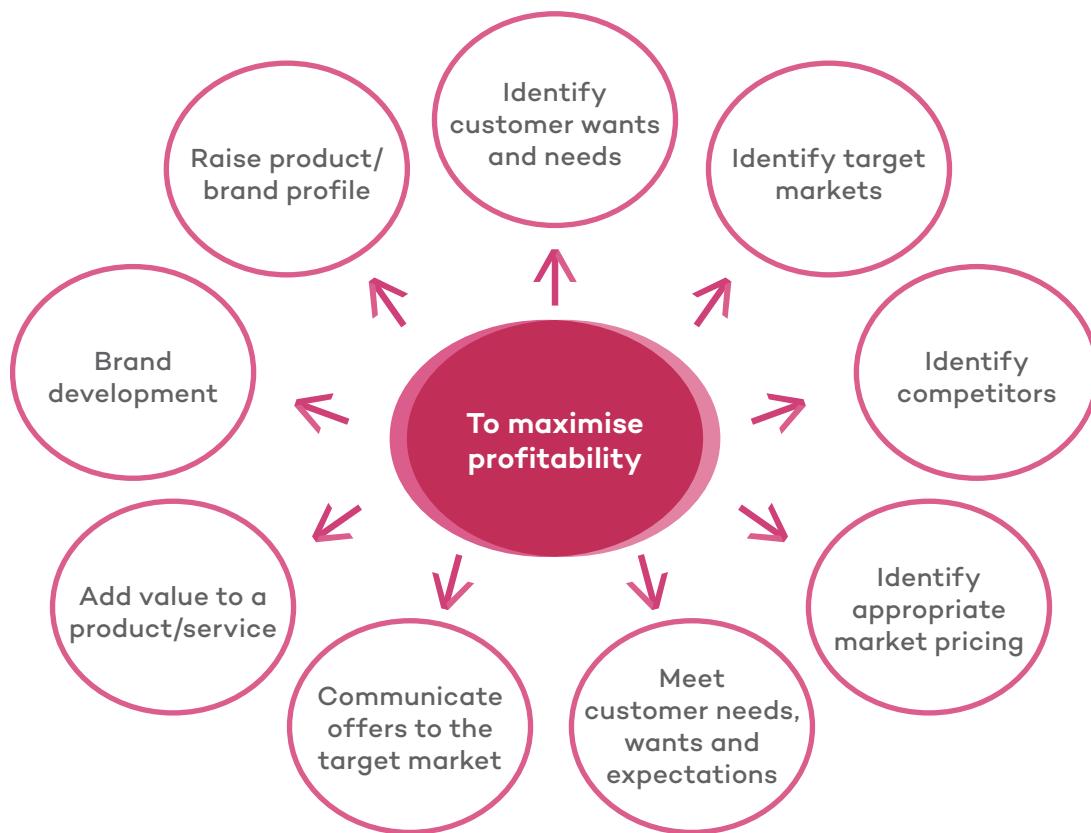


Figure 5.1 How to maximise profitability

## Factors that influence marketing decisions

There are many potential factors which will shape and influence the marketing decisions of a personal training business:

- **Internal factors** are factors within the personal training business that impact the approach and success of the business, e.g. finances, human resources, operational issues and business culture (customer-focussed/sales-orientated).
- **External factors** are outside the personal trainer's control, e.g. the economy, competitors, market dynamics and technological, social and political change.

## Marketing mix

The marketing strategy of the business revolves around what is referred to as the ‘marketing mix’. In its simplest form, the marketing mix is sometimes known as ‘the four Ps’:

**Product      Price      Promotion      Place**

Since the development of the original marketing mix, the principle has been extended to include three more Ps:

**People      Processes      Physical resources**

In order to be successful, the marketing strategy needs to be balanced and include elements of all seven Ps. If any one of the elements of the marketing mix is weak, or non-existent, the whole marketing strategy is likely to be weak and ineffective.



If one element of the ‘marketing mix’ is weak, the whole marketing strategy is likely to be ineffective.



### Price

Establishing the price of a product or service can be a real challenge, as there are many ways to set prices. The key is to ensure that the customer is getting ‘value for money’. This may not be purely based on the cost. There may be many factors in addition to the financial cost that affect a customer’s perception of ‘value for money’, including emotional desire, prestige, benefits or product worth.



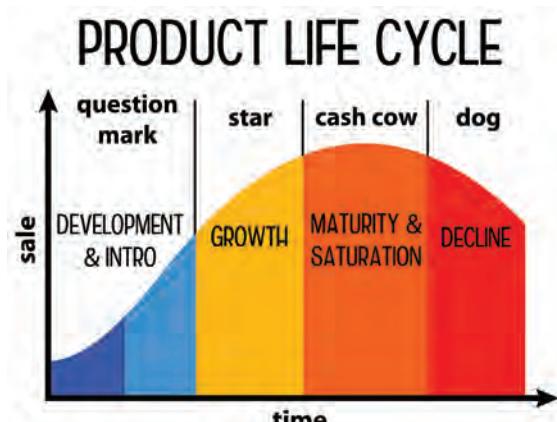
### QUESTION

How many ‘fitness trends’ have come and gone?

### Product

The product may not just be the actual product or service itself; it could also include the benefits (perceived or real) of the product or service. The product or service on offer must be something that people want and are prepared to buy or take part in. When considering the product in the marketing mix, it must also be noted where the product or service is in its life cycle. Nothing lasts forever and all products and services have a lifespan – in other words, a ‘sell-by date’. This is seen quite often in the fitness industry; there are always new fitness trends which disappear a year later. Every trend, whether it is equipment or type of training, will follow a ‘product life cycle’. This consists of:

- Introduction – the idea for a new activity or product is introduced.
- Growth – the product becomes increasingly popular.
- Maturity – the product becomes very well-known and popular.
- Saturation – everybody has one or there is little opportunity to grow the market any bigger.
- Decline – past its sell-by date and lacking in popularity, the product eventually ‘dies’.



The fitness industry is renowned for trends and we have all seen different types of classes/equipment rise in popularity, reach a peak and then decline; then find that everyone has moved on to the next latest craze.

## Promotion

When preparing a marketing strategy there is a need to consider the most effective way to communicate with existing and potential customers. Marketing budgets are often limited, so it is important that any expenditure is effective and produces the required outcome (e.g. more sales/clients). Traditional methods of promotion involve advertising, direct mail, newspaper advertisements, etc. However, social media is gaining popularity as a marketing tool because it's a low-cost, low-resource option with the potential to reach larger and even global audiences.

## Place

Traditionally, the term 'place' in the four Ps related to ensuring that the marketing activities were carried out in the correct geographical location. For example, a billboard located too far from a leisure facility would have little impact, as the people who would use the facility are not located in that place.

This term also prompted consideration of how large an area marketing should occur in. For example, a national TV advertising campaign for a local organisation would provide poor returns because although a large amount of people would see the advert, only a few of them would realistically have the potential to become customers. National campaigns are unlikely to be of benefit to the personal trainer, unless they work nationally, as their client base will be within a defined geographic area.

However, technological advances in electronic and digital marketing are presenting another consideration relating to the term 'place' – the personal trainer can now pinpoint specific target markets and areas. They should consider:

- Where digital advertisements are placed and on which webpages.
- What keywords would improve the placing of their business webpage/marketing information on a search engine.
- Filtering of adverts to ensure they reach the right target market, e.g. Facebook advertising has filtering facilities.
- How to best place an advert so that it grabs a customer's attention.



### ACTION POINT

Consider what opportunities the PT will have for offering clients additional services or products.

## People

When implementing a successful marketing campaign, it is essential that all the people who may have contact with potential clients have accurate and clear information that relates to the product or service and any current offers or promotions. For the personal trainer, this may include:

- Administration staff.
- The centre that they work out of.
- Colleagues.
- Previous and existing customers.
- Other potential customers.

A marketing strategy should therefore include consideration and planning for how the marketing messages can be delivered to each group of people to maximise the potential impact.

## Processes

This term relates to any system involved in the selling, delivery or aftercare of a product or service. Consideration must be given to how each process will run smoothly and meet customer expectations, for example:

- If the personal trainer promises a service that cannot be delivered (e.g. free personal training sessions once a week as part of a membership) then the customer expectations will be unrealistically high.
- If the client is expecting an outcome (e.g. weight loss) to be delivered within a week but it actually takes a month, the customer perception is likely to be negative, even if it was better for the client to lose weight slowly. If demand for the personal training service is surprisingly high and appropriate processes are not in place to supply that demand, this could increase negative customer perceptions.

The key to process consideration is to ensure plans are realistic and to only promise what can be delivered. It is also essential to include some type of contingency planning and leeway in any claims made about processes to ensure a customer is always pleasantly surprised. For example, if a client set a target to lose weight in a month but lost weight sooner, then the client reaction is likely to be positive. Although the overriding concept is to avoid 'over-promising' and 'under-delivering' it is also important to not excessively 'under-promise and over-deliver', as this can have a negative effect on customer perception: the value of marketing claims and information is lost as a consequence of the inaccuracy.

Essentially, the marketing strategy should ensure that processes are:

- Well-planned.
- Well-implemented.
- Smooth and efficient.
- Sufficient.
- Appropriate.
- Consistent.

## Physical resources

The provision and utilisation of physical resources and evidence to support marketing messages can be very powerful when convincing customers to make a purchase. Case studies and customer testimonials can be useful for supporting any claims made, especially if they demonstrate positive customer experiences that reflect the marketing messages and customer expectations, wants and needs. Supporting evidence can also be useful for convincing clients that a message is accurate. For example, if a client

is looking for a personal trainer on the internet but the website photographs are poor quality or show incorrect technique, the potential client is likely to believe that the service you provide will be poor quality too. Alternatively, an excellent photograph that illustrates the service in a positive way, alongside a clear brief of the service details and some customer testimonials, would give the client confidence that the service will be high quality.



The PT must ensure that they have relevant marketing strategies to engage and attract prospective clients.

## Common marketing methods/techniques

The personal trainer must take the time to carefully market their services as this is crucial in order to be successful in such a competitive market.

The digital age and the introduction of online marketing and social media have transformed the ways personal trainers can interact and engage with their audience. Meanwhile, promoting services through business cards, flyers and posters remains effective, and can be a great way to gain local clients.

There are many common marketing tools, which all have advantages and disadvantages, and the choice of marketing tool will depend on the marketing objective.

Examples of common marketing tools include:

- Websites/search engine optimisation.
- Social media.
- Webinars/blogs.
- Media, e.g. newspapers, magazines, radio.
- Flyers/posters/business cards.
- Email marketing.
- Marketing platforms, e.g. Google AdWords.
- Word of mouth/referral incentives.
- Trade fairs/exhibitions.

# Purpose of a marketing strategy for the personal trainer

Most personal trainers will have come into the industry for the simple reason that they enjoy fitness and have a passion to help others live healthier lives. However, in order to ensure personal training is a viable long-term business opportunity, marketing and promotion are every bit as important as the knowledge and skills acquired by the personal trainer. In order to promote new business, gain financial benefits and keep ahead of the competition, the personal trainer will need to put in place a rounded, comprehensive and engaging marketing strategy. The marketing strategy will be made up of data collected from market research and market intelligence.

Market research is the process of collecting, analysing and presenting information to answer or address a specific marketing question, concept or problem (e.g. statistics, feedback and opinion about a product, service, brand or strategy). In contrast, market intelligence is the term used to describe the general collection of data about the marketplace (e.g. competitor analysis).

## Market research and intelligence

Before beginning market research and deciding which methods to use, the personal trainer will need to choose the specific purpose of the research. This may be assessment of whether the demand is there for a particular type of session or the use of a new piece of equipment. Factors for consideration are:

### Clients:

- Who are your potential clients?
- Where do they live?
- What are their habits?
- What is their budget?

### Competition:

- Who else operates in your area?
- What services do they offer?
- What do they charge?
- How do they market?



There are many methods of collecting data to answer a specific marketing question, but market research can often be labour-intensive, time-consuming and costly, so it is important to collect the correct data in the most appropriate way to ensure expenditure is managed.

- Have a clear purpose for the market research.
- Have clear questions that facilitate the gathering of useful information.
- Choose the most efficient and effective method of collecting the data.

Market research questions can be quantitative or qualitative in nature. Specific methods of collection include:

**One-to-one interviews**

**Focus groups**

**Surveys**

**Questionnaires**

**Field trials and experimentation**

**Secondary research**

**Observation**

## Crowdsourcing

Crowdsourcing is a modern term used to describe the locating and obtaining of services, opinions or ideas from large communities. The method of communication used for crowdsourcing is usually online, as this offers the opportunity to reach the maximum amount of people with the least amount of effort.

Crowdsourcing is being used across the world to:

- Innovate and develop new ideas using a range of people with different perspectives who would not be easily accessible using traditional methods.
- Complete projects cheaply and efficiently by breaking down large tasks which would have previously been done by one person into micro-tasks that can be accomplished by many people.
- Design products, services, graphics and webpages cheaply and with better quality control than traditional approaches (a large amount of submissions are received and only the most appropriate are purchased).
- Fund new initiatives and investments (many people can invest or donate a small amount to create a large investment pot).
- Perform market research across wide populations.

Crowdsourcing facilitates access to a vast and diverse network of people who can help create, develop and fund projects, consequently adding weight to the statements 'many hands make light work' or 'two heads are better than one; many are even better'.

## Conducting market research



Figure 5.2 Market research processes

## Market research analysis

Depending on whether the data collected is quantitative, qualitative or both, the analysis would be carried out slightly differently.

### Qualitative data

Qualitative data consists of opinions, feedback and comments related to the question posed and is primarily exploratory in nature. Analysis of this type of data involves uncovering any particular trends, thoughts and opinions. When reporting qualitative data, it is customary to include real examples of comments that illustrate the noted trends. Typical qualitative research methods include focus groups, interviews and observations. Qualitative questions tend to be open and encourage broad, discussion-based comments and answers.

### Quantitative data

Quantitative data consists of measurable, numerical information. Analysis of this type of data entails creating statistics and quantifiable results that are more structured and tangible than qualitative results. When reporting quantitative data, it is customary to use tables, graphs and charts to demonstrate patterns. Typical quantitative research methods include questionnaires and surveys.

Different research methods can lend themselves to the collection of either quantitative or qualitative data; however, this very much depends on the type of question(s) asked.

Quantitative questions tend to be closed and require a definite numerical, yes/no/don't know-type response. Qualitative questions tend to be open and encourage broad, discussion-based comments and answers.

### For example

#### Quantitative question

How would you rate the comfort of wearing a heart rate monitor out of 10?

#### Qualitative question

How do you feel about wearing a heart rate monitor?

Analysis should also include drawing comparisons between the collected data and:

- Market competition.
- Initial plans, projections and expected outcomes.

### SWOT analysis

At this stage it may also be beneficial to conduct a SWOT analysis of the product, service or brand, taking into account all the types of information collected during market research, competitor analysis and other planning and preparation activities.

The strengths and weaknesses analysis boxes encourage identification of inherent pros and cons of the specific product, service or brand (e.g. a strength of a product may be that it is bright and eye-catching, whereas a weakness may be that it is flimsy and easy to break).

The opportunities and threats analysis boxes require the identification of any external pros and cons (e.g. an opportunity may be that the product fills a gap in the market and there is nothing like it around at the moment; a threat may be that a competitor is currently developing an alternative product).



### Presenting and acting on research findings

All findings should be presented in a clear and manageable manner that puts the main points and actions across to ensure the project is a success. In order to do this, a marketing plan must be well-structured and include only key information that benefits the project (see Figure 5.3). Avoiding including all the information that was collected can be challenging but useful, as excessive information in a marketing strategy can negatively affect clarity and impact.

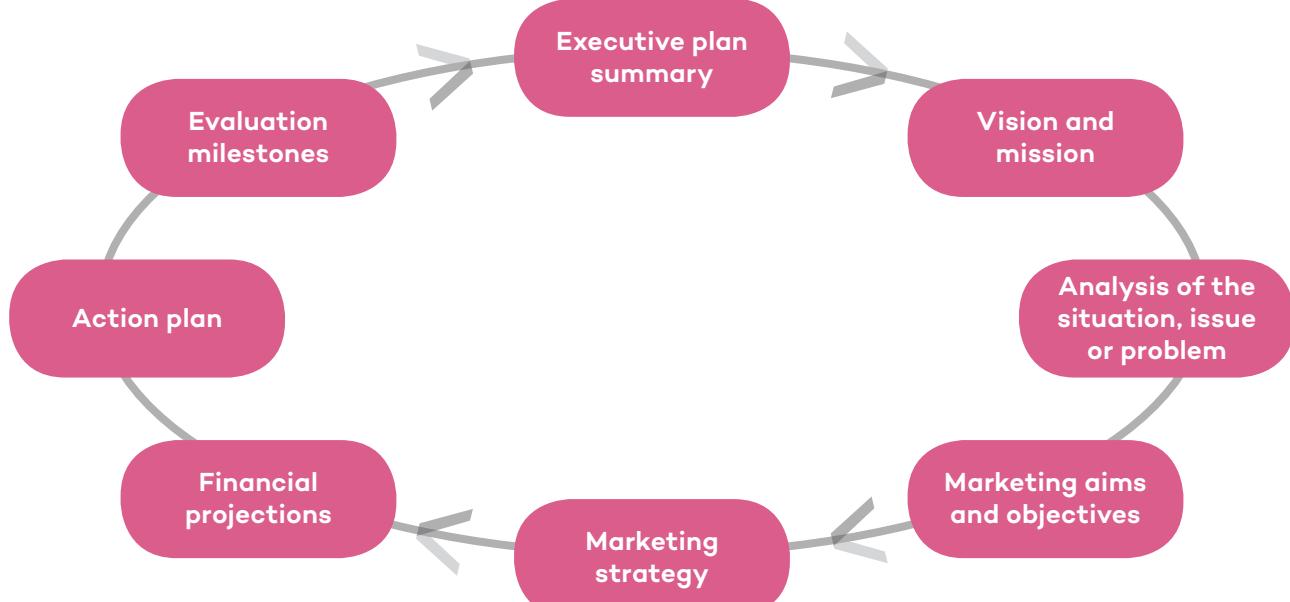


Figure 5.3 The structure of a marketing plan

## Important points for maximising marketing success

### Goal-setting

Goal-setting is an important process to ensure that goals are met as they are a reminder of where the personal trainer is currently at and where they want to go. Setting goals is relatively easy but achieving them is not always so easy. SMART goals help to clarify aims and objectives and keep the personal trainer on track (see Figure 5.4).



Figure 5.4 The SMART acronym

### Personal characteristics and interpersonal skills

Personal characteristics and interpersonal skills are crucial when marketing self and the PT business.

How the PT is perceived and communicates will influence the success of building/growing a PT business. Good interpersonal skills are essential for maintaining a professional image and positive relationships. Development of a PT's personal and social competencies is essential to influence positive relationships and performance. The best marketing plan may not be effective if communication and interpersonal skills are poor. Positive personal characteristics and interpersonal skills for maximising the success of any marketing plan include being:

- Outgoing and friendly.
- Approachable.
- Empathetic.
- Charismatic.
- Willing to learn new skills.
- Passionate.
- Knowledgeable.
- Organised.
- Confident.
- Professional.
- Flexible.
- Interested.
- Enthusiastic.

### Positive promotion of self and personal training business

It is essential for the PT to be able to effectively and positively promote themselves and the business in order to drive the business forward. There are many resources the PT can use for promotion purposes: some are free (e.g. positive word of mouth, networking and promotion) and others require significant financial investment (e.g. external advertising and advertorials). It is important that the PT selects the right type of promotion methods for their specific business so that the costs are proportional to the potential income they could stimulate.

Some simple methods of ensuring positive promotion of a PT business include:

- Creating a unique visual profile.
- Use of positive imagery.
- Creating and maintaining a positive digital profile.

## Visual profile

The visual profile will be how the PT communicates and asserts their business identity through print and online media, e.g. logo and website. It is important that the image portrayed is positive and professional so that the PT stands out from their competitors.

A good visual profile must meet certain criteria:

- Must be recognisable.
- Must give the business personality.
- Must stand out from competitors.
- Must be professional.
- Must portray the right message and image.

A properly developed visual profile will bring many benefits, including:

- Awareness – as identity becomes developed, awareness of business will grow.
- Bonding – a strong identity creates a sense of belonging and reliability.
- Staying power – control of business identity will allow quick and effective response to change, assisting in ability to survive change.
- Positioning – gives opportunity for the PT to show the culture, value and ethics of the business.
- Savings – a well-designed identity will save money long term, as there will be no need to constantly update graphics, etc.

It is likely that PTs will be using technology to enhance and expand their visual profile and presence. The PT will at least have a website and possibly be using social media sites. Technology has brought with it the ability to showcase ‘unique professional stories’ and PT businesses in many unique and creative ways. If used correctly, technology can help the PT to enhance their reputation, network, advertise, convey values and differentiate from competitors. It is important for the PT to maintain a positive and professional digital profile as a negative profile will affect business and deter clients.

## Use of positive imagery

Images are known to have a more powerful and immediate effect than words. The brain is more accustomed to processing images and this can be seen from birth. For example, a baby understands the image of their mother months before being able to understand what the word ‘mummy’ means. Basically, we understand images instantly and have to learn to interpret text (Pant, 2016).

Images and visual content will engage clients much more than words and should be used as powerful marketing tools. PTs have the opportunity to enhance their business presence with the use of many uploadable files, e.g. photos, images, blogs and videos. PTs should be aware of any images which are related or linked to themselves or their business and ensure that they positively reflect the business vision and values.

## Creating and maintaining a positive digital profile

Almost everyone has a digital profile and reputation. We create a lot of profiles for ourselves through social media and other websites. However, digital and social media often blur the lines between private and professional lives.

A digital profile will often give people a lot of information about the PT and their business. A poor digital reputation can affect friendships, relationships and ultimately a business. It is important that the PT is aware of the picture they are painting of themselves online and take action to protect and uphold a good digital reputation.



Ways to protect a positive digital reputation include:

- Stop and think about content that is posted.
- Always treat others with respect online.
- Use privacy settings.
- Keep an eye on photos tagged by friends and remove any that may cause offence.
- Remember that online information may be viewed by existing and potential clients, business partners or external parties who may discuss their findings with existing and potential clients.

### Cleaning up a digital reputation

Cleaning up a digital reputation can be a difficult task but it is not impossible. The past cannot be erased and information could be there forever, but the PT can build a better image of themselves over time. Steps that can help to clean up a digital reputation include:

- **Find it** – Determine what damaging information exists.
- **Bury it** – Information cannot be made to disappear, but creating more good information can make it harder to find the bad.
- **Remove it** – Request removal of the damaging information from the owner of the site.
- **Hire a service to resolve it** – There are a growing number of services who can help to manage or clean up an individual or business' online reputation.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- What is the purpose of marketing?
- Should marketing focus on maximising sales or profitability?
- What are the risks if marketing is focussed towards maximising sales only?
- List the factors that you need to consider and put in place to maximise profitability.
- List the components of the marketing mix. For each 'P', give an example in relation to personal training.
- Consider the advantages and disadvantages of commonly used marketing tools.
- What is the purpose of a marketing strategy for the personal trainer?
- Identify the differences between market research and market intelligence.
- What marketing strategy would you use to attract and engage with prospective clients?
- List specific reasons why a PT may wish to carry out market research.
- List common methods used to collect data. Consider the advantages and disadvantages of each.
- In your own words, explain your understanding of 'crowdsourcing'.
- What is the difference between qualitative and quantitative data?
- What is a SWOT analysis?
- Perform a SWOT analysis on a potential business idea.
- List the stages of a marketing plan.
- Consider factors that can help to maximise success in marketing. For each factor, consider why they are important.
- What is a visual profile made up of?
- List the factors that would make a good visual profile.
- What is your digital profile made up of?
- List the advantages and disadvantages of using a digital profile for business.

# Section 6: Closing a sale

PTs are generally committed, enthusiastic individuals who have a variety of skills, knowledge and experience that they can use to help their clients achieve their health and fitness goals. However, the most competent and capable PT may not do very well in business if they do not have a basic understanding of selling and ultimately the ability to close a sale. There are many skills, techniques and methods the PT can use to help them successfully sell their services, close a sale and gain new business. Whichever technique or method is selected, it is essential that the PT and the potential client are comfortable. Any discomfort can lead to a degeneration in the relationship and rapport that have been built during the sales process. This may result in a lost sale, either immediately or in the future.

## Building rapport

When looking to close a sale, the first thing the PT needs to do is build trust and rapport. Trust and rapport can take time to build but making a positive initial connection with prospective clients is a good start. Building rapport is extremely important as the client is more likely to share goals/aspirations and personal information if they feel at ease. They are also much more likely to purchase a product or service from someone with whom they share a positive rapport. Initial connections need to be sincere and not contrived if the PT is to secure the client's business.

- A contrived connection would be when the PT seems unnatural, actions and conversation are laboured and the meeting is obviously planned or calculated.
- A sincere connection would be when the PT seems natural, genuine, spontaneous and/or without pretence.

Effective communication is the key to building trust and rapport. Showing a real and legitimate interest in the needs of the client is more likely to instil trust in the PT. Tips to facilitate positive rapport building include:

- Focus on listening to the client rather than on asking and recording questions.
- Do not feel the need to 'fill in the gaps' if the client pauses.
- Take time to develop questions to find out exactly what the client wants.
- Use open-ended questions followed by a positive affirmation or reflective statement to ensure each answer has been understood correctly.
- Use probing questions to gather additional information and demonstrate interest in any information being given.
- Qualify and confirm clients' needs and expectations.

## Gaining commitment and closing a sale

Once the PT has confirmed exactly what the client wants, they need to move the conversation forward, toward a sale, by gaining commitment. This involves selling the benefits or results (not the product or service itself) and using questions which require confirmation from the client.

Questions that can help to gain commitment are generally closed questions which require clear confirmation from the client and address potential solutions to the problem. For example:

- 'Would three training sessions a week be a viable option?'
- 'Based on my summary, do you feel I have a good understanding of your goals?'
- 'Do you agree that we can work to improve your fitness levels and help you to lose weight?'

Other questions that are useful for gaining commitment are ones that empower the client, instilling confidence and belief that they can actually achieve their goals. For example:

- 'What actions can you begin to take today to start to lose weight?'

Answering these questions will enable the client to visualise taking part in the personal training sessions and raise their belief that their personal goals are achievable if this service is used.

Commitment can also be obtained by focussing on issues that the client is uncomfortable or unhappy about. For example, they may comment that they are upset at how slowly they are losing weight. Whenever a factor is exposed that the client is uncomfortable or unhappy about, a commitment point should be obtained.

A commitment point can be obtained by asking a question. In the context of the previous example, commitment can be obtained by asking a question such as ‘is losing weight important to you?’ Although the answer will be ‘yes’ as they have already given this information, the ‘yes’ is an agreement that losing weight is important.

This is a button that can be used to close the sale by reminding them of why they want personal training.

Offering complementary sessions is another method of gaining commitment. This gives the client an opportunity to ‘try before they buy’ and gives the PT a chance to showcase their skills, knowledge and experience, whilst building on the client relationship. If this method of gaining commitment is selected, it is absolutely essential to ensure that the sale is closed at the end of the complementary session, otherwise the PT has expended time, energy and money giving away a service that has not brought about a sale. If a client commits to a complementary session, then they have already demonstrated a clear commitment to using the PT service. This should make the final sale closure simpler, and conversion from potential client to client should be easy following this session.



## Closing a sale

Once the client has agreed to take action, it is time to close the sale. If left unclosed, it means that there has been no resolution and the chances of the client returning are significantly diminished. For example: ‘I will check back with you next week to see what you want to do’ allows the client to walk away and gives them time to consider their actions and come up with reasons why they should not take this further.

One key aspect of closing a sale is the identification of when to make the close. The PT should closely observe any prospective client to identify ‘buying signals’ and at that point the sale should be closed. A common mistake that can potentially lose a PT a sale is to continue to sell and offer services after the client has already indicated that they are willing to commit. Buying signals can be defined as signs that the client is ready to make a purchase and may include comments/questions such as:

- How would that session benefit me?
- Which type of session would help me to lose weight?
- When do you have time free for new PT clients?

Finally, and before parting company with the client, the PT must ensure that the client:

- Is booked in for a training session.
- Has signed an agreement.
- Has arranged payment methods.

Leaving any of these things unresolved can offer the client a reason to back out of the sale.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- Why is it important to build rapport with a client prior to closing a sale?
- Explain ways to build rapport with a client.
- Give examples of types of communication that would not build rapport.
- Give examples of different ways to gain commitment from a client.
- Describe a scenario where a sale is left unresolved.
- List buying signals and the types of comments clients may make.
- Explain how to close a sale – what would the PT have to do?

# Section 7: Setting budgets and managing finances in a personal training business

## Annual budgets

Annual budgets outline both the expected income and expenditure over a 12-month period. It is a crucial part of the PT business as it gives an overview of how the business is doing, what the personal trainer can expect to be paid, whether targets/objectives are being met and what expenditure will need to be outlined and when.

Budgets will give the PT:

- A financial representation of a business plan.
- A financial plan of income and expenditure for a specific period of time.
- A set of financial targets to help them meet their annual objectives.
- A tool to help with business planning and strategy.
- A tool to help monitor the performance of the business.

A budget is important to:

- Make long- and short-term financial projections.
- Avert a financial crisis.
- Get the most from your money.
- Plan for financial changes.
- Achieve peace of mind.

## Setting a budget

Budgets must be:

- SMART (specific, measurable, achievable, realistic and relevant, time-bound).
- In line with business objectives.
- In line with market trends.

When setting a budget, the following information is needed:

- Previous financial performance.
- Future business objectives.
- Internal factors that can affect income or expenditure.
- External factors that can affect income or expenditure.
- Strengths and weaknesses.
- Opportunities and threats.

## Income and expenditure budgeting

Income and expenditure budgeting is used to plan and balance the flow of cash in and out of a business.

The PT would need to consider potential income. This can be done by calculating:

- How many days per week PT sessions will be delivered.
- How many sessions per day.
- How much each session costs.

### For example

5 days per week, 5 sessions per day =  
25 sessions

Cost of session = £40

Potential weekly income =  
 $25 \times £40 = £1000$

This information will give an estimate of what can realistically be earned each week.

It is important to be realistic when calculating how many days/sessions will be spent working with/training clients. Working every day will make more money, but will be at the risk of overuse or burnout. The PT will also need to consider potential outgoings and expenses, e.g. hire of facilities and insurance.



At their simplest level, income and expenditure budgets allow decisions to be made about the cash demands of the business in the future. These budgets can also be thoroughly analysed to help identify and plan for periods when expenditure may be out of balance with income.

When budgets are established, it is necessary to compare expenditure and income targets against that budget, usually on a monthly basis. This provides a 'snapshot' of how well the business is operating, and whether or not the budgetary restraints are being followed. Put simply, it would be poor management to use 90% of the annual budget within the first month of operation.

## Cash flow

With a cash flow that is out of balance, the PT could realistically be in profit, although they may have run out of cash. The effects of this could be that the PT may have plenty of clients on their books, but they cannot afford the cost of providing the service (e.g. do not have the cash in hand to pay for the hire of the facility).

For example, a PT's busiest period may be just after Christmas when everyone goes back to the gym. Combined with the usual January sale periods, this might be a good time to buy new equipment as cash flow is coming into the business and the costs of purchases are low. In contrast, the PT should not be planning for purchases during quiet periods, such as the summer holidays, as cash flowing into the business may be minimal and costs may be higher. This is likely to be a time to adjust costs or save income.

Projecting and managing cash flow can be simple. A basic spreadsheet can be used to list potential income and costs on a monthly basis, with yearly totals for each. This will enable the PT to identify times of the year when business may be quiet and allow time to put contingency plans in place.

## Gross and net profit

When running a PT business there are two types of profit to consider:

- **Gross profit** is the total company revenue (equivalent to total sales) minus the cost of goods sold (variable expenses).
- **Net profit** is the actual profit after working expenses (fixed expenses) not included in the calculation of gross profit have been paid. It's also referred to as net income.

Variable expenses are recorded as cost of goods sold. Fixed expenses are operating/working expense, and sometimes called selling and general administrative expenses.



## Typical business costs for the personal trainer

There are numerous costs that the PT needs to include in their budget. Costs are generally categorised as direct (variable) or indirect (fixed).

**Direct costs:** Tend to be **variable** because they link directly to sales and will change in proportion to the activity or the organisation. These costs are also known as 'cost of sales'. For example, PT's wages and depreciation on equipment used.

**Indirect costs:** Tend to be **fixed** as they are independent of the organisation's sales performance, e.g. not directly linked to a product or service. Fixed costs can also be called 'overheads'. For example, advertising, office/administration expenses, professional fees, rent, utilities, insurance, petrol, marketing.

## Balance sheet and profit and loss accounts

The purpose of a **balance sheet** is to show a snapshot of a company's financial position at a single point in time. It does so by outlining the total assets that a company owns and any amounts that it owes. The balance sheet will include all assets and liabilities.

A **profit and loss account** is an accounting term used to depict a company's trading during a given period of time. It will include all income (e.g. income from sales and bank interest) and all expenses (e.g. stationery and accountancy fees).

The expenses are deducted from the income to give a business profit for the given period. This is not the same as the cash in a bank account as there are likely to be non-cash items in the profit and loss account as well as outstanding invoices to pay (expenses) or to be paid (income).

The amount of tax that a business pays is worked out on its net profits. It is essential to ensure that income and costs are calculated accurately otherwise the tax bill could be incorrect.

### Limited companies

Limited companies can pay dividends to shareholders from the profit made in the current year, plus any profit in reserve from previous years. Directors of the limited company must check that the profit and loss account has sufficient funds available before declaring a dividend.

## Key performance indicators (KPIs)

In order to ensure that a personal training business is achieving its objectives, the PT would normally set a series of KPIs. KPIs make it possible to confirm that targets have been met and to provide information that could be used for setting targets in the future.



The PT must produce clear business objectives and KPIs to be able to measure the success of their personal training business.

Typical KPIs include:

- Sales targets for a particular month, e.g. four new personal training clients in January.
- A percentage target for growth, e.g. to increase membership by 5% by the end of March.
- Targets for tasks or projected achievement, e.g. to launch a new website by the end of June.

For KPIs to be useful, it is essential that they are SMART (specific, measurable, achievable, realistic/relevant and time-bound). KPIs can be linked to the annual performance of a business or they could be linked to a specific project, target or task. By setting SMART targets it is easy to assess whether or not the business project, target or task is on time and within budget.

## Additional services or products

PTs work in an extremely competitive market and therefore need to be creative and diverse to survive. They need to stand out from the crowd and refine and develop their skills and knowledge to meet the ever-changing demands of their clients. There are many factors that will influence what additional services to offer, including:

- Financial climate.
- Latest trends (what does everyone want?).
- New equipment/service launches.
- Competition.
- What others are offering.
- Venues/environments.
- Resources.
- Cost.
- Access to training.

### POINT OF INTEREST

Anything that the business owns or owes would not be found in a profit and loss account. These are called **assets and liabilities** and are found on the balance sheet.



The introduction of additional products or services can offer significant benefits to the clients and to the PT business.

Client benefits:

- More choice.
- All products/services can be sourced from one PT.
- Maximising workouts whilst minimising time.

PT business benefits:

- Increased profitability and success.
- Increased earning power.
- Increased access to more clients.
- Stimulated interest in the PT business.



Consider what additional services or products may interest clients.

The introduction of new services or products needs careful consideration to ensure that opportunities are implemented in the most effective and efficient ways. The offering of a new service or product would be a business objective and would be monitored by KPIs.

## Summary

For the PT business to be successful it is essential that all of the factors discussed in this section are taken into account. The PT must firstly have a clear strategy with specific business objectives that they wish to achieve. It is important that these objectives can be measured and KPIs are the ultimate tool to evaluate success and progress. As things often do not run to plan, the PT must have a certain degree of flexibility and contingency plans in place to allow for adaptation of strategies to ensure development and sustainability in line with their KPIs. Regular review dates must be planned to allow monitoring and evaluation of the PT business in line with KPIs. Appropriate action can then be taken in a timely manner, if needed, which might include the implementation of contingency plans or a rethink of objectives.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- In your own words, give a definition of a budget and why a budget is important.
- What factors need to be taken into account when preparing a budget?
- Create an income and expenditure budget for a PT business.
- Devise an annual predicted cash flow for a PT business, identifying months where cash flow and expenditure may be high or low.
- What are the consequences of having a cash flow that's out of balance?
- Give examples of gross and net profit.
- List typical examples of costs that the PT may incur and split them into direct and indirect costs.
- What is the purpose of a balance sheet and what would it include?
- What information would you find in a profit and loss account?
- Give examples of KPIs for a PT.
- Why are KPIs useful?
- Devise strategies to retain existing and gain new business.
- List the different types of service that a PT could provide.
- What are the benefits of offering additional products or services?

# Section 8: Using information technology (IT) applications in business

## Gathering, monitoring and interpreting business data using IT applications

The digital age has brought with it a plethora of different software and applications that can be used to manage businesses more effectively and efficiently. For the PT this means that they can manage and streamline all aspects of their business from their desktop, phone or laptop, which also means they can be connected to their business whether at home or work.

Personal training is a competitive market and the PT must be able to embrace technology and learn new skillsets. Using software and applications for their business will give instant access to information and allow the collection, monitoring and interpretation of information at the touch of a button.

Software and applications can be used strategically to manage a PT business through the gathering, monitoring and interpretation of data. Collected data subjected to statistical operations can reveal relationships, patterns, trends and the level to which the answers received can be trusted.

The correct collection and analysis method must be applied as data is of little value unless meaningful information can be extracted. Correct analysis enables conclusions to be drawn from the data, which can then be used to further support and benefit the PT business.

### Methods of gathering, monitoring and interpreting business data

Methods are continually advancing and the PT can use a multitude of different IT applications:

- Internet searches, e.g. footfalls.
- Smartphone applications.
- Generic mapping software, e.g. Adware.
- Third party surveys.
- Social media.
- Blogs.
- Mail-shots.
- Smart technologies (e.g. watches, phones, tablets).
- Smart technology applications.
- Databases.
- Webpage click monitoring.
- Online surveys.
- Spreadsheets.

### Presenting data

Data should be presented in a meaningful way to ensure the message the data is giving is clear. There are numerous ways to present data, including text, tables, charts, graphs, etc. Data presented in the wrong format will not bring the information to life; for example, it would be no good to use a pie chart (used comparing parts of a whole) if wanting to measure change over time, e.g. weight loss. A pie chart would be better used to represent the percentages of different food groups consumed, whereas a bar graph would clearly show an amount of weight loss over a period of time.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- What are the benefits of a PT using IT to gather, monitor and interpret information?
- Give examples of the types of information a PT can obtain using IT.
- For each of the IT application methods, give an example of how and why a PT might use it.
- Evaluate each IT application method, listing its advantages and disadvantages.
- List different ways of presenting data.
- List appropriate uses of a range of different presenting methods.

# Section 9: Using information technology (IT) to support effective business planning and delivery

In addition to using IT for data collection and analysis, it can also be used to support effective business planning and delivery. The PT can use IT to enable a more efficient and effective use of time and to support clients with achieving their fitness goals without the need to leave the house. Generally, applications will be interactive or informational.

Examples of how IT applications can be used:

- Keeping in touch with clients (database management).
- Storing client profiles.
- Sending out promotions.
- Controlling, managing and recording payments (income and expenditure).
- Contract development.
- Building client support resources (e.g. fitness programmes, technique and lifestyle guidance).
- Creation and management of client discussion forums.
- Planning and time management (e.g. to organise schedules).
- Managing and facilitating online bookings.
- Providing client and PT automated reminders.
- Managing finances.
- Tracking progress and commitment.

## Risks and benefits of using information technology applications

There are a multitude of benefits for the personal trainer using IT applications, however there are also risks to consider.

### Benefits of using IT applications:

- They can support effective and efficient running of the business.
- They can allow the PT to easily keep track of clients' progress/act as monitoring tools.
- They can be very effective motivational tools.
- They can be very effective communication tools.
- Monitoring and tracking (fitness levels, nutritional intake, etc.) of client progress and commitment can be easily carried out.
- Realistic goals can be set, accessed and amended by both client and PT at all times.
- They can be used to provide ongoing workout ideas to stimulate clients.
- They can help the PT improve their time management.
- IT applications are often intuitive and easy to use for both client and PT.

### Risks of using IT applications:

- Viruses/cyber bugs can trigger events that negatively impact infrastructures, systems, data or business operations.
- Infrastructure failures can significantly impact business and client motivation and communication.
- Decreased system availability will negatively impact the relevant aspects of the business.
- Compliance failure can result in reputational damage, poor press coverage or even prosecution.
- Network problems will slow down or stop the ability of the PT to carry out their daily roles and responsibilities.
- Security breaches/data protection issues can result in lost data, reputational damage and even prosecution.
- Disruption of business function.

## Evaluation

Ultimately, IT applications have become integrated into usual work and home activities of daily life and are increasingly becoming an essential for PTs. The benefits are clear:

- Providing instant access to information, clients and suppliers.
- Being able to do more work in less time.
- Being able to work from anywhere.
- Using new technology can be exciting, thrilling and inviting for both clients and PTs.

However, IT applications can also have a negative impact which can affect our home life, relationships, work and health, including:

- The wasting of valuable time.
- Less face-to-face interaction with clients.
- Increased challenge of separating career, personal and business lives.

According to Greg Bovitz from Center for the Digital Future (2013), ‘Millennials may embrace technology more enthusiastically than non-millennials, but larger percentages of them also recognise that using technology comes with consequences’.

## END OF SECTION Revision activities

Complete the activities and make notes to revise this section.

- List examples of how a PT can use IT to support effective and efficient planning and delivery.
- What are the benefits for a PT using IT applications?
- What are the risks associated with using IT applications?
- What can a PT do to reduce risks associated with using IT applications?
- Evaluate the use of IT applications for a PT.

# Section 10: Professional and personal importance of continuing professional development

## Continuing professional development

Continuing professional development (CPD) is a fundamental factor for the PT wishing to realise and maximise their potential and development in their professional and personal lives. CPD can help to maintain, improve and broaden knowledge, skills and personal qualities. It is also a key element of maintaining currency of qualifications, to keep up to date within the industry and for recognition of professional associations.

Benefits of CPD:

- Learning something new can provide fresh opportunities which might not otherwise have arisen.
- Increased personal satisfaction from life if individuals understand more about who they are and what they do.
- Better results and a more rewarding working day.
- Opportunity to specialise and potentially earn more or move to a better job.
- A more highly skilled and knowledgeable worker is an asset to any company and can lead to faster promotion and salary increases.
- Developing knowledge and skills in a job is crucial to enable individuals to maintain, improve and broaden knowledge and skills and develop personal qualities required in professional lives.
- Builds social awareness of the needs of other individuals/groups and the importance of different relationships and team roles.

CPD can take many forms and include formal learning (such as a course/qualification) and informal learning (e.g. talking, observing others). All learning is important and its value depends on how that learning is used in everyday life/work to realise and maximise potential.

Examples of CPD activities include:

- Courses/qualifications.
- Seminars/discussions.
- Reading (manuals, journals, reports).
- Writing articles.
- Attendance at events/meetings.
- Training.
- Observing/shadowing others.
- Talking to others/networking.
- Mentoring.

## Reflection

Reflection is an important factor in order to identify where development is required. Development might be required for a personal or educational aspect or to further/progress an individual's career. Reflection is a way to:

- Assess skills and qualities.
- Consider aims in life.
- Set goals.
- Reflect on own learning, performance and achievement.

The personal trainer should ask themselves:

- How well am I doing?
- What are my strengths and weaknesses?
- What could I do better?
- What activities will help me achieve my goals?



## Working with others to evaluate own skills, knowledge and practice

As well as self-evaluation, feedback from others is an essential part of evaluating performance. Colleagues, peers, clients, even family and friends may all be able to objectively identify areas for improvement.

Feedback helps to:

- Identify areas for improvement.
- Raise awareness of own practice.
- Highlight problems before they arise.
- Identify things to do differently in the future.

### Importance of self-evaluation

When setting up in a business it is essential for the PT to evaluate their own strengths, weaknesses, opportunities and threats.

This may reveal areas where personal development is needed to facilitate a successful business.

Feedback can be gathered formally (e.g. in appraisals or meetings) or informally (e.g. during conversations or group discussions).

The PT should encourage constructive and honest feedback if they truly want to develop. Specific examples should be encouraged to fully understand any issues raised and where development needs to take place. Whether positive or negative, feedback is always something that can improve performance. Even if it's negative, feedback can be turned into a positive for the future. Figure 10.1 details some helpful tips on how to receive feedback on performance.

Focus on the person giving the feedback (if in person).

Stay calm and listen.

If something is not clear, ask the person giving feedback to rephrase it or ask them further questions to clarify.

Thank the person for the feedback.

Ensure it is all in writing.

Reflect on the feedback.

Find ways to develop in the future based on the feedback.

Set clear SMART goals to develop in line with the feedback.

Carry out actions to achieve the SMART goals set.

Review SMART goals regularly and update in line with any additional feedback gathered.

Figure 10.1 Helpful tips on receiving feedback

## Personal development plan

A personal development plan (PDP) is a continuing cycle of self-reflection and action. A PDP encourages self-development and planning for the future by becoming more self-aware.

It is a continual process of:

- Self/peer assessment.
- Identifying and addressing areas for development.
- Planning/setting goals.
- Taking necessary action for development.
- Reflection and review.



A personal development plan should contain:

- Short-term goals.
- Medium-term goals.
- Long-term goals.
- Goals that are SMART (specific, measurable, achievable, realistic/relevant and time-bound).
- Achievement dates and review dates.

A PDP should be flexible and change as personal requirements and aspirations change.

## Planning, organising and managing time

Planning and organisational skills are extremely valuable if in pursuit of a career or personal goal. Planning is preparing a sequence of action steps to achieve a specific goal. If done effectively, it can reduce much of the necessary time and effort of achieving the goal – making it an effective time management tool.

Being able to plan and manage time effectively has many benefits, including:

- Increased productivity.
- Better work/life balance.
- Reduced work costs.
- Reduced staff workloads.
- Better relationships.
- Reduced stress.

Planning, organising and managing time is often very difficult and is a skill that needs discipline and practice. However, the investment of time to plan and prioritise can make a major difference in time management.

Key factors that will help the PT to manage their time more effectively:

- Prioritise tasks as urgent, important and not important and address them in that order:
  - Urgent tasks demand immediate attention and will have consequences if not done.
  - Important tasks may not have serious consequences.
- Task lists should be reviewed regularly as priorities will change.
- Jobs should be delegated wherever possible.
- Keep work areas tidy – this improves self-esteem and motivation.
- Stay focussed and do not procrastinate.
- Do not multi-task as it takes the brain time to re-focus. Do one job at a time and finish it.



Having time for exercise and eating properly is important and should not be compromised in favour of more 'urgent' activities.

- Stay calm and keep things in perspective. Getting stressed can lead to feeling overwhelmed.
- Set goals.
- Learn to say no to keep focus on priorities.
- Work at the best time to suit circadian rhythms. Everyone has a time they work best.
- Break big tasks down into smaller chunks so they appear less daunting and more achievable.
- Minimise possible disruptions/interruptions.

## Effective communication and the enhancement of professional opportunities

Effective communication skills are an extremely valuable resource and are sought after by employers. Good communication in the workplace is essential to improve morale and create healthy working relationships, which ultimately result in increased productivity and profitability.

Effective communication is much more than just exchanging information. It is about understanding the emotion and intentions behind the communication.

Communication can be verbal and non-verbal. An effective communicator will be able to convey a message so that it is received and understood in exactly the way it was intended. It also involves the ability to listen to what is being said, e.g. interpretation of what the other person is communicating through non-verbal gestures such as facial expressions and body language.

Tips for effective communication:

- Listen attentively (e.g. demonstrate active listening).
- Ask and invite questions.
- Provide feedback and ask for feedback.
- Interpret body language/gestures.
- Communicate assertively (but not aggressively).
- Be tolerant of others and put yourself in their shoes.
- Demonstrate respect and empathy.
- Speak positively, clearly and distinctly.
- Communicate negative or difficult messages without creating conflict.
- Control emotions (e.g. not showing stress, dislike, annoyance).
- Communicate purposefully (e.g. stay focussed on the message).
- Body language should reinforce what is being said and make others feel comfortable and welcomed, rather than defensive (e.g. avoid sending negative signals).
- Build trust/rapport and connections.
- Find common ground/goals.
- Be honest, open and have a sense of humour.

## Summary

All of the factors discussed in this section are important aspects that can help individuals to develop in both their personal and professional lives. Self-reflection and CPD should become a natural and ongoing process to facilitate self-growth and success. As the fitness industry is dynamic and subject to change, a PT may have to undertake additional training just to keep up to date in order to retain and attract new clients.

When first starting up a business, reflection and CPD are most pertinent as the PT is likely to be entering a whole new world. The PT may already possess some specific skills and knowledge, but when entering new territory it is likely that some CPD/training will be needed. It is therefore crucial the PT undertakes self-evaluation in terms of their own personal strengths, weaknesses, opportunities and potential threats. They should then devise an action plan in advance of setting up their business to gain the required skills and knowledge in order to give them the best opportunity for success.

### IMPROVE YOUR TIME MANAGEMENT SKILLS

- Delegate tasks
- Prioritise work
- Avoid Procrastination
- Schedule tasks
- Avoid stress
- Set up deadlines
- Avoid multitasking
- Start early
- Take some breaks
- Learn to say No



Listening is not the same as hearing.

**END OF SECTION Revision activities**

Complete the activities and make notes to revise this section.

- What does CPD mean?
- List the benefits of CPD for a PT.
- List types of activities that a PT can do for CPD.
- In order to identify what sort of CPD is needed, what factors should a PT reflect upon?
- Explain how feedback can be gained from others.
- Explain how negative feedback can be turned into a positive.
- What is a personal development plan?
- Devise your own personal development plan.
- Why is time management important?
- List different ways to manage time more effectively.
- Explain how being an effective communicator can enhance professional opportunities.
- List ways to communicate effectively.

# References

- ACAS. (2013). 'The Use of Social Media in the Recruitment Process'. [Online]. Available at: <http://www.acas.org.uk/media/pdf/0/b/The-use-of-social-media-in-the-recruitment-process.pdf> [Accessed 6 August 2016].
- Bovitz, G. (2013). 'The Benefits and Drawbacks of Online Technology'. Center for the Digital Future. [Online]. Available at: <https://news.usc.edu/54256/the-benefits-and-drawbacks-of-online-technology>. [Accessed 19 August 2016].
- Business balls. (2016). 'Time management techniques and systems'. Available at: <http://www.businessballs.com/timemanagement.htm> [Accessed 19 August 2016].
- Coulson, M. (2013). *The Complete Guide to Personal Training*. London: Bloomsbury Sport.
- Goodman, J. (2015a). *Personal Trainer Pocketbook: A Handy Reference for All your Daily Questions*. CreateSpace Independent Publishing Platform.
- Goodman, J. (2015b). *Ignite the Fire: The Secrets to Building a Successful Personal Training Career (Revised, Updated, and Expanded)*. CreateSpace Independent Publishing Platform.
- Goodman, J. (2016). Personal trainer development centre. 'Overworked, overstressed and overburdened? Strategies for Personal trainer time management'. [Online]. Available at [www.theptdc.com/2013/06/overworked-overstressed-and-overburden](http://www.theptdc.com/2013/06/overworked-overstressed-and-overburden) [Accessed: 20 August 2016].
- HM Government. (ND). 'Working for yourself'. [Online] Available at: <https://www.gov.uk/working-for-yourself/overview> [Accessed 5 August 2016].
- HM Government. (1998). 'Data Protection Act, 1998'. [Online]. Available at: <http://www.legislation.gov.uk/ukpga/1998/29/contents> [Accessed 26 August 2016].
- HM Government. (1999). 'The Management of Health and Safety at Work Regulations, 1999'. [Online]. Available at: [http://www.legislation.gov.uk/ukssi/1999/3242/regulation/3/made](http://www.legislation.gov.uk/ukksi/1999/3242/regulation/3/made) [Accessed 26 August 2016].
- HM Government. (2010). 'Equality Act, 2010'. [Online]. Available at: <http://www.legislation.gov.uk/ukpga/2010/15/contents> [Accessed 26 August 2016].
- HM Government. (2016). 'Cyber Security Breaches Survey 2016'. [Online]. Available at: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/521465/Cyber\\_Security\\_Breaches\\_Survey\\_2016\\_main\\_report\\_FINAL.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/521465/Cyber_Security_Breaches_Survey_2016_main_report_FINAL.pdf) [Accessed 5 August 2016].
- HSE. (1974). 'The Health and Safety at work Act etc. 1974'. [Online]. Available at: <http://www.hse.gov.uk/legislation/hswa.htm> [Accessed 26 August 2016].
- Information Commissioner's Office. (2016). 'Guide to data protection'. [Online]. Available at: <https://ico.org.uk/for-organisations/guide-to-data-protection/principle-1-fair-and-lawful/> [Accessed 12 August 2016].
- Ive, F. (2011). *Self-Employment – The Essential Guide*. Peterborough, UK: Need2Know.
- Johnson, R. (2016). 'What Are the Benefits of Effective Communication in the Workplace?' [Online]. Available at: <http://smallbusiness.chron.com/benefits-effective-communication-workplace-20198.html> [Accessed 19 August 2016].
- Kimball, C. (2012). *Start Your Own Personal Training Business: Your Step-By-Step Guide to Success*. London: Entrepreneur Press.
- Kraakevik, J. (2016). 'Crafting a positive professional digital profile to augment your practice'. [Online]. Available at: <http://cp.neurology.org/content/early/2016/01/21/CPJ.000000000000211.abstract> [Accessed 19 August 2016].
- Lester, P.M. (2006). Syntactic theory of visual communication. Retrieved December, 3, p.2010.
- Mind Tools. (2016). 'Managing Interruptions, Maintain Focus, Keep Control of Your Time'. [Online]. Available at: [https://www.mindtools.com/pages/article/newHTE\\_94.html](https://www.mindtools.com/pages/article/newHTE_94.html) [Accessed 16 August 2016].

- Oh, A. (2013). *The Business of Personal Training. Essential Guide for the Successful Personal Trainer*. CreateSpace Independent Publishing Platform.
- Pant, R. (2016). ‘Visual Marketing: A Picture is Worth 60,000 words’. [Online]. Available at: <http://www.business2community.com/digital-marketing/visual-marketing-pictures-worth-60000-words-01126256#dv2AAb02xIRyByle.97> [Accessed 19 August 2016].
- Pattengale, A. (ND). ‘Developing a Personal Training Marketing Plan’. [Online]. Available at: <https://www.nfpt.com/blog/developing-a-personal-training-marketing-plan> [Accessed 19 August 2016].
- Peraine, J.N. (2007). *How to Open and operate a financially Successful Personal Training Business*. Florida: Atlantic Publishing Co.
- Register of Exercise Professionals (REPs). (2009). ‘UK Level 3 Occupational Descriptor’. [Online]. Available at: <http://www.exerciseregister.org/images/documents/l3%20personal%20trainer%20-%20v7%20sept%2009.pdf> [Accessed 19 August 2016].
- Register of Exercise Professionals (REPs). (2011). ‘Code of Ethical Conduct’. [Online]. Available at: <http://www.exerciseregister.org/images/documents/codeofethicalconduct.pdf>. [Accessed 21 August 2016].
- Register of Exercise Professionals (REPs). (2012). ‘Personal Trainers – how to plan a successful marketing strategy’. [Online]. Available at: <http://www.exerciseregister.org/1621-personal-trainers-how-to-plan-a-successful-marketing-strategy> [Accessed 19 August 2016].
- St. Michael, M. and Formichelli, L. (2011). *Becoming a Personal Trainer for Dummies*. Hoboken: Wiley.
- The Chartered Institute of Marketing (2016). ‘What is Marketing?’. [Online]. Available at: <http://www.cim.co.uk/more/getin2marketing/what-is-marketing/> [Accessed 12 September 2016].
- Wenben, A. Lai. (1995). Consumer Values, Product Benefits and Customer Value: a Consumption Behavior Approach, in NA – *Advances in Consumer Research*, 22, eds. Frank R. Kardes and Mita Sujan. Provo, UT: Association for Consumer Research, pp.381-388.



# PT toolkit

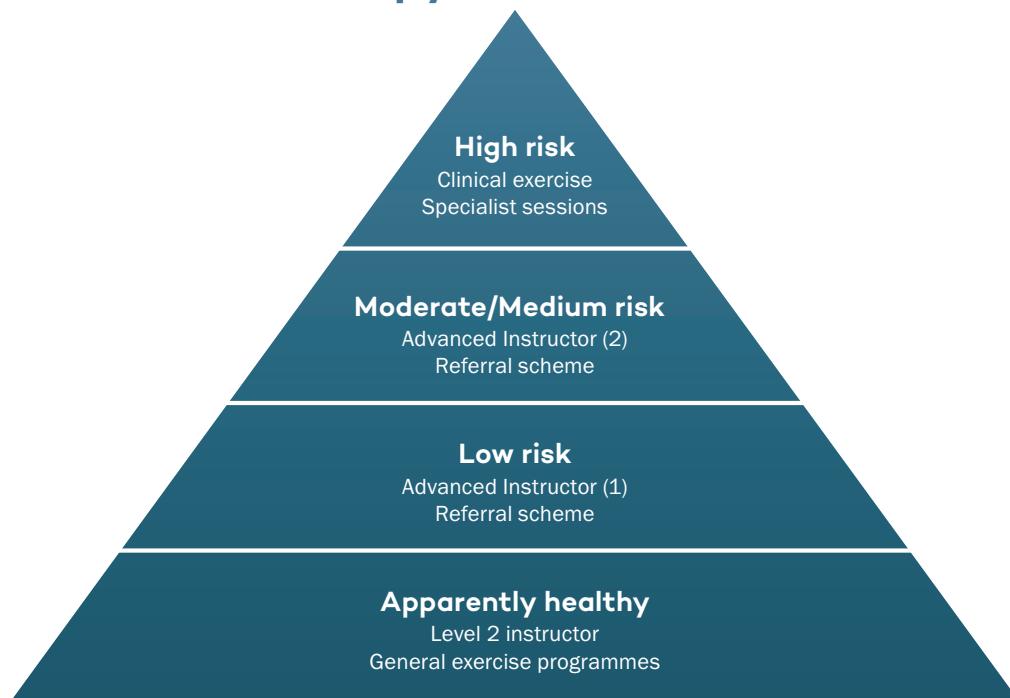
## Introduction

This section will provide the personal trainer with examples of practical tools that can be used to:

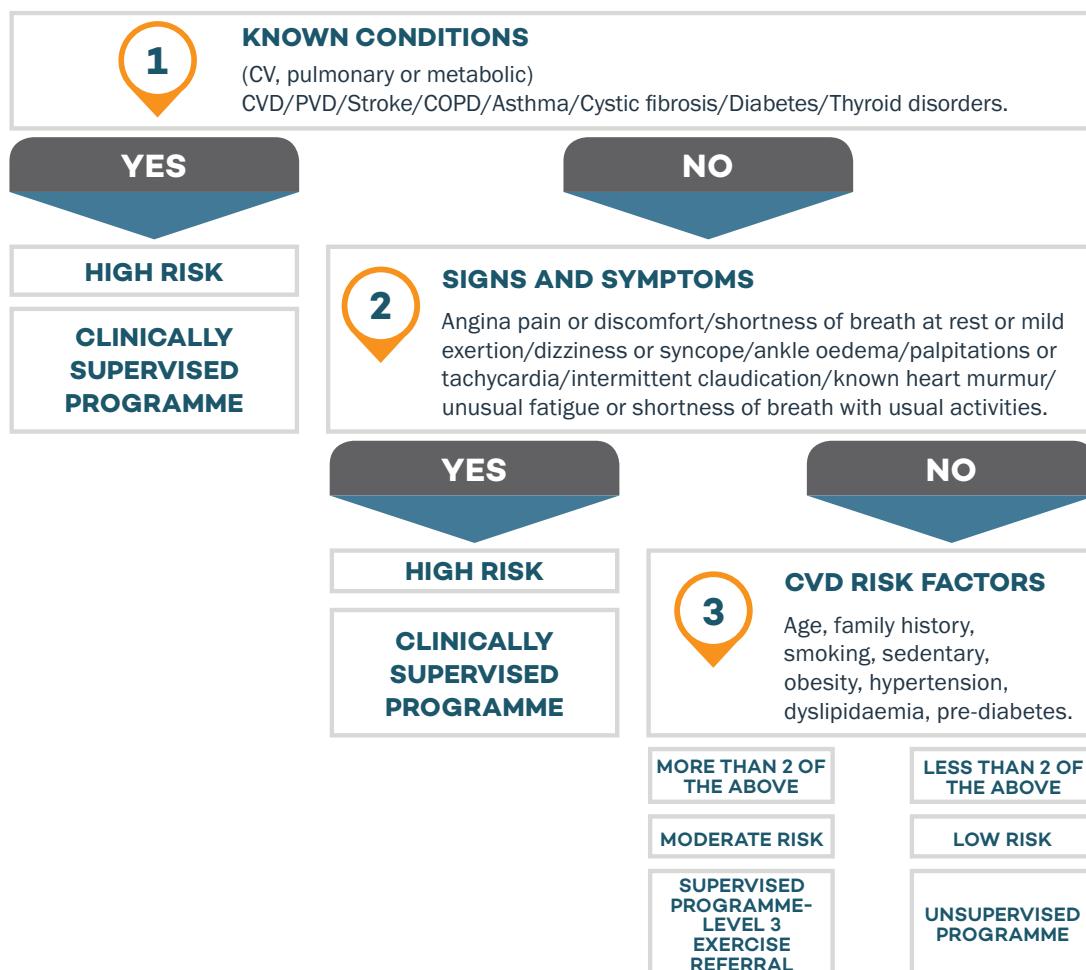
- Risk stratify clients.
- Perform health screening, fitness and postural assessments.
- Plan progressive and periodised exercise programmes and sessions.
- Deliver safe and effective PT sessions using appropriate exercise techniques.

# Section 1: Risk stratification models

## The risk stratification pyramid



## Logic model for risk stratification



# Cardiovascular disease risk stratification (ACSM, 2014)

<b>Cardiovascular disease risk factors</b>		<b>Normal</b>	<b>Special attention 2 or more = moderate risk Signpost to GP</b>	<b>Medical referral</b>
Age.		Male <45 years. Female <55 years .	Male >45 years. Female >55 years.	
Family history.	MI or sudden death in 1st degree relative. Male <55 years. Female <65 years.	No family history.	Positive family history.	
Smoking.		Non-smoker.	Current smoker (1+/day) or quit within the last 6 months.	
Exercise (physical activity levels for a minimum of 8 weeks).		≥30+ mins CV 3-5 times/week.	<30 mins CV 3-5 times/week (inactive).	
Blood pressure.	SBP & DBP (mmHg).	≤139 and ≤89	≥140 or ≥90	≥160 or ≥100
Cholesterol.	Total cholesterol (mmol/L).	≤5.2	>5.2	>5.7
	LDL cholesterol (mmol/L).	≤3.4	>3.4	
	HDL cholesterol (mmol/L).	≥0.9 (or 25%+ of Total)	<0.9 (or <25% of Total)	
Impaired glucose fasting (Diabetes).	Fasting blood glucose (mmol/L).	≤6.0	6.1–6.9	≥7.0 Diabetic.
<b>Other factors</b>		<b>Normal</b>	<b>Special attention May require clearance if other risks present</b>	<b>Medical referral</b>
Resting heart rate.		≤89 bpm	90–99 bpm	≥100 bpm Contraindication for exercise.
Body Composition.	Body fat (% body fat).	Male 18–25% Female 25–30%	<6% or 26–30% <14% or 31–40%	>30% >40%
	Waist-to-hip ratio.	Male <0.85 Female <0.75	>0.9 >0.8	
	BMI.	18.5–24.9 kg/m <sup>2</sup>	25–29.9 kg/m <sup>2</sup>	30+ kg/m <sup>2</sup>
Alcohol consumption.	Units of alcohol per week.	Male ≤21 units. Female ≤14 units.	Male 29–42 units. Female 22–35 units.	Male ≥43 units. Female ≥36 units. Cirrhosis.
Lung function.	Forced expiratory rate (FER).	Within predicted range values.	Below predicted range values.	Known pulmonary disorder unless under control.

## Recommended levels of supervision for assigned risk (ACSM, 2014)

Risk status	Criteria	Activity guidelines Recommended level of supervision
Low.	<p>Men &lt;45/Women &lt;55 years of age who are asymptomatic and meet no more than 1 risk factor threshold:</p> <ul style="list-style-type: none"> <li>• Family history.</li> <li>• Smoking.</li> <li>• Hypertension.</li> <li>• High cholesterol.</li> <li>• Impaired fasting glucose.</li> <li>• Obesity.</li> <li>• Sedentary lifestyle.</li> </ul>	<p>Medical exam not necessary. Supervision of exercise test not necessary. Activity – Unsupervised.</p>
Moderate.	<p>Men ≥45/Women ≥55 years or those who meet the threshold for 2 or more risk factors.</p>	<p>Medical exam recommended prior to vigorous exercise (&gt;60% VO<sub>2</sub> max). Supervision of maximal exercise test (not necessary for submaximal test). Activity – Supervised.</p>
High.	<p>Individuals with one or more of the following signs and symptoms:</p> <ul style="list-style-type: none"> <li>• Anginal pain or discomfort.</li> <li>• Shortness of breath at rest or with mild exertion.</li> <li>• Dizziness or syncope.</li> <li>• Orthopnoea or paroxysmal nocturnal dyspnoea.*</li> <li>• Ankle oedema.</li> <li>• Palpitations or tachycardia.</li> <li>• Intermittent claudication.</li> <li>• Known heart murmur.</li> <li>• Unusual fatigue or shortness of breath with usual activities.</li> </ul> <p>Or known cardiovascular, pulmonary or metabolic disease:</p> <ul style="list-style-type: none"> <li>• Cardiac (myocardial infarction, coronary artery bypass surgery, coronary angioplasty or angina).</li> <li>• Cerebrovascular (stroke, transient ischaemic attack).</li> <li>• Peripheral vascular disease.</li> <li>• Pulmonary disease (chronic obstructive pulmonary disease/cystic fibrosis or asthma).</li> <li>• Metabolic disease (diabetes (type 1 and type 2), thyroid, renal or liver disease).</li> </ul> <p>*Orthopnoea – breathlessness (dyspnoea) occurring at rest in the recumbent position that is relieved by sitting upright.</p> <p>Paroxysmal nocturnal dyspnoea – breathlessness, which usually begins 2-5 hours after going to sleep.</p>	<p>Medical exam recommended prior to moderate and vigorous exercise. Supervision of submaximal exercise test and maximal test. Activity – Supervised.</p>

## Irwin and Morgan risk stratification tool (BHF Toolkit, 2016)

<b>Low risk</b>	
Overweight.	No complications.
High normal blood pressure.	130-139/85-89. Not medication controlled.
Deconditioned.	Due to age or inactive lifestyle.
Type 2 diabetes.	Diet controlled.
Older adults >65.	No more than 2 CHD risk factors and not at risk of falls.
Prenatal.	No symptoms of pre-eclampsia/no history of miscarriage.
Postnatal.	Provided 6 week postnatal check complete and no complications.
Osteoarthritis.	Mild where physical activity will provide symptomatic relief.
Mild bone density changes.	BMD >1 SD and <2.5 SD below young adult mean.
Exercise-induced asthma.	Without other symptoms.
Smoker.	One other CHD risk factor and no known impairment of respiratory system.
Stress/mild anxiety.	No other psychiatric diagnosis.
Seropositive HIV.	Asymptomatic.
<b>Medium risk</b>	
Hypertension stage 1.	140-159/90-99. Medication controlled.
Type 2 diabetes.	Medication controlled.
Type 1 diabetes.	With adequate instructions regarding modification of insulin dosage depending on timing of exercise and warning signs.
Physical disabilities.	No other risk factors or conditions.
Moderate osteoarthritis or rheumatoid arthritis.	With intermittent mobility problems.
Clinical diagnosis of osteoporosis.	BMD >-2.5 at spine, hip or forearm or >4 on fracture index, no history of previous low trauma fracture.
Surgery pre and post.	General or orthopaedic – NOT CARDIAC.
Intermittent claudication.	No symptoms of cardiac dysfunction.
Stroke/TIA.	>1 year ago. Stable CV symptoms. Mobile, no assistance required.
Asthma.	Mild (ventilatory limitation does not restrain submaximal exercise).
COPD.	Without ventilatory limitation but would benefit from optimisation of respiratory system mechanics and correction of physical deconditioning.
Neurological conditions.	E.g. young onset Parkinson's disease (stable), multiple sclerosis.
Early symptomatic HIV.	Moderately diminished CD4 cells. Intermittent or persistent signs and symptoms e.g. fatigue, weight loss, fever, lymphadenopathy.
Chronic fatigue syndrome.	Significant de-conditioning due to long-standing symptoms.
Depression.	Mild to moderate.
Fibromyalgia.	Associated impaired functional ability, poor physical fitness, social isolation, neuroendocrine and autonomic system regulation disorders.

High risk	
Older adults >65 at risk of falls.	REFER directly to falls service.
Frail older people with osteoporosis and history of fractures.	REFER directly to falls service. (BMD >-2.5 at spine, hip or forearm in the presence of 1 or more documented low trauma or fragility fractures).
Unstable/uncontrolled cardiac disease.	
Claudication with cardiac dysfunction.	
Orthostatic hypotension.	Fall SBP >20mmHg or DBP >10mmHg within 3 minutes of standing.
Stroke/TIA.	Recent (<3 months ago).
Severe osteoarthritis/rheumatoid arthritis.	With associated immobility.
Type 1 or type 2 diabetes (advanced).	With accompanying autonomic neuropathy, advanced retinopathy.
Moderate to severe asthma.	Where ventilatory limitation restrains submaximal exercise.
COPD/emphysema.	With true ventilatory limitation.
AIDS.	With accompanying neuromuscular complications, severe depletion of CD4 cells, malignancy or opportunist infection.
Psychiatric illness/cognitive impairment/dementia.	AMT score <8.

## Absolute contraindications to exercise

BACR (2005) and ACSM (2005) guidelines for absolute contraindications	BHFNC (2010) guidelines for absolute contraindications
<ul style="list-style-type: none"> <li>Unstable* angina.</li> <li>Resting systolic blood pressure of more than 180mmHg.</li> <li>Resting diastolic blood pressure of more than 100mmHg.</li> <li>Symptomatic hypotension (BP drop &gt; 20 mmHg demonstrated during ETT). This will not be evident unless client undergoes an exercise stress test or has exercising blood pressure measured.</li> <li>Resting or uncontrolled tachycardia &gt; 100bpm.</li> <li>Unstable* or acute heart failure.</li> <li>New or uncontrolled arrhythmias (atrial or ventricular).</li> <li>Valvular heart disease/aortic stenosis.</li> <li>Unstable* diabetes.</li> <li>Febrile illness.</li> <li>Acute systemic disease (such as cancers).</li> <li>Neuromuscular, musculoskeletal or rheumatoid disorders that are exacerbated by exercise.</li> <li>Unmanaged pain.</li> </ul>	<ul style="list-style-type: none"> <li>A recent significant change in a resting ECG, recent myocardial infarction or other acute cardiac event.</li> <li>Symptomatic severe aortic stenosis.</li> <li>Acute pulmonary embolus or pulmonary infarction.</li> <li>Acute myocarditis or pericarditis.</li> <li>Suspected or known dissecting aneurysm.</li> <li>Resting systolic BP ≥180mmHg.</li> <li>Resting diastolic BP ≥100mmHg.</li> <li>Uncontrolled/unstable* angina.</li> <li>Acute uncontrolled psychiatric illness.</li> <li>Unstable* or acute heart failure.</li> <li>New or uncontrolled arrhythmias.</li> <li>Other rapidly progressing terminal illness.</li> <li>Experiences significant drop in BP during exercise.</li> <li>Uncontrolled resting tachycardia (≥100 bpm).</li> <li>Febrile illness.</li> <li>Experiences pain, dizziness or excessive breathlessness during exertion.</li> <li>Any unstable, uncontrolled condition.</li> </ul>

\*a condition is defined as being unstable if there has been a need for a change in medication, or deterioration in signs and symptoms in the previous month.

# Section 2: Health screening measurements

## Resting heart rate

Resting heart rate (RHR) is the amount of times your heart beats every minute at rest. The average resting heart rate is between 60 and 80 (Heyward and Gibson, 2014) and is measured in beats per minute (bpm).

Resting heart rate (bpm) references		
	Men	Women
Normal.	60-80	60-80
Average.	70	75
Special attention.	≥90	≥90
Medical referral.	≥100	≥100

Adapted from Heyward and Gibson, 2014

Resting heart rate can be taken manually or automatically using a heart rate monitor.

### Manual testing protocol

1. Ensure that your client has rested for 5-10 minutes in a relaxed, seated position prior to measuring heart rate.
2. Locate the correct site of the carotid or radial artery. These are the most commonly used sites.
3. Use the tips of the middle and index fingers to gently locate the artery. Do not use your thumb; it has a pulse of its own and may produce an inaccurate count.
4. Allow 30 seconds for your client to get comfortable with the method and relax.
5. Count pulse for 60 seconds, record the result and repeat for accuracy.

### Locations of pulse

**Carotid:** The common carotid artery sites are located on both sides of the front of the neck. Each are in the groove formed by the larynx (Adam's apple) and the sternocleidomastoid muscles (muscles on the side of the neck) just below the mandible (lower jawbone).

**Radial:** The radial artery runs deeply on the anterolateral (thumb side) aspect of the forearm and becomes superficial near the distal head of the radius (directly in line with the base of the thumb). The radial pulse is therefore taken on the underside of the wrist about 3-4 finger widths below the base of the thumb.

## Blood pressure

Category	Systolic (mmHg)	Diastolic (mmHg)	Recommendation
Low.	<100	<60	Seek medical guidance prior to exercising.
Optimal.	120	80	If the client has no other causes for concern, exercise is recommended.
Stage 1 hypertension.	140	90	Seek medical guidance prior to exercising.
Stage 2 hypertension.	160	100	Seek medical guidance prior to exercising.
Severe hypertension.	>180	>100	It is a complete contraindication to advise a client to exercise. Any medically recommended exercise should be performed in an appropriate environment under specialist supervision.

Blood pressure classifications (BHF, 2010; NICE, 2011; ACSM, 2014)

## Blood pressure testing protocol (Reeves, 1995)

### Cuff application (manual or electronic measurement)

1. Ensure that your client has been relaxed for at least 5 minutes.
2. The client should be sitting with their legs uncrossed and feet flat on the floor. The client's arm should be restriction-free, bare and resting at a 45-degree angle, supported on a flat surface at heart height with the palm facing upwards.
3. Palpate the brachial artery and wrap the deflated cuff firmly around the upper arm so that the midline of the cuff is directly over the located pulse. The edge of the cuff should be approximately 2.5cm above the inner elbow crease.
4. Ensure the cuff is snug around the arm; if it is too loose then BP will be underestimated.

### Additional electronic testing protocol

- Start the test and wait for the cuff to fully inflate and deflate. Record the result shown.

### Additional manual testing protocol

- Position the earpieces of the stethoscope so that they are aligned with the auditory canals (i.e. angled anteriorly).
- Place the head (bell) of the stethoscope over the brachial pulse, but not under the cuff. Make certain that the entire head of the stethoscope is in contact with the skin without too much heavy pressure.
- Close the valve by rotating the switch clockwise and quickly and steadily inflate the cuff pressure to 20-30mmHg above the estimated systolic value. This will collapse the brachial artery and there will be no blood flow.
- Partially open the valve by turning the switch anti-clockwise slightly and slowly deflate the cuff at a constant rate of 2-3mmHg/sec.
- The first sharp thud caused by the sudden rush of blood as the artery opens (the arterial pressure and cuff pressure are equal) corresponds to the systolic BP.
- Continue to reduce the pressure at a constant rate. As soon as the pulsing sound becomes muffled and disappears, the cuff pressure is equal to the diastolic pressure and normal blood flow is restored – this is the diastolic BP.

## Body composition

### Skinfold callipers

#### *Identifying skinfold sites*

The skinfold sites (Durnin and Wormersley, 1974) are listed below. The values obtained from the four sites are added together and entered into tables to convert to body fat percentage.



**Triceps** – a vertical fold on the posterior midline of the upper arm, measured exactly halfway between the posterior acromion on the scapula and olecranon process of the ulna.



**Biceps** – a vertical fold on the anterior midline of the upper arm over the bicep muscle, located 1 cm higher than the level used to mark the triceps.



**Sub-scapular** – an angled fold taken 2cm below the inferior angle of the scapula and angled at 45° rising up towards the spine.



**Suprailliac** – an almost horizontal, slightly oblique fold taken 1-2 cm above and parallel to the iliac or pelvic crest and in line with the anterior axilla or most anterior point of the armpit.

## Skinfold analysis protocol (Adapted from Heyward and Gibson, 2014)

1. Take all measurements on the left side of the body (English normative data – left; American – right).
2. Anatomical land marking needs to be measured and marked up accurately.
3. Place the thumb and index finger of the left hand 8cm apart just above the land mark, gather up the full skinfold and hold away from the body throughout the full measuring process.
4. Place the jaws of the calliper perpendicular to the skinfold directly on the landmark about half the depth of the fold. Release the jaw pressure slowly.
5. The dial is read as accurately as possible 1-2 seconds after the grip has been released and the jaws of the calliper have come to rest on the skinfold.
6. Open the jaws of the calliper and remove before finally releasing skinfold from between the thumb and finger.
7. Take a minimum of two measurements at each site to confirm accuracy, rotating around the sites between measures rather than consecutive measures at the same site.

Once all of the skinfold sites have been measured and checked, the trainer then determines the total of all four skinfold measures in millimetres. This total is then compared to the correct gender normative data table and cross-referenced to the correct age range. This will provide an estimate of their current body fat percentage. Body fat percentage can then be used to determine the client's overall lean mass and body fat mass. This data can provide more information for future reference when the client has made changes to their body composition.

### POINT OF INTEREST

There has been shown to be only 1-2mm difference between the left and right sides, when testing has taken place comparing the two measurements.

### For example

A 34-year-old female client weighing 78kg has the following skinfold measurements:

- Triceps; 25mm.
- Biceps; 14mm.
- Subscapular; 18mm.
- Suprailiac; 28mm.

Total = 85mm which, according to norms tables, is 35.12% body fat.

This means that 27.4kg of the client's weight is body fat and 50.6kg is lean tissue.

Three months later, her body weight is 75kg. Her skinfold measurements are tested again:

- Triceps; 19mm.
- Biceps; 11mm.
- Subscapular; 13mm.
- Suprailiac; 21mm.

Total = 64mm which, according to norms tables, is 31.65% body fat.

This means that 23.7kg of the client's weight is now body fat, a loss of 3.7kg, and 51.3kg is lean tissue, an increase of 0.7kg. This shows that the client has lost even more body fat than the weighing scales have indicated as she has gained lean tissue.

<b>WOMEN % FAT FOR SUM OF SKINFOLD MEASUREMENTS AT ALL FOUR SITES</b>					
<b>Sum of skinfold sites (mm)</b>	<b>Age (years)</b>				
	<b>17-19</b>	<b>20-29</b>	<b>30-39</b>	<b>40-49</b>	<b>50+</b>
<b>10</b>	3.46	4.88	8.72	11.71	12.88
<b>12</b>	5.70	7.27	10.85	13.81	15.10
<b>14</b>	7.62	9.30	12.68	15.59	16.99
<b>16</b>	9.29	11.08	14.27	17.15	18.65
<b>18</b>	10.77	12.66	15.68	18.54	20.11
<b>20</b>	12.10	14.08	16.95	19.78	21.44
<b>22</b>	13.32	15.38	18.10	20.92	22.64
<b>24</b>	14.43	16.57	19.16	21.95	23.74
<b>26</b>	15.46	17.67	20.14	22.91	24.76
<b>28</b>	16.42	18.69	21.05	23.80	25.71
<b>30</b>	17.31	19.64	21.90	24.64	26.59
<b>32</b>	18.15	20.54	22.70	25.42	27.42
<b>34</b>	18.94	21.39	23.45	26.16	28.21
<b>36</b>	19.69	22.19	24.16	26.85	28.95
<b>38</b>	20.40	22.95	24.84	27.51	29.65
<b>40</b>	21.08	23.67	25.48	28.14	30.32
<b>42</b>	21.72	24.36	26.09	28.74	30.96
<b>44</b>	22.34	25.02	26.68	29.32	31.57
<b>46</b>	22.93	25.65	27.24	29.87	32.15
<b>48</b>	23.50	26.26	27.78	30.39	32.71
<b>50</b>	24.04	26.84	28.30	30.90	33.25
<b>55</b>	25.32	28.21	29.51	32.09	34.51
<b>60</b>	26.49	29.46	30.62	33.17	35.67
<b>65</b>	27.58	30.62	31.65	34.18	36.74
<b>70</b>	28.58	31.70	32.60	35.11	37.74
<b>75</b>	29.53	32.71	33.49	35.99	38.67
<b>80</b>	30.41	33.66	34.33	36.81	39.54
<b>85</b>	31.24	34.55	35.12	37.58	40.36
<b>90</b>	32.03	35.40	35.87	38.31	41.14
<b>95</b>	32.78	36.20	36.58	39.00	41.88
<b>100</b>	33.49	36.97	37.25	39.66	42.59
<b>110</b>	34.82	38.39	38.51	40.89	43.90
<b>120</b>	36.04	39.70	39.66	42.02	45.10
<b>130</b>	37.17	40.91	40.73	43.06	46.22
<b>140</b>	38.22	42.04	41.72	44.03	47.25
<b>150</b>	39.20	43.09	42.65	44.94	48.22
<b>160</b>	40.12	44.08	43.52	45.79	49.13
<b>170</b>	40.99	45.01	44.34	46.59	49.98
<b>180</b>	41.81	45.89	45.12	47.35	50.79
<b>190</b>	42.59	46.73	45.85	48.07	51.56
<b>200</b>	43.33	47.53	46.55	48.75	52.29

<b>MEN % FAT FOR SUM OF SKINFOLD MEASUREMENTS AT ALL FOUR SITES</b>					
<b>Sum of skinfold sites (mm)</b>	<b>Age (years)</b>				
	<b>17 - 19</b>	<b>20 - 29</b>	<b>30 - 39</b>	<b>40 - 49</b>	<b>50 +</b>
<b>10</b>	0.41	0.04	5.05	3.30	2.63
<b>12</b>	2.46	2.10	6.86	5.61	5.20
<b>14</b>	4.21	3.85	8.40	7.58	7.39
<b>16</b>	5.74	5.38	9.74	9.31	9.31
<b>18</b>	7.10	6.74	10.93	10.84	11.02
<b>20</b>	8.32	7.96	12.00	12.22	12.55
<b>22</b>	9.43	9.07	12.97	13.47	13.95
<b>24</b>	10.45	10.09	13.87	14.62	15.23
<b>26</b>	11.39	11.03	14.69	15.68	16.42
<b>28</b>	12.26	11.91	15.46	16.67	17.53
<b>30</b>	13.07	12.73	16.17	17.60	18.56
<b>32</b>	13.84	13.49	16.84	18.47	19.53
<b>34</b>	14.56	14.22	17.47	19.28	20.44
<b>36</b>	15.25	14.90	18.07	20.06	21.31
<b>38</b>	15.89	15.55	18.63	20.79	22.13
<b>40</b>	16.51	16.17	19.17	21.49	22.92
<b>42</b>	17.10	16.76	19.69	22.16	23.66
<b>44</b>	17.66	17.32	20.18	22.80	24.38
<b>46</b>	18.20	17.86	20.65	23.41	25.06
<b>48</b>	18.71	18.37	21.10	24.00	25.72
<b>50</b>	19.21	18.87	21.53	24.56	26.35
<b>55</b>	20.37	20.04	22.54	25.88	27.83
<b>60</b>	21.44	21.11	23.47	27.09	29.20
<b>65</b>	22.42	22.09	24.33	28.22	30.45
<b>70</b>	23.34	23.01	25.13	29.26	31.63
<b>75</b>	24.20	23.87	25.87	30.23	32.72
<b>80</b>	25.00	24.67	26.57	31.15	33.75
<b>85</b>	25.76	25.43	27.23	32.01	34.72
<b>90</b>	26.47	26.15	27.85	32.83	35.64
<b>95</b>	27.15	26.83	28.44	33.61	36.52
<b>100</b>	27.80	27.48	29.00	34.34	37.35
<b>110</b>	29.00	28.68	30.05	35.72	38.90
<b>120</b>	30.11	29.79	31.01	36.99	40.33
<b>130</b>	31.13	30.82	31.89	38.15	41.65
<b>140</b>	32.08	31.77	32.71	39.24	42.87
<b>150</b>	32.97	32.66	33.48	40.26	44.02
<b>160</b>	33.80	33.49	34.20	41.21	45.10
<b>170</b>	34.59	34.28	34.88	42.11	46.12
<b>180</b>	35.33	35.02	35.53	42.96	47.08
<b>190</b>	36.04	35.73	36.13	43.77	48.00
<b>200</b>	36.71	36.40	36.71	44.54	48.87

## Bioelectrical impedance

### Pre-test protocols for bioelectrical impedance (adapted from Heyward and Gibson, 2014)

1. No eating or drinking within 4 hours of the test and the client should have been to the toilet within 30 minutes of the test.
2. No alcohol consumption within 48 hours of the test.
3. Avoid caffeine or other diuretic substances prior to a test, unless medically prescribed.
4. No moderate or intense exercise within 12 hours of the test.
5. If there is any feeling, signs or symptoms of water retention (e.g. a woman in her pre-menstrual period) the test should be postponed.

## Body mass index (BMI)

The body mass index (BMI) is worked out using the following equation:

÷ + WORK  
- × IT OUT

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{Weight (kg)}}{\text{Height}^2 (\text{m})}$$

#### For example

If a 70kg man (2.2lbs = 1kg) stands 5ft 8in tall (2.45 cm = 1 inch), then:

$$\text{BMI} = \frac{70\text{kg}}{1.72\text{m}^2} = \frac{70}{2.96} = 23.6\text{kg/m}^2$$

BMI classification	
Underweight	<18.5
Normal range	18.5-24.9
Overweight	≥25.0
Preobese	25.0-29.9
Obese	≥30.0
Obese class I	30.0-34.9
Obese class II	35.0-39.9
Obese class III	≥40.0

Foresight, 2007

## Waist and hip measurements

### Waist and hips measurement tests protocol

#### Waist measurement test protocol

1. Locate the narrowest part of the abdominal region, midway between the ribs and pelvis.
2. Wrap the tape measure around the waist at this height, checking that the tape measure is not twisted, there is nothing trapped underneath and that the waist is not being compressed by the tape.
3. Read and record the result.



#### Hips measurement test protocol

1. Locate the widest part of the hip region, around the hinge of the hip.
2. Wrap the tape measure around the hips at this height, checking that the tape measure is not twisted, there is nothing trapped underneath and that the hips and bottom are not being compressed by the tape.
3. Read and record the result.



## Waist risk classifications

	Increased risk	Substantially increased risk
<b>Men</b>	Over 94 cm.	Over 102 cm.
<b>Men (African-Caribbean, South Asian and some other minority ethnic groups)</b>		Over 90 cm.
<b>Women</b>	Over 80 cm.	Over 88 cm.
<b>Men (African-Caribbean, South Asian and some other minority ethnic groups)</b>		Over 80 cm.

National Obesity Forum, BHF

## Waist-to-hip ratio calculation

÷ + WORK  
- × IT OUT

$$\text{Waist-to-hip ratio} = \frac{\text{Waist}}{\text{Hips}}$$

### For example

If a man with a 94cm waist and 100cm hips has a waist-to-hip ratio of 0.94, this places him in the moderate risk category.

### Waist-to-hip ratio classifications

Fat stored around the abdominal region (as opposed to your legs, hips and arms) is considered to be a greater risk factor for CHD. Health risk increases with waist-to-hip ratio, and standards for risk vary with age and gender.

Classification	Male	Female
<b>High risk</b>	>1.0	>0.85
<b>Moderate risk</b>	0.90–1.0	0.80–0.85
<b>Low risk</b>	<0.90	<0.80

Adapted from Van Itallie, 1988

# Section 3: Fitness tests

## Cardiovascular tests

### Balke treadmill test

Balke and Ware (1959) devised one of the most commonly used treadmill protocols. During the Balke test:

- The treadmill speed is set at 3.3 miles per hour (5.3 kilometres per hour) and the initially flat gradient rises to 2%.
- Increase the gradient by 1% with each subsequent minute until the client is unable to maintain the intensity of the exercise.

Maximum treadmill time (minutes and fractions of minutes) is directly related to aerobic capacity, and  $\text{VO}_2 \text{ max}$  can be reliably predicted from the following equation.



$$\text{VO}_2 \text{ max (ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}) = 1.444(\text{time}/60) + 14.99$$

(Pollock et al, 1976)

For example, a treadmill time of 950 seconds predicts a  $\text{VO}_2 \text{ max}$  of 37.9  $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ .

$$[1.444 \times (950/60) + 14.99]$$

The score can be compared with the  $\text{VO}_2 \text{ max}$  norms offered in the norms tables.

The gradual and equal increments make the Balke protocol suitable for many adults, including older and/or deconditioned individuals. However, the test may take too long for more fit individuals. It should be stressed that, due to the gradual nature of the test, no separate warm-up is required.

Fitness categories for males based on $\text{VO}_2 \text{ max}$ expressed in $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$					
Age (years)	Low	Fair	Average	Good	High
20-29	≤24	25-33	34-42	43-52	≥53
30-39	≤22	23-30	31-38	39-48	≥49
40-49	≤19	20-26	27-35	36-44	≥45
50-59	≤17	18-24	25-33	34-42	≥43
60-69	≤15	16-22	23-30	31-40	≥41

(Cooper and Storer, 2001)

Fitness categories for females based on $\text{VO}_2 \text{ max}$ expressed in $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$					
Age (years)	Low	Fair	Average	Good	High
20-29	≤23	24-30	31-37	38-48	≥49
30-39	≤19	20-27	28-33	34-44	≥45
40-49	≤16	17-23	24-30	31-41	≥42
50-59	≤14	15-20	21-27	28-37	≥38
60-69	≤12	13-17	18-23	24-34	≥35

(Cooper and Storer, 2001)

## Cooper 3-mile walk test

For many individuals, Cooper's 3-mile walk test provides an indication of aerobic fitness without requiring a maximal effort. As a result, the test is suitable for healthy males and females aged 13–70 years who have been actively walking for at least 6 weeks (Cooper and Storer, 2001). If the course is accurately measured, the test can be performed indoors or outdoors. Participants should be instructed to walk 3 miles as fast as possible without running. Time to completion can be used to assess aerobic fitness, as indicated in the table.

<b>Classification of cardiorespiratory fitness based on the Cooper 3-mile walk test (Cooper and Storer, 2001).</b> <b>Values represent time (mins) to complete the 3-mile walk.</b>					
<b>Age (y)</b>	<b>Very poor</b>	<b>Poor</b>	<b>Fair</b>	<b>Good</b>	<b>Excellent</b>
<b>13-19</b>					
Males	≥45:01	45:00-41:01	41:00-37:31	37:30-33:00	≤32:59
Females	≥47:01	47:00-43:01	43:00-39:31	39:30-35:00	≤34:59
<b>20-29</b>					
Males	≥46:01	46:00-42:01	42:00-38:31	38:30-34:00	≤33:59
Females	≥48:01	48:00-44:01	44:00-40:31	40:30-36:00	≤35:59
<b>30-39</b>					
Males	≥49:01	49:00-44:31	44:30-40:01	40:00-35:00	≤34:59
Females	≥51:01	51:00-46:31	46:30-42:01	42:00-37:30	≤37:29
<b>40-49</b>					
Males	≥52:01	52:00-47:01	47:00-42:01	42:00-36:30	≤36:29
Females	≥54:01	54:00-49:01	49:00-44:01	44:00-39:00	≤38:59
<b>50-59</b>					
Males	≥55:01	55:00-50:01	50:00-45:01	45:00-39:00	≤38:59
Females	≥57:01	57:00-52:01	52:00-47:01	47:00-42:00	≤41:59
<b>60+</b>					
Males	≥60:01	60:00-54:01	54:00-48:01	48:00-41:00	≤40:59
Females	≥63:01	63:00-57:01	57:00-51:01	51:00-45:00	≤44:59

## Cooper 1.5-mile run test

Aerobic fitness can be assessed using the 1.5-mile run test first described by Cooper in 1968. The test can provide a valid measure of aerobic capacity, but it requires pacing and a sustained, near-maximal effort. For these reasons, at least six weeks' aerobic training (preferably running) is recommended before attempting the test. After warming-up, participants should be instructed to complete the 1.5-mile distance as fast as possible. Time is recorded to the nearest second, and a gradual cool-down should follow the test. Interpret test performance using the corresponding table. If the Cooper 1.5-mile run test is performed on a treadmill, the incline should be set at 1% to replicate the energy cost of running outdoors (Jones and Doust, 1996).

<b>Classification of cardiorespiratory fitness based on Cooper 1.5 mile run test (Cooper, 1982).</b> <b>Values represent time (mins) elapsed in completing 1.5 miles</b>						
<b>Age (y)</b>	<b>Very poor</b>	<b>Poor</b>	<b>Fair</b>	<b>Good</b>	<b>Excellent</b>	<b>Superior</b>
<b>13-19</b>						
Males	≥15:31	15:30-12:11	12:10-10:49	10:48-9:41	9:40-8:37	≤8:36
Females	≥18:31	18:30-16:55	16:54-14:31	14:30-12:30	12:29-11:50	≤11:49
<b>20-29</b>						
Males	≥16:01	16:00-14:01	14:00-12:01	12:00-10:46	10:45-9:45	≤9:44
Females	≥19:01	18:31-19:00	15:55-18:30	13:31-15:54	12:30-13:30	≤12:29
<b>30-39</b>						
Males	≥16:31	16:30-14:44	14:45-12:31	12:30-11:01	11:00-10:00	≤9:59
Females	≥19:31	19:01-10:30	16:31-19:00	14:31-16:30	13:00-14:30	≤12:59
<b>40-49</b>						
Males	≥17:31	17:30-15:36	15:35-13:01	13:00-11:31	11:30-10:30	≤10:29
Females	≥20:01	20:00-19:31	19:30-17:31	17:30-15:56	15:55-13:45	≤13:44
<b>50-59</b>						
Males	≥19:01	19:00-17:01	17:00-14:31	14:30-12:31	12:30-11:00	≤10:59
Females	≥20:31	20:30-20:01	20:00-19:00	19:00-16:31	16:30-14:30	≤14:29
<b>60+</b>						
Males	≥20:01	20:00-19:01	19:00-16:16	16:15-14:00	13:59-11:15	≤11:14
Females	≥21:01	21:31-21:00	20:30-19:31	19:30-17:30	17:30-16:30	≤16:29

## 9- or 12-minute distance tests

A simple alternative to the Cooper run or walk tests, the 9 or 12 minute distance tests can be used to measure progression in relation to distance covered in a period of time. For athletes, this test can be performed using a track, measuring how far they travel (e.g. run or cycle) in 9 or 12 minutes. For general PT clients, a local environment can be used, however in order to gather reliable results the course must be:

- **Measured.** The progression made can only be quantified if the measure is clear. A measurement could be using a specific unit (e.g. kilometres or metres), or it could be using environmental points (e.g. reached the crossing on the high street). The measure should be of value to the client and be something they understand and can relate to.
- **The same for each attempt at the test.** Even small changes in incline or surface can affect the speed a client travels. The course followed must be the same to allow comparison between test and re-tests.

The simplicity of these tests is that the client can walk or run as they wish and the measurement is simple to calculate and record accurately. In order to maximise reliability, the PT should not only record the result of the test, but an accurate representation of the course so it can be easily replicated. This could be achieved using a printed or electronic map, written directions, or wearable technology that now facilitates simple recording (e.g. GPS tracker watches). Technology may also provide useful visual aids to demonstrate progression to the client (e.g. online charts, comparisons).

## Queens College step test

Step tests are useful for assessing cardiorespiratory fitness because they can be administered to individuals or large groups of people without requiring expensive equipment or highly trained personnel. Like many step tests, the Queens College step test uses recovery heart rate as the comparable measure.

For the validated test protocol the step height is set at 41.3cm which is the height of many gymnasium bleacher seats in the USA. PTs may have access to steps which can accurately re-create this step height, however in the field a PT may have to improvise. If improvisation is required the PT should try to make the step height as close to 41.3cm as possible. They should then accurately record the step height (using a tape measure, or if risers are being used to increase the height of the step then the amount of risers may be recorded as an alternative). Every re-test should then utilise the same step set at the same height. If the step height is significantly different from that of the validated protocol then it may not be possible to compare against the norms tables, however comparison from test to test can take place and general comparison to norms tables may still be useful.



Following the test, the PT should utilise the following formula (if step height is accurate) to predict  $\text{VO}_2 \text{ max}$ :

$$\text{Female } \text{VO}_2 \text{ max (ml/kg/min)} = 65.81 - (0.1847 \times \text{HR})$$

$$\text{Male } \text{VO}_2 \text{ max (ml/kg/min)} = 111.33 - (0.42 \times \text{HR})$$

The Balke treadmill tables can be used to identify fitness categories following this test.

### Queens College step test protocol

- Step height is set as 41.3cm.
- A metronome should be set to 88 beats per minute (BPM) for females (22 steps per minute) and 96 BPM for males (24 steps per minute) to keep clients in time for the duration of the test. Check and ensure that the beats are audible at all times.
- Make sure the client is comfortable with how to step up and down in time with the beats (up, up, down, down, four beats, one complete step). If the client needs to practise, allow rest and recovery prior to starting the actual test.
- The client performs the steps in time for 3 minutes.
- Precisely 5 seconds after the test has ended, the heart rate is measured for 15 seconds.
- Multiply the 15 second result by 4 to give the heart rate result.

## The multistage fitness test

Leger and Lambert (1982) first developed a 20-metre shuttle run for the prediction of  $\text{VO}_2 \text{ max}$ . The ‘bleep test’ is now recognised as one of the most popular and valid tests of aerobic fitness in individuals or groups. The test should be performed on a dry, firm and flat surface with sufficient space for the 20-metre course and for deceleration at each end (around 5-10 metres). During the test, participants move between markers whilst the bleep intervals become progressively shorter. The audio for the multistage fitness test can be obtained via download or audio CD.

## The yo-yo test

Similar to the multistage fitness test and using 20-metre shuttle distances, the yo-yo test is commonly used in football to assess an individual’s ability to perform repeated intervals for a period of time. There are two types of yo-yo test (endurance and intermittent).

The endurance version mimics the style of the multistage fitness test and each stage gets faster as the test progresses, however the speed increments tend to be quicker and more intense than a traditional multistage fitness test.

The intermittent version incorporates a very short recovery period after every 40 metres completed.

The audio for these fitness tests can be obtained via download or audio CD.

## Velocity at VO<sub>2</sub> max (vVO<sub>2</sub> max)

This concept is based on the work performed by the highly respected French researcher Veronique Billat (1999). She advocates the importance of something called vVO<sub>2</sub> max which is the exercise velocity which causes your body to utilise oxygen at its highest possible rate.

This measurement has been a better predictor of ability and performance than VO<sub>2</sub> max, as it encompasses elements of movement economy and efficiency (how well the individual moves without wasting effort and oxygen on unnecessary movement).

Training at an intensity equivalent to vVO<sub>2</sub> max has been shown to not only increase this variable, but also the ability to tolerate the fatiguing effects of lactic acid and movement economy, both of which are key features in enhanced performance. The next question, therefore, is how to calculate vVO<sub>2</sub> max and how to use this in programme design. It should be emphasised that this is a test for intermediate to advanced clients who are clear of any risk factors and who are well-motivated.

Determining vVO<sub>2</sub> max is relatively easy to do. The activity mode chosen obviously depends on the client's sport and/or chosen activity. The rowing ergometer will be used in this example. After performing an appropriate warm-up, the timer on the ergometer should be set to 6 minutes and the display to indicate distance travelled in metres. It is then a simple matter of working as hard as possible for this 6-minute time trial. It is tough, and if the client is not used to pacing him/herself over this duration, they may want to have a few attempts to fully optimise performance.

Once the client has completed a good 6-minute effort, divide the distance travelled by 6 (metres per minute). For example, if the client rowed 1700 metres in 6 minutes this would be  $1700/6 = 283.2$ . This is the vVO<sub>2</sub> max in metres per minute. The test should also produce a maximum heart rate for the client. Based on the above result, exercise intensity can be prescribed. For example: 50% of 283.2 = 141.6 metres per minute.

## Muscular strength and endurance tests

### Spring loaded dynamometers

There are a number of different types of dynamometer that can be used to assess the load a muscle/group of muscles can apply (e.g. hand grip dynamometer, back and leg dynamometers). The dynamometer is formed from a spring which changes length when force is applied and this moves a needle which indicates force.

Dynamometer assessments can be used to measure maximal force, or the length of time a certain force can be applied. The protocol is simple and should be reliably recorded to allow comparability. The client should have 2-3 attempts at each test and the highest reading is taken in each case.

One of the major drawbacks in using these kinds of tests is that they only measure a small, selected group of muscles in one way. The dynamometer also needs regularly calibrating to ensure result accuracy.

### One-repetition maximum (1RM)

One-repetition maximum tests are carried out to identify the maximum weight a client can lift for one complete repetition of the specified movement with perfect technique (Heyward and Gibson, 2014). Exercises commonly used for 1RM tests include the bench press, bicep curl, lat pull down or pull-up, leg press, leg extension and leg curl.

A PT must consider whether this maximal test is the most appropriate for many general clients. Any 1RM test must be safely and effectively spotted as failure is inevitable and the client must be familiar and comfortable enough with the techniques and how to avoid injury when failing at these techniques to ensure safety can be maintained throughout. In addition, the maximal exertion required is very intense and will naturally increase the injury risks to the client, even if the most experienced spotters are in place. 1RM should therefore only be used for clients who have a specific need, the experience and resources at their disposal (e.g. a power lifter who is trying to increase their 1RM for competition).

### One-repetition maximum (1RM) test protocol (adapted from Heyward and Gibson, 2014)

- Client to warm up using a light resistance (40-60% of estimated 1RM) for 5-10 repetitions.
- Provide a 1-minute rest period, including light stretching of the muscle(s) to be tested.
- Client performs 3-5 repetitions of the exercise at 60-80% of estimated 1RM.
- Increase the load to just below estimated 1RM (the client needs to achieve at least one successful lift to be able to identify 1RM, if the initial weight is set too high, no result can be recorded).
- Client attempts the lift.
  - If the client achieves the lift, provide 3-5 minutes' rest prior to attempting the next weight.
  - If the client fails at the lift, the last successful lift is recorded as the 1RM.

#### Please note:

- Weight increments for each attempt should be conservative.
- The 1RM should be achieved within 3-5 trials. Should the 1RM not be determined within those 5 attempts, another test date should be set as fatigue may play a role in any results.

## Estimated strength test

The estimated strength test is an alternative to the 1RM test and is suitable for clients who should not be taken to maximum load. These tests rely on a formula to predict maximum strength.

### Estimated strength test protocol (adapted from Sandler, 2005)

- Select one upper and one lower body exercise.
- Client to warm up using a light resistance (40-60% of estimated 1RM) for 5-10 repetitions.
- Provide a 2-minute rest period, including light stretching of the muscle(s) to be tested.
- Select a weight that would mean a client reached failure between two and ten repetitions.
- Calculate 1RM using the appropriate formula.



#### Upper body rep max predictor:

Upper body estimated 1 repetition maximum = Weight used for reps  $\times (1 \div (1 - [\text{Reps made} \times 0.025]))$ .

#### Lower body rep max predictor:

Lower body estimated 1 repetition maximum = Weight used for reps  $\times (1 \div (1 - [\text{Reps made} \times 0.035]))$ .

Upper body rep max predictor:	Lower body rep max predictor:
<b>Step 1</b> Reps made $\times 0.025 = X$ e.g. 12 reps $\times 0.025 = 0.3$	<b>Step 1</b> Reps made $\times 0.035 = A$ e.g. 12 reps $\times 0.035 = 0.42$
<b>Step 2</b> $1 - X = Y$ e.g. $1 - 0.3 = 0.7$	<b>Step 2</b> $1 - A = B$ e.g. $1 - 0.42 = 0.58$
<b>Step 3</b> $1 \div Y = Z$ e.g. $1 \div 0.7 = 1.43$	<b>Step 3</b> $1 \div B = C$ e.g. $1 \div 0.58 = 1.72$
<b>Step 4</b> Weight used for reps $\times Z = \text{Estimated 1 repetition maximum.}$ e.g. $50\text{kg} \times 1.43 = 71.43 \text{ kg}$ estimated 1RM	<b>Step 4</b> Weight used for reps $\times C = \text{Estimated 1 repetition maximum.}$ e.g. $50\text{kg} \times 1.72 = 86.2 \text{ kg}$ estimated 1RM

## Core tests

### Back extensor test

This test does not have a set of normative values but provides a reference point for comparing future performance.

#### Back extensor test protocol (adapted from McGill, 2002)

- The client lies in a prone position with the upper body extended over the end of a table or bench. Hips, knees and pelvis should be secured and supported by the table or bench.
- Arms are crossed so the hands rest on the opposite shoulders.
- The client extends at the hips so their body is straight and parallel to the floor, with the lower part of the body (to the hips) secure and supported by the bench and the upper part of the body held in position using the back extensors.
- The test is timed from the moment a client reaches the parallel position, until they cannot hold a fixed position.

### Sit-up, curl-up test

There are a number of different sit-up and curl-up tests which involve using different hand, feet, body positions and protocols. Many of these variations have undergone validation research, although the correlation demonstrated between measurement taken and outcome has been limited (e.g. a curl-up test is shown to be a poor indicator of abdominal endurance or reduced risk of low back pain (Heyward and Gibson, 2014)). This may be due to the simplicity of the test (measuring the ability of a client to perform isolated curl-up exercises, using large movement-oriented muscles in a non-functional position) and the contrasting complexity of the functionality of the core (the core works as a unit, rather than in isolation, to produce, assist and stabilise functional movements).

A PT may find that these types of isolated endurance tests may be best avoided with clients who have functional or performance goals, however there may still be times when this type of test can be motivational as it can demonstrate clear progress from one test to another.

#### Sit-up test protocol

- The client lies on their back with the soles of their feet flat on the floor and knees at 90 degrees.
- Arms are crossed so the hands rest on the opposite shoulders.
- Whilst keeping the feet on the floor and arms crossed, the client performs a technically correct sit-up.
- The client performs as many sit-ups as they can in one minute.
- The PT observes technique and only full repetitions (e.g. the scapula should contact the floor before a repetition can be considered complete) with accurate technique are counted.

## Core stability test

Core stability can be assessed using a number of exercises, including a prone plank, a side plank, single or double leg raises, back extension or bridge positions. The PT would ensure the client could complete the selected exercise with appropriate technique. Then the client would aim to hold the exercise using good technique for as long as possible while they were timed by the PT. As soon as technique quality is lost, the time is stopped and the amount of time held is recorded (e.g. a full prone plank held for 2 minutes 10 seconds).

These types of tests tend to have no normative values, but can provide PTs with results that could be used to compare progression from test to test.



## Power tests

### Vertical jump test

Vertical jump tests can be performed in two distinct ways: the squat jump (SJ) and the countermovement jump (CMJ). Both assess the ability of the musculature of the hips, thighs and lower legs to propel the individual vertically into the air, but unlike the SJ, the CMJ utilises the elasticity in muscles and the stretch-shortening cycle. If the PT wishes to perform just one variant of the vertical jump test, then the CMJ is probably more appropriate as it more closely replicates the way the body loads then unloads in function.

#### Countermovement jump

This test is used to measure the generation of vertical height utilising the stretch-shortening cycle and the body's ability to produce coordinated upper and lower body power.

#### Countermovement jump test protocol

- The client rubs chalk on the fingertips of the dominant hand, or stands beside a vertical jump tester.
- The client stands side-on to the wall/tester, with the shoulder of the dominant hand approximately 15cm from the wall.
- With feet flat on the floor, the client reaches as high as they can and makes a mark on the wall, or tester.
- The client performs a maximal countermovement jump:
  - Rapidly flex the hips and knees, bring the torso forward and down and swing the arms behind the body to eccentrically load the lower body musculature.
  - Immediately jump as high as possible by rapidly extending the hips and knees and simultaneously reaching up with the arms.
  - At the top of the jump, the client must make a mark on the wall or tester.
- The PT measures the distance between marks to identify the jump height.
- The client repeats the test three times and the best performance is recorded.

Normative table for vertical jump performance (CMJ)		
Performance % rank	Female height (cm)	Male height (cm)
91-100 World class	76-81	86-91
81-90	71-75	81-85
71-80	66-70	76-80
61-70	60-65	71-75
51-60	55-59	66-70
41-50	50-54	60-65
31-40	45-49	55-59
21-30	40-44	50-54
11-20	35-39	45-49
1-10	<35	<45

Adapted from Chu (1996)

The normative table for this test is derived from data obtained from competitive athletes. General clients are likely to perform a jump which is ranked to a very low percentile which could be demotivating. The comparison of results against the normative table should be considered by the PT to ensure that usage is appropriate and positive.

### Squat jump

The squat jump is similar to the countermovement jump, except the client moves into the eccentrically loaded squat position and holds for at least 2 seconds prior to performing the maximal jump. This removes the stretch-shortening cycle from the equation and as such readings are likely to be slightly lower when compared to a countermovement jump. The squat jump protocol is the same as the countermovement jump, the only difference is the 2 second hold. The results are therefore measured and recorded in the same way as the countermovement jump protocol.

### Standing broad jump

This test is similar to the vertical jump tests, except it measures the distance a client can travel horizontally, rather than vertically. This jump can also be completed using a countermovement jump, or a squat jump variation.

#### Standing broad jump protocol

- Mark the start point on the ground with a straight line.
- The client performs the appropriate jump and attempts to jump as far as they can horizontally.
- The PT marks the back of the heel of the client.
- The PT measures the distance between start and finish points to identify the jump distance.
- The client repeats the test three times and the best performance is recorded.

Normative table for standing board jump performance (CMJ)		
Performance % rank	Female distance (m)	Male distance (m)
91-100 World class	2.94-3.15	3.40-3.75
81-90	2.80-2.94	3.10-3.39
71-80	2.65-2.79	2.95-3.09
61-70	2.50-2.64	2.80-2.94
51-60	2.35-2.49	2.65-2.79
41-50	2.20-2.34	2.50-2.64
31-40	2.05-2.19	2.35-2.49
21-30	1.90-2.04	2.20-2.34
11-20	1.75-1.89	2.05-2.19
1-10	1.60-1.74	1.90-2.04

Adapted from Chu (1996)

# Section 4: Posture

## Neutral (optimal) posture – key technique points

When viewing a client in a side-on position, neutral posture will appear as figure 4.1. This is also called a **plumb line alignment** because if an imaginary plumb line were hung from the top centre of the client's head, it would pass through:

- The earlobe.
- The centre of the shoulder.
- The elbow.
- The centre of the hip.
- Slightly anterior to the midline of the knee.
- Slightly anterior to the ankle bone.

When viewing a client from the front, or back, neutral posture will appear symmetrical as left and right sides are balanced. This can be viewed by drawing imaginary horizontal lines between the major joints as shown in figure 4.2. The horizontal lines between the shoulders, or hips, should be parallel to the floor.

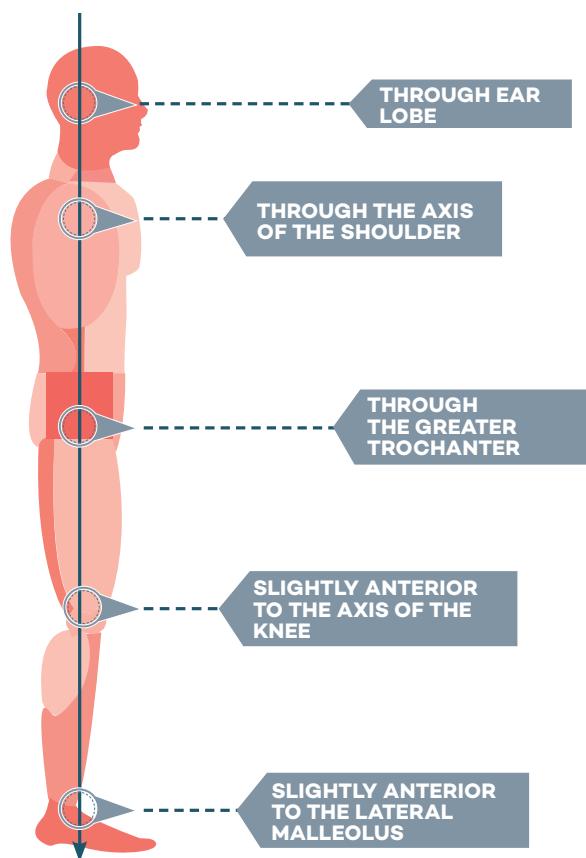


Figure 4.1 Neutral posture

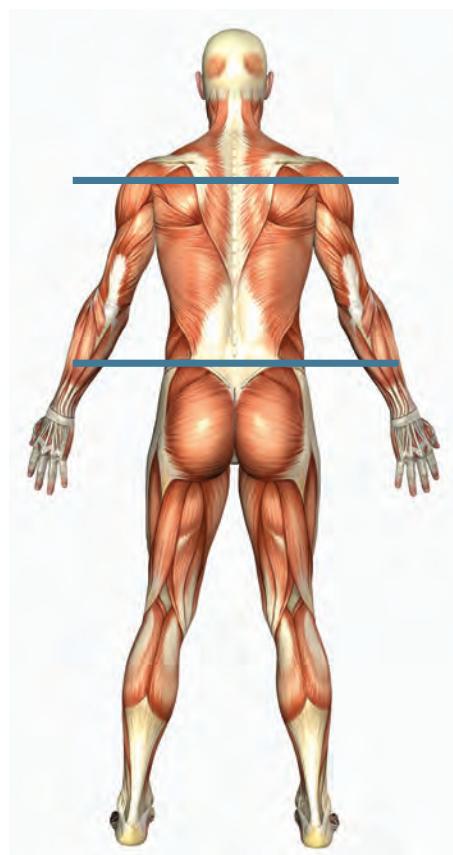


Figure 4.2 Neutral posture

### Other neutral posture guidance

Joint	Neutral
Neck	<ul style="list-style-type: none"> <li>• Head central, no lateral lean.</li> <li>• Head not poking forward or arching back.</li> <li>• Chin parallel to floor.</li> </ul>
Shoulders	<ul style="list-style-type: none"> <li>• Chest open.</li> <li>• Shoulder blades slightly back and down.</li> <li>• No rounding, or lifting.</li> </ul>
Elbows	<ul style="list-style-type: none"> <li>• Straight but not locked.</li> </ul>
Wrists	<ul style="list-style-type: none"> <li>• No excessive flexion or extension.</li> <li>• Back of hand, wrist and forearm make a straight line.</li> </ul>
Spine, pelvis and hips	<ul style="list-style-type: none"> <li>• Natural spinal S-shaped curves maintained.</li> <li>• Central pelvic alignment – no anterior or posterior tilt.</li> <li>• Brace the core to a comfortable, but stable, level.</li> </ul>
Knees	<ul style="list-style-type: none"> <li>• Straight but not locked.</li> <li>• Centre of kneecap aligned with middle toe.</li> </ul>
Ankles	<ul style="list-style-type: none"> <li>• Feet aligned with knees.</li> <li>• Natural arch of the foot maintained.</li> <li>• Weight distributed evenly between left and right, front and back.</li> </ul>

## Range of motion and postural assessments

Posture and range of motion assessments can provide PTs with valuable information that can identify strengths, weaknesses and imbalances or postural distortions that may affect function. They also provide comparative information from test to test to clearly demonstrate progressions of flexibility. This information can be used to provide specific exercises to address any issues. For example, if a client demonstrates a significant anterior pelvic tilt it may indicate that the hip flexors are shortened. If the hip flexors are shortened then the gluteus maximus is likely to be lengthened. The PT can therefore include some hip flexor stretches and glute strengthening exercises into the programme to address these functional issues. When the client is reassessed following completion of the programme, they should show a reduced anterior pelvic tilt and their hip flexor range of motion assessment will have improved.

When performing postural and range of motion assessments it is key to prioritise any results in line with the needs of the client. It is very easy to build a programme purely around improving the posture and range of motion of a client, however a PT must understand that this may detract from a client's other goals and as such this may reduce client motivation and the likelihood of goal achievement. By balancing postural correction with the appropriate development of other client-specific abilities, the PT can effectively improve posture and facilitate goal achievement in combination.

### Active and passive range of motion tests

It is possible to assess the flexibility of individual muscle/muscle groups and this can be used to identify any potential impact on posture, joint motion and function. These tests can be performed actively (the client moves the body into position), or passively (the PT moves the client's body whilst the client stays relaxed). There are risks and benefits for each type of test and considerations of these factors should occur prior to testing to ensure that clients undergo the most appropriate tests for them.

Active range of motion tests can be used to provide the PT with important information about the client's own ability to use their passive flexibility. By comparing active results with passive results, a PT can identify any functional limitations that may be addressed using appropriate programming. By comparing left and right sides on the body, a PT can identify any imbalances. By comparing results from one assessment to another, a PT can identify flexibility progressions.

Analysis of the active results can help the PT to identify tight or short musculature so that subsequent flexibility work can be specifically targeted to the needs of the individual. They can also be used to check if there are any mechanical or functional impingements that may cause discomfort or pain to the client when performing passive range of motion tests. For this reason, the recommended order of range of motion tests is to perform active first, followed by passive tests.

Passive range of motion is usually slightly larger than active range of motion. This is because the client is relaxed, therefore there tends to be less resistance applied by the surrounding musculature. Significant differences between active and passive range of motion tests may be a useful indicator of functional weaknesses or imbalances that could be addressed within a progressive programme. For example, if a client's lower back arches significantly more during a wall standing shoulder flexion active test in comparison with the passive test, this may be indicative of core instability. A PT could therefore look to add a two-point box to the client's programme to develop core stability when a client is moving their arms.

#### Active range of motion test protocol

- The PT selects the ranges of motion to be tested and clearly demonstrates the test, detailing any key technique points.
- The client moves\* the body part into the desired position and holds the joint in place for measurement using isometric muscle contractions.
- The PT measures the angle at the specified joint (measurements can be performed using a goniometer or a video analysis tool; alternatively, basic measurement can be made using observed estimations).
- The joint angle is recorded.
- If there is any pain or discomfort felt by the client, this test should not be repeated passively.

\*Movements should be slow and smooth to limit the effects of the stretch reflex.

### Passive range of motion test protocol

- The client focusses on relaxing the musculature around the joint being tested.
- The PT supports the limb/body part and slowly moves\* it into the position just prior to where technique is lost, postural adaptation occurs or restriction is felt (point of tension).\*\*

\*\*The PT must avoid forcing additional range of motion as this may result in compensation and adaptation at a related joint, inaccurate results, additional joint stress and even injury. The PT must also ensure they can observe or feel any compensations or adaptations at related joints. For example, a PT completing a hamstring test should observe and feel for adaptations at the lower back, hip, knee and ankle. As soon as any compensation occurs, the client's end range of motion has been reached.

#### Hip flexor protocol

- Client lies in the supine position, arms by their sides.
- PT places two hands on the client's 'non-assessed' lower leg (shin), leaving the foot relaxed.
- The lower leg is moved into knee and hip flexion and the knee is pulled towards the chest.
- The pelvis is taken into posterior pelvic tilt, so the client has a flat back, and when the hip flexor becomes taut the 'assessed' knee will start to lift.



#### Hamstring protocol



- Client lies in the supine position, arms by their sides.
- PT places one hand underneath the client's lumbar vertebrae and the other on the leg being assessed.
- The leg is kept straight (not locked) and raised into hip flexion, until the client starts to go into a posterior pelvic tilt.
- This tilt will be felt as the spinous processes press onto the PT's hand.

#### Quadriceps protocol

- Client lies in the prone position.
- PT places one or two hands on the client's lower leg (shin), leaving the foot relaxed and the knee on the floor.
- The ankle is brought towards the bottom and the knee is flexed, until the 'spongy' end of ROM is reached or until the pelvis rotates anteriorly.



**Adductor protocol**

- Client lies in the supine position, arms slightly out to the sides.
- Trainer places one hand on the client's 'non-assessed' or far side ASIS (anterior superior iliac spine).
- The leg nearest to the PT is abducted from the hip.
- Trainer feels for the point where the ASIS starts to move, indicating a pelvic lateral tilt and that the hip adductors have reached their end of ROM.

**Soleus and gastrocnemius protocol**

- Client lies in the supine position with a neutral spine with their arms resting by their sides.
- The client is guided to relax the lower leg.
- The leg is kept straight (not locked) and the foot is taken into ankle dorsiflexion to assess gastrocnemius ROM (ideal of 15-20°).
- Soleus flexibility can be assessed by repeating the tests above with one hand, or a bolster or pad under the back of the knee, taking the knee into flexion.

**Pectorals and latissimus dorsi protocol**

- Client lies in the supine position in a posterior pelvic tilt (flat back) with their arms resting above their head.
- The arms are moved to flex the shoulders, then the arms are allowed to gently fall into their end ROM.
- Tight pectoral muscles will try to pull the arms into adduction.
- Tight latissimus dorsi muscles will try to pull the arms into extension.

**Wall standing shoulder flexion protocol**

- Client stands against the wall, feet placed four inches away with back flat and arms by sides.
- Both arms are kept straight (not locked) and raised above the head, flexing at the shoulder as much as possible without letting the lower back lift away from the wall.
- Stop the test when lower back lifts and observe the arms' distance from the wall.
- A result less than 180° (arms flat against the wall above the head), would be indicative of poor thoracic mobility and tightness in the shoulder medial rotators.



## Postural assessments

Common exercises used to perform formal postural assessments include:

- Static postural observation (a client stands as naturally as they can and the PT observes their static posture from all sides).
- Squats.
- Squats with arms raised above the head (to identify the coordination of the upper and lower body during dynamic movements).
- Lunges.
- Single-leg balance (to identify differences between left and right sides).
- Push exercises (e.g. standing cable chest press, press-up, bench press).
- Pull exercises (e.g. standing cable row, pull-up, bent over row).



A PT can choose to observe clients using one of these exercises, or they can perform an assessment using an exercise that relates to a client's individual functional requirements or goals. It is essential that when performing a postural assessment, clear details of the exercises chosen and protocol followed are recorded to allow recreation during the follow-up assessment.

Postural assessment results should be recorded as deviations away from the ideal (neutral) (see Figure 4.3). Abbreviations or short notes can be used, however a PT must be aware that it should be possible for another professional to read and understand any notes made.

<b>Assessment(s) completed</b>	<i>Static posture, squat and single-leg balance.</i>
--------------------------------	--

<b>Checkpoint</b>	<b>Observations noted</b>
<b>Feet/ankles</b>	<i>External rotation of left foot. Right foot inverts significantly during single-leg balance.</i>
<b>Knees</b>	<i>Adduct during squat ascent.</i>
<b>Hips/LPHC</b>	-
<b>Shoulders</b>	<i>Protracted left and right.</i>
<b>Head</b>	-

Figure 4.3 Example postural assessment record

If a client demonstrates a distortion away from neutral the PT must consider what may be the cause of this.

In some cases there may be a mechanical or medical issue (e.g. pins in the ankles which limit dorsiflexion) that the PT can do nothing about. In these instances the PT may look to limit their impact on the rest of the body (e.g. making the squat technique as close to ideal as possible, without increasing dorsiflexion).

In other cases the PT may be able to improve function and future assessment results by incorporating:

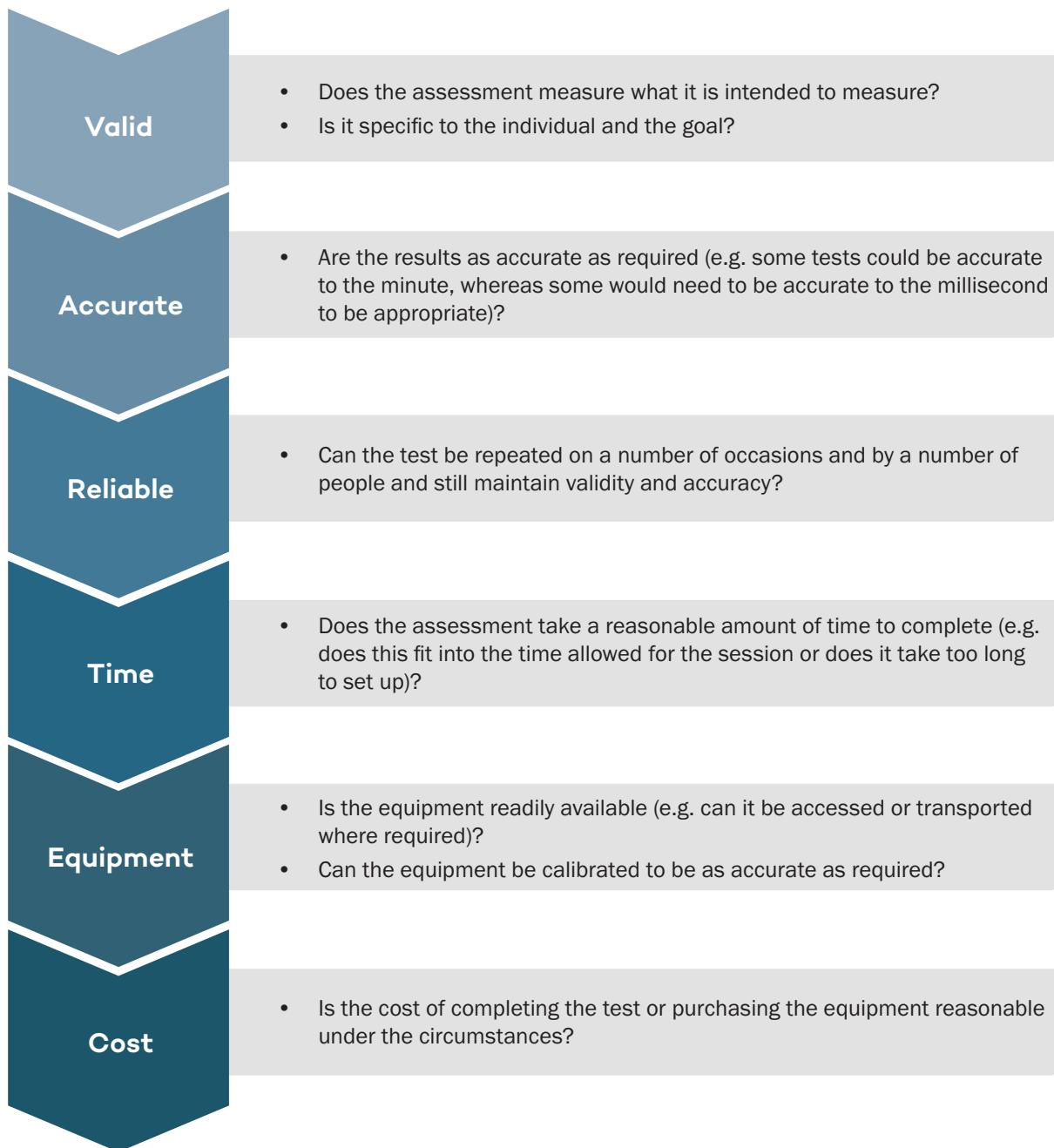
- Developmental stretches to lengthen tight, short muscles.
- Exercises to strengthen a muscle group, which will not only address a weakness but help to shorten an excessively long muscle.
- Coordination exercises to build effective movement patterns and to improve technique.
- Balance exercises to improve static and dynamic balance and joint stability.
- Core stability or strength exercises to improve whole body stability, core stabilisation and strength and upper and lower body coordination.

#### Tips when completing postural assessments

- View clients from a number of different positions.
- Ensure views are clear and not skewed by perspective (anterior view, lateral view, posterior view).
- Identify deviations from neutral posture.
- Perform additional assessments to clarify initial findings.
  - For example, if an initial range of motion assessment indicates that the latissimus dorsi may be tight, a dynamic postural pull assessment can be carried out to confirm. If the client then demonstrates an anterior pelvic tilt as they elongate the muscle then the tightness is confirmed.
- Record results as deviations from ideal posture.

# Selecting the most appropriate tests

## The VARTEC acronym



# Section 5: Planning

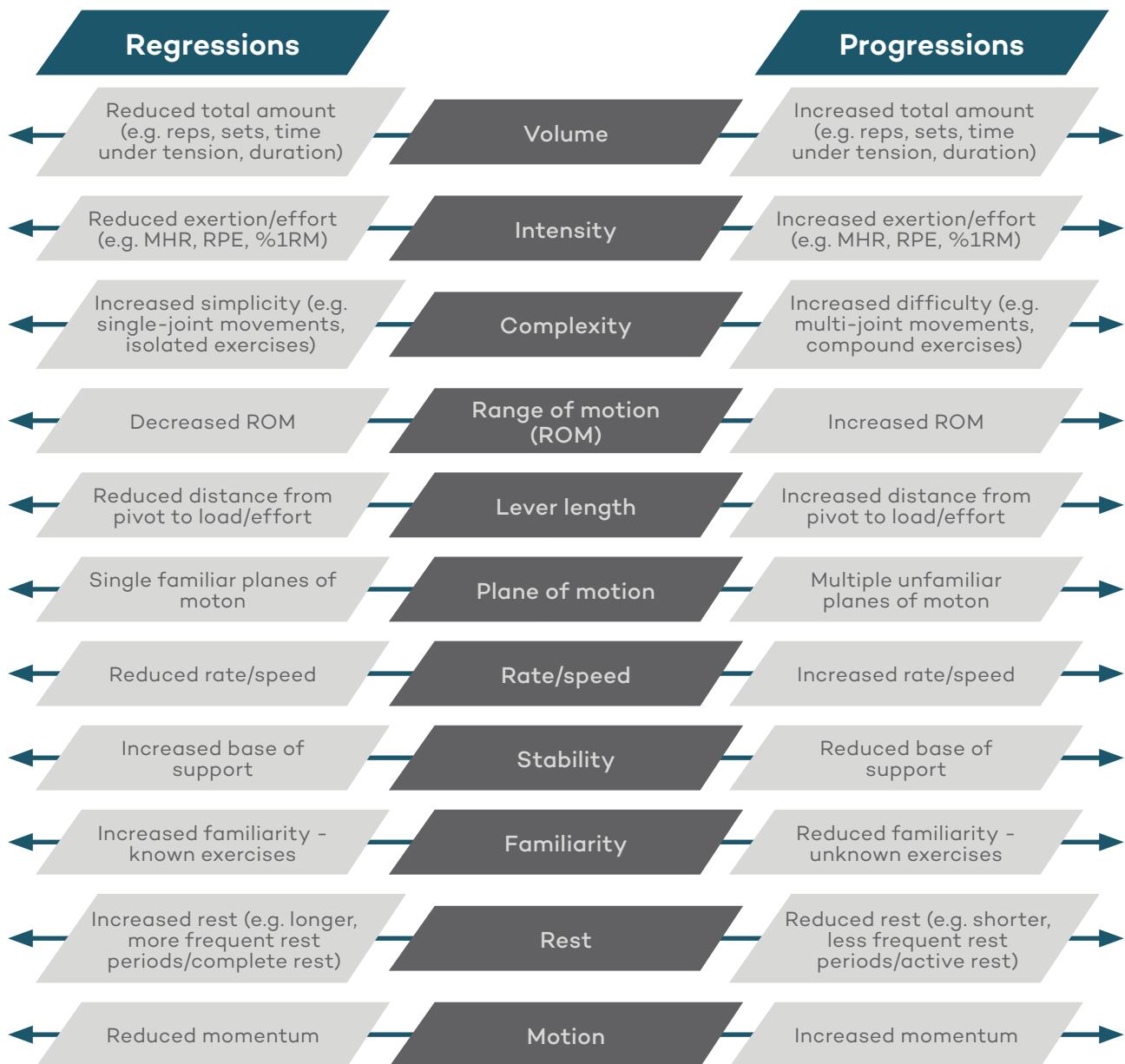
## Goal-setting



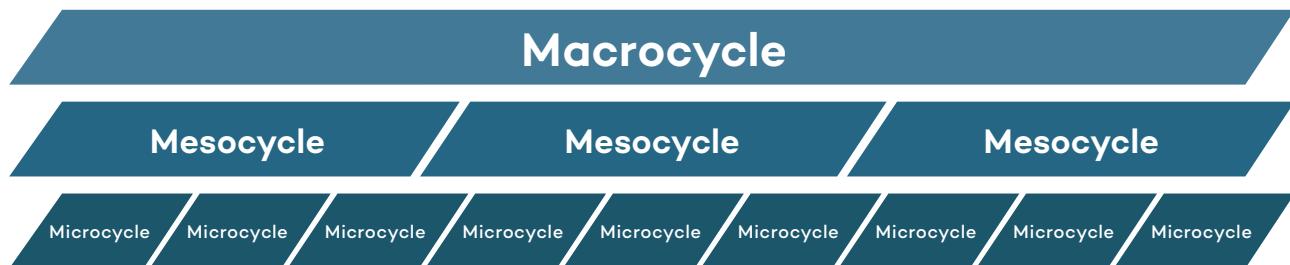
### For example

- **Process goals:**
  - To have completed the exercise programme at least twice per week for eight weeks (April to June).
  - Eat one additional portion of fruit or veg per day for four weeks (May).
  - Take a brisk walk three times per week for four weeks (May).
  - Join a running group in the local area by 30th September.
  - Stop using the car and walk the children to school at least three days per week (review will take place 30th August).
  - Keep a food diary for the month of June to log all food and drink intake.
  - Perform 5-10 minutes of meditation every week day in July.
- **Performance goals:**
  - To have dropped one dress size (from a size 16 to a 14) by the end of September.
  - To reduce time taken to run 10km by 2 minutes by 24th August.
  - To complete a triathlon for the first time by 30th December.
  - To run up Hill Street without stopping by 20th April.
  - To be able to row 500 metres in under 2 minutes by the end of November.
  - To increase the amount of press-ups that can be done in 1 minute by the next reassessment.
- **Outcome goal:**
  - To complete the local triathlon (November) in the top 100 participants.
  - To climb up and down 'Roseberry Topping Hill' faster than at least one other member of the walking group during the August walk.

## Programme variables



## Periodisation strategies

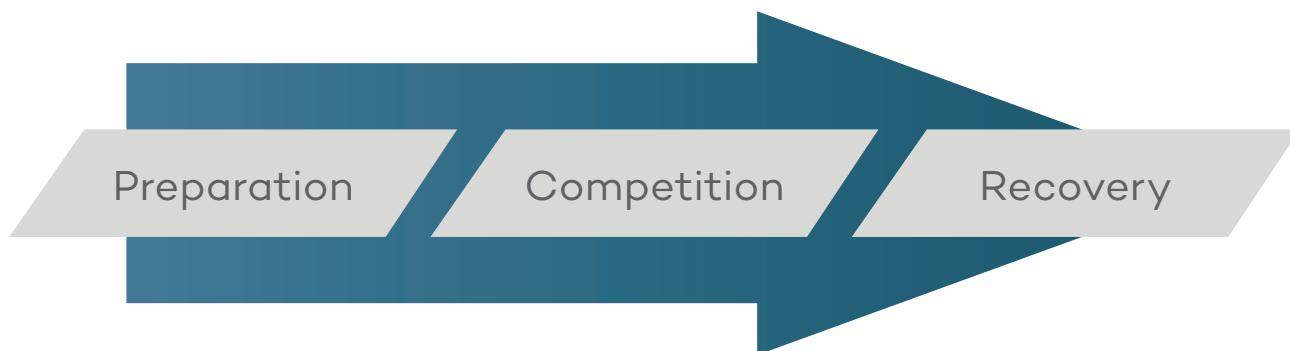


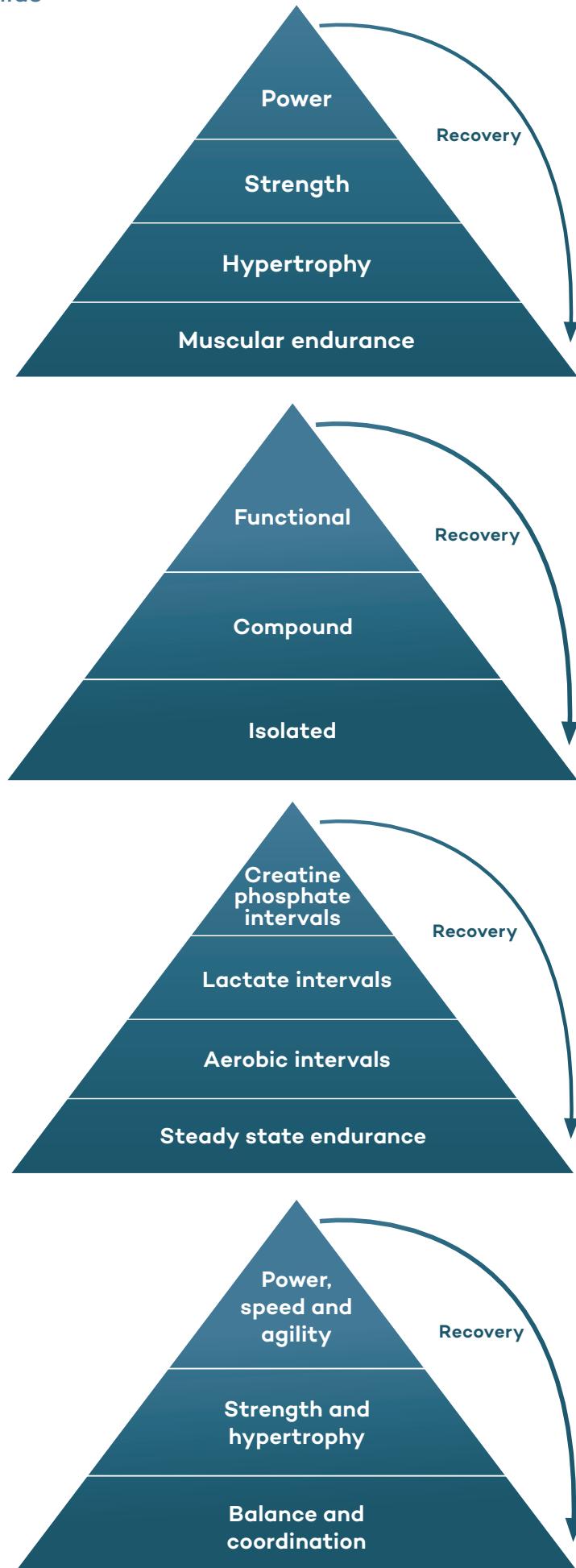
### Common periodisation strategies

#### *Step loading*



#### *Competition phasing*



*Progression pyramids*

# Section 6: Delivery

## Key instructing skills

### Communication

A PT must utilise a range of good verbal communication skills to:

- Give clear instructions and exercise cues.
- Explain the purpose of each exercise (what it does, the muscles it works and how it benefits the client).
- Explain the correct set-up and starting positions for exercises.
- Reinforce teaching points and safety points.
- Correct client technique.
- Offer alternatives, regressions and progressions.
- Give feedback, praise and encouragement.
- Ask questions and gather feedback from the client.
- Motivate clients.
- Demonstrate enthusiasm.

Unspoken communication reinforces and consolidates verbal interaction. Good non-verbal communication skills can be used to:

- Demonstrate exercises using a safe and effective technique and posture.
- Give positive feedback and encouragement using positive body language, facial expressions and gestures (e.g. eye contact, nods of the head, smiling).
- Support verbal messages (e.g. pointing to the muscles worked or pointing out the alignment of the knees with the feet).
- Demonstrate interest in the client (e.g. active listening signals).
- Motivate clients.
- Demonstrate enthusiasm.

When delivering sessions a PT can use a range of strategies to ensure the client receives and understands all the key points about the exercises being given and performed. A common instructing strategy used to ensure all the information is given in a structured, clear fashion is the use of the NASTY acronym (see Figure 6.1).

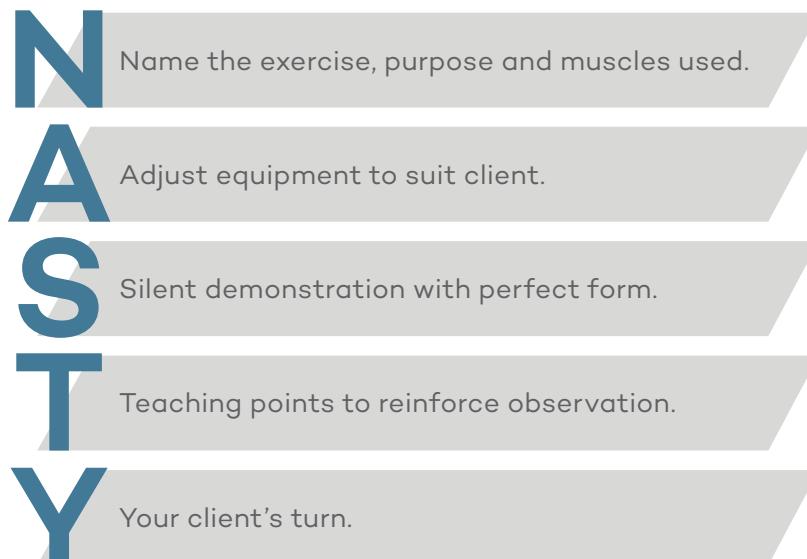


Figure 6.1 NASTY acronym

All communication must be adapted to meet individual clients' needs. Some clients respond more effectively to verbal communication while others respond better to visual communication. Some clients may need a combination of styles to effectively get the message across.

To identify the best ways to communicate with a client, a PT must consider the learning styles of each client. It is generally accepted that there are three main learning styles (visual, auditory and kinaesthetic). Clients will use a combination of all three styles although they will tend to find that one style is dominant and preferable. The PT should identify the preferred learning styles in order to individualise their approach and maximise the impact of any messages being communicated.

## Visual clients

Visual clients tend to learn best by observing physical demonstrations or pictures. They also respond well to the use of eye contact, facial expressions and gestures.

Effective training strategies include:

- Staying in a client's field of vision.
- Focussing on demonstrating exercises and corrections visually.
- Using gestures to highlight and reinforce key points.
- Using a mirror to encourage a client to observe their own technique and performance.
- Using visual imagery, where possible, to explain exercises (e.g. 'light as a feather' or bracing the core in anticipation of an impact).

## Auditory clients

Clients with an auditory learning preference process information most effectively when it is explained verbally. They benefit from deep, verbal explanations with good volume, tone and pitch variations.

Effective training strategies include:

- Keeping visual demonstrations brief.
- Using clear verbal cues and instructions.
- Explaining corrections and key points verbally.
- Using motivational language and encouragement.
- Being mindful of noises in the exercise environment.
  - An auditory client may benefit from training in a quieter environment when learning new skills.
  - Music can be a powerful motivational tool for auditory learners, once technique has been mastered.
  - The wrong music can also have a very detrimental effect on an auditory client and guidance or assistance that helps a client avoid noises and music that they don't enjoy can be much appreciated.

## Kinaesthetic clients

Clients with a kinaesthetic preference learn best by getting involved and physically performing any exercises or movements. They benefit from doing things and taking part in activities.

Effective training strategies include:

- Keeping verbal and visual explanations short.
- Keeping the client moving and active at all times.
- Performing visual demonstrations, whilst encouraging the client to mirror or practise the movements along with the PT.
- Getting the client to practise movements and exercises as soon and often as possible.
- Using manual corrections and physical contact (with authorisation from the client) to correct technique (e.g. touching the client's lumbar spine to maintain neutral posture during an exercise).



## ***Identifying learning styles and the best forms of communication to use with a specific client***

Each client is an individual, therefore a PT should avoid making assumptions about a client when initially meeting them. To do this a PT must always use an approach that encompasses all three learning styles and a range of communication skills. This means that a PT can test and evaluate what works best as rapport is being built and the PT gets to know a client. Developing an individualised approach can be a process of trial and error as a PT tries particular approaches and finds they work, or do not work. Ways to develop an understanding of a client's communication and learning preferences include:

- Ask clients how they learn best.
- Observe clients as they will give signals that indicate which communication methods they respond to. For example, they will:
  - Show signs of interest.
  - Engage and ask questions.
  - Display positive body language and active listening signals.
- Listen and be observant to the types of communication a client engages in. Their strengths would often correspond to their personal preferences.
- Gather feedback from a client following each session to identify ways to improve in future.

## ***Maintaining a client's motivation and engagement***

Maintaining a client's motivation and engagement is essential for exercise adherence and ongoing commitment to sustaining long-term changes. Finding the most effective methods of motivating and engaging can make a significant difference to a client's long-term success. Skills a PT can use to maximise effectiveness include:

### **Voice volume**

- Some clients feed off an energetic, loud trainer, whereas others may prefer a quieter, more subtle approach.

### **Imagery**

- Visual or verbal imagery and the use of similes and metaphors that a client can relate to can increase client understanding and engagement.

### **Reinforcement and praise**

- Reinforcing a client's belief in their ability and praising them is a useful tool to emphasise success (e.g. 'you are doing brilliantly', 'well done').
- A PT must be aware that praise and reinforcement must be realistic and appropriate, or the value can be lost as the client begins to feel comments are not genuine.

### **Giving feedback**

- Feedback must always be positively presented, yet it must be genuine, objective and fair too to be of value to the client.

### **Gaining feedback**

- Gathering feedback from a client can demonstrate that their opinion is valued. This is very positive and motivating.

### **Keep it simple**

- Overloading a client with information can be boring, demotivating and detrimental to the impact of any message.
- The 'rule of three' is a useful guide to follow during session delivery (give a maximum of three pieces of information or feedback to ensure the client hears, engages and acts upon advice given).

# Section 7: Exercise technique and safety

Whatever equipment is being used to perform exercise, the first priority of any PT is to ensure that technique is safe and effective. This means that feedback, guidance and corrections should be focussed on ensuring technique is as close to the ideal (neutral) as possible. Section 4 of this PT toolkit explained key technique points that can be used when a client is performing any exercise. This section (7) of this PT toolkit explains the additional teaching points relevant to the use of specific equipment and exercises.

## Incorporating equipment safely

Fitness facilities, gyms and alternative environments (e.g. green gyms, trim trails and clients' homes) will be equipped with wide varieties of equipment. This means that PTs must be adaptable and able to apply general safety and usage points to safely deliver exercise to clients using the available equipment. General safety guidance includes:

- Check any equipment for safety prior to usage with a client.
- Report or address any safety or maintenance issues as soon as they are identified (e.g. label the piece of equipment as 'out of order' and arrange for maintenance and repair to be carried out).
- Do not use any piece of equipment if safety cannot be verified.
- Do not use any piece of equipment that the PT is not competent to instruct on (e.g. the PT should know the manufacturer's guidelines and should understand how to safely set up and instruct exercises on the equipment).
- Maintain safe exercise technique at all times, ensuring the client demonstrates the best technique that is as close to ideal (neutral) as possible.
- Correct technique that is unsafe or having a negative effect on the outcome of the exercise completion.

### Cables

Additional key safety points for the use of cables:

- Position the pivot point of any adjustable cables carefully, ensuring the locking mechanism is fully engaged.
- Ensure the handles are in good working order and connected to the cables safely and in line with manufacturer's instructions.

### Medicine balls

Additional key safety points for the use of medicine balls:

- Ensure the medicine ball is held safely in the hands and cannot slip.
- If throwing or bouncing the medicine ball, make sure the surface/wall is appropriate and can withstand the required force. If in doubt do not throw a medicine ball at a wall, or bounce it on a floor.
- Make sure the catcher is prepared for the throw and there are no obstructions (human or environmental) that could be in the way, or could get in the way at any point of the throw.
- Ensure that any medicine balls are placed away safely following use to avoid any risks to safety caused by the ball rolling away.

### Stability balls, wobble and Bosu™ boards

Additional key safety points for the use of stability balls, wobble and Bosu™ boards:

- Make sure a client can get on and off the equipment safely prior to beginning any exercise.
- Ensure a constant state of balance is achievable and the client is only challenged within their limits of stability.
- Ensure that any stability balls are placed away safely following use to avoid any risks to safety caused by the ball rolling away.

## Categorising exercises

The variations and combinations of exercises that can be used by a PT with clients is literally endless. The vast variety of exercises available for selection has therefore given rise to a number of ways to categorise the exercises. Muscle groups worked or equipment used have been the traditional categorisations for describing exercises.

The issue with these categorisations is that the introduction of more functional training methods has seen an influx of minor adaptations to exercises which can completely change the emphasis and therefore the traditional categorisation of an exercise.

### For example

A squat traditionally sat in the lower body musculature category and, as a squat was usually performed with a barbell or dumbbell, it would be described as also being in the free weights category when considering equipment used.

Now, a squat is commonly performed on one leg, on a Bosu™ board or using a stability ball and it is often combined with many upper body exercises to produce an almost unlimited variety of complexes.

Where would all these new adaptations fit in the traditional categories?

This variety and potential confusion has led to a new way to categorise exercises: by movement pattern.

Our bodies can actually only perform a finite range of functional movement patterns. To put it simply, they can push or pull (upper body), squat, lunge or hinge (lower body). They can do this unilaterally (one-armed, one-legged), or bilaterally (two limbs working together) and they can work through a single plane, or in a multiplanar fashion.

### For example

Whenever our bodies anteriorly push a force, they will use a combination of pectoral and triceps brachii muscles, when pushing upwards they will use a combination of deltoids, upper trapezius and triceps brachii muscles. Exercise variations may change the way that these muscles are used (e.g. by narrowing the hands during a push exercise the amount of elbow flexion required will increase and therefore the triceps brachii will have to work harder) but the general movement, muscle groups and techniques will remain the same.

By understanding the simplicity of the movements available, a PT can begin to reduce some of the potential confusion and complexity and as such they can begin to use existing exercises and develop their own adaptations that can provide clients with the specificity and variety they need to be able to meet their individual needs.

In essence, by simplifying the way exercises are categorised, this sets the PT free to be able to use every possible exercise or movement combination quickly and easily, even if they have never seen, or been taught, this option before.

This section explains the techniques required to perform all the major movements used in exercise instruction. There are also examples of specific exercises to provide the PT with ideas and options. Once these are fully understood, the PT can then combine movement patterns and adapt positions to develop the best, most specific exercises for their individual clients.

# Example exercises

## Push and pull patterns

Additional, specific technique points for push and pull pattern exercises:

- Brace the core to maintain stability.
- Avoid shoulder rounding (protraction) or lifting (elevation) by holding the shoulder blades back and down throughout all exercises.
- Maintain the neutral alignment of all other joints throughout the exercise.

### Push exercises

Key prime movers and synergists: Pectoralis major and triceps brachii

#### Stability ball single-arm dumbbell press



#### Specific technique points:

- Engage the glutes to hold a stable ball bridge position.
- Start position: Hand, wrist and shoulder are in vertical alignment.
- Finish position: Hand is vertically aligned with elbow, elbow is kept aligned with the shoulder.

#### Adaptations:

- Perform as a double-arm, or alternating-arm exercise.
- Increase stability by holding the non-weighted arm out to the side as a counterbalance.
- Reduce stability by narrowing the stance or raising one leg off the floor.

#### Medicine ball press-up



#### Specific technique points:

- Maintain a stable plank position throughout.
- Maintain wrist, elbow, shoulder alignment throughout.

#### Adaptations:

- Perform as a ¾ or box press-up.
- Increase stability by widening stance.
- Reduce stability by raising one leg off the floor.
- Roll medicine ball from one hand to another between reps to increase core challenge.

### Pull exercises

Key prime movers and synergists: Latissimus dorsi, mid to lower trapezius, biceps brachii

#### Single-leg single-arm cable row



#### Specific technique points:

- Maintain alignment of hips, knees and ankles throughout.
- Retract shoulder blades as cable is drawn back and down.

#### Adaptations:

- Perform as a double-arm exercise.
- Increase stability by performing on two legs.
- Reduce stability by performing on a wobble or Bosu™ board.
- Add in a squat or lunge to increase complexity.

## Squat and lunge patterns

### Squat exercises

Additional, specific technique points for squat pattern exercises:

- Brace the core to maintain stability.
- Hip and knee flexion (downwards phase) and extension (upwards phase) should be smooth and simultaneous (tibial and trunk lines parallel).
- The centre of each kneecap is aligned with the middle toe of the foot.
- The heels maintain contact with the floor at all times.
- Drive through the upwards movement, contracting the quadriceps and gluteals to stand upright.
- Maintain the neutral alignment of all other joints throughout the exercise.

### Lunge exercises

Additional, specific technique points for lunge pattern exercises:

- Brace the core to maintain stability.
- The stride length should allow a full range of motion that results in both knees being roughly at right angles at the lowest part of the lunge.
- The back knee does not contact the floor at any point.
- The centre of each kneecap is aligned with the middle toe of the foot.
- The heel of the back leg lifts to allow the lunge action.
- The feet should remain hip-width apart throughout the exercise (even when one leg is forward).
- Drive through the upwards movement, contracting the quadriceps and gluteals to stand upright.
- Maintain the neutral alignment of all other joints throughout the exercise.

## Squat exercises

Key prime movers and synergists:  
Quadriceps, hamstrings, gluteus maximus, erector spinae, calf complex.

### Back squat



#### Specific technique points:

- Position the bar on the fleshy part of the upper back.

#### Adaptations:

- Use body weight only.
- Use dumbbells.
- Use a Smith machine or squat rack.
- Use a split squat stance.

## Lunge exercises

Key prime movers and synergists: Quadriceps, hamstrings, gluteus maximus, calf complex.

### Multiplanar lunge

#### Sagittal plane



#### Frontal plane



#### Transverse plane



#### Specific technique points:

- Maintain balance throughout and only work in a stable range of motion.

#### Adaptations:

- Use body weight only.
- Use dumbbells.
- Use a medicine ball.
- Perform as a walking lunge to increase the stability challenge.
- Use a split squat stance.
- Perform with the weights overhead to increase the challenge to the core.

### Step squats and lunges

#### Step squat



#### Anterior Bosu™ lunge



#### Posterior swiss ball lunge



#### Specific technique points:

- Maintain balance throughout and only work in a stable range of motion.

#### Adaptations:

- Use body weight only.
- Use dumbbells.
- Use a medicine ball.
- Replace the step with an unstable piece of equipment (e.g. Bosu™ or stability ball) to increase the stability challenge.

## Hinge patterns

Additional, specific technique points for hinge pattern exercises:

- Brace the core to maintain stability.
- Back remains straight throughout all hinge movements.
- Hinge movement originates at the hip joint (flex at the hip).
- Maintain the neutral alignment of all other joints throughout the exercise.

### Straight-leg deadlift



#### Specific technique points:

- Hold the barbell with the arms shoulder-width apart.
- Start position: Arms straight, barbell is kept close to the body.
- Finish position: Barbell is vertically aligned with the shoulders.

#### Adaptations:

- Use body weight only.
- Use dumbbells.
- Reduce stability by performing on one leg.
- Combine with a bent-over row to increase complexity.

### Prone flye



#### Specific technique points:

- Start position: Dumbbells are held by straight arms that are vertically aligned with the shoulders.
- Finish position: Shoulders retracted, arms at shoulder height.

#### Adaptations:

- Use body weight only.
- Use resistance bands.
- Adopt a split stance.
- Reduce stability by performing on one leg.
- Combine with a straight-leg deadlift to increase complexity.

### Bent-over row



#### Specific technique points:

- Start position: Arms are shoulder-width apart and barbell is vertically aligned with shoulders.
- Finish position: Shoulders protracted, barbell pulled into abdomen.

#### Adaptations:

- Widen grip (barbell should be drawn upwards towards the chest in this variation).
- Use resistance bands.
- Adopt a split stance.
- Reduce stability by performing on one leg.
- Combine with a straight-leg deadlift to increase complexity.

## Single-leg patterns

Additional, specific technique points for all single-leg exercises:

- Brace the core to maintain stability.
- The hips maintain horizontal alignment throughout (no hip hitching of the free leg).
- Any hip and knee flexion (downwards phase) and extension (upwards phase) should be smooth and simultaneous (tibial and trunk lines parallel).
- The stance foot is aligned with the stance knee.
- The centre of each kneecap is aligned with the middle toe of the foot.
- The knee should not lock out at any point of the exercise.
- The natural arch of the foot is maintained throughout.
- Maintain the neutral alignment of all other joints throughout the exercise.

### Stork and cobra



#### Specific technique points:

- Start in a single-leg balance position.
- Hinge at the hip and lean forwards, reaching the arms out and stretching the trail leg behind.
- Lean as far forward as can be controlled (until the arms, torso and legs are horizontal with the floor), maintaining straight alignment from fingers to toes.
- Hold this position for a few seconds.
- Travel in a controlled manner up to single-leg standing position with arms hanging down by sides, maintaining a neutral, controlled posture throughout.
- Externally rotate at the shoulders.
- Squeeze shoulder blades back and down.
- Flex the raised leg at the knee and hip and dorsiflex the ankle.

#### Adaptations:

- Rest the foot down when feeling unstable to increase stability.
- Perform each movement separately.
- Use dumbbells.

### Stability ball single-leg squat



#### Specific technique points:

- Stability ball is positioned between the lumbar spine and a wall.
- Arms are held in front of the body at shoulder height.

#### Adaptations:

- Arms held out to the side for increased stability.
- Allow the trail leg to touch the floor for balance for increased stability.
- Perform on two legs to increase stability.
- Use dumbbells.
- Perform without the stability ball to reduce stability.

### Pistol squat



#### Specific technique points:

- The foot of the raised leg begins in line with the support foot.
- The raised leg straightens and extends in front of the body as the squat descends.
- At the point of full descent the leg is fully extended and is horizontal to the ground.

#### Adaptations:

- Limit the range of motion to what can be controlled.
- Reduce the range of motion of the raised leg.
- Allow the foot of the raised leg to touch the floor for increased stability.
- Introduce multiplanar movement to the raised leg during the descent (finish position would involve external rotation of the hip).

## ***Multi-planar patterns***

Additional, specific technique points for frontal and transverse plane, upper body exercises:

- Brace the core to maintain stability.
- Avoid shoulder rounding (protraction) or lifting (elevation) by holding the shoulder blades back and down throughout all exercises.
- Maintain the neutral alignment of all other joints throughout the exercise.

Additional, specific technique points for frontal plane, lower body exercises:

- Brace the core to maintain stability.
- Step out to the side, or lift the leg to the side, maintaining alignment of the hip, knee and foot at all times.
- Body weight should be redistributed as required to maintain balance throughout.
- Maintain the neutral alignment of all other joints throughout the exercise.

Additional, specific technique points for transverse plane, lower body exercises:

- Brace the core to maintain stability.
- When making any transverse movements ensure control and balance is achievable at all times.
- Maintaining the alignment of each leg's hip, knee and foot at all times.
- The back foot should pivot to the same degree as the leading leg to help maintain hip, knee and foot alignment at all times.
- Body weight should be redistributed as required to maintain balance throughout.
- Maintain the neutral alignment of all other joints throughout the exercise.

### Single-arm cable chest press with rotation



#### Specific technique points:

- Rotational movement is a whole body movement from feet to hands.

#### Adaptations:

- Rotate from the hips upwards only to reduce the coordination challenge.
- Perform as a single-leg, single-arm exercise.
- Introduce a lunge to increase complexity.

### Multiplanar deltoid raises

#### Lateral raise



#### Front raise



#### Standing cobra



#### Specific technique points:

- Maintain soft elbows throughout.

#### Adaptations:

- Perform as individual exercises.
- Use body weight only.
- Add a squat or single-leg squat to increase complexity.
- Perform as a single-arm exercise.

### Single-leg squat reaches

#### Anterior reach



#### Lateral reach



#### Transverse reach



#### Specific technique points:

- Reach as far as can be controlled without losing balance.

#### Adaptations:

- Perform as individual exercises.
- Reach without squatting.
- Use dumbbells, or a medicine ball.
- Reach downwards, or upwards with the hands to increase complexity.

## Core exercises

Additional, specific technique points for core exercises:

- Brace the core to maintain stability (any instability, weakness or discomfort should result in a regression of the exercise).
- Maintain a neutral lumbar spine at all times (if the lumbar spine begins to over-arch, this is an indicator that the client's limits are being reached and stability is being lost).
- Maintain a regular breathing rhythm. Avoid breath-holding.

### Stability ball abdominal plank



#### Specific technique points:

- Adopt a kneeling position with ball in front of the body.
- Place elbows and forearms on top of the ball.
- Brace the core and extend the knees and hips.

#### Adaptations:

- Perform in a  $\frac{3}{4}$  position with the knees on the floor to regress.
- Perform without the stability ball to regress.
- Roll the ball in small circles to progress.
- Lift one leg off the ground to reduce stability.
- Roll the ball away from the body to flex at the shoulders and progress the exercise.

### Dead bug



#### Specific technique points:

- Adopt a supine position with hips and shoulders flexed at  $90^\circ$ .
- Extend at the hips and flex at the opposite shoulder, lowering the arm and leg towards the floor.
- Repeat with the other arm and leg.

#### Adaptations:

- Bend the knees to  $90^\circ$  to regress.
- Perform the arm and leg movements separately to regress.
- Use a medicine ball to progress.
- Perform with both arms and legs together to progress.

### Two-point box



#### Specific technique points:

- Start position: Hands are directly under the shoulders and knees directly under hips.
- Simultaneously flex at the shoulder and extend at the opposite hip.
- Raise the leg and arm to the height of the torso.
- Aim to elongate the body as much as possible whilst holding the position.
- Repeat with the other arm and leg.

#### Adaptations:

- Perform arm and leg movements separately to regress.
- Start in a plank position to progress.
- Place a wobble board under one hand or knee to reduce stability.

## Power patterns

Additional, specific technique points for powerful lifts:

- Ensure there is sufficient clear, free space available to facilitate a full, safe repetition of the power exercise.
- Brace the core to maintain stability.
- Ensure the whole movement is fluid and smooth throughout.

Additional, specific technique points for powerful throwing movements:

- Ensure there is sufficient clear, free space available to facilitate a full, safe repetition of the power exercise.
- Brace the core to maintain stability.
- Prepare for the explosive movement by eccentrically loading the muscles briefly prior to performing the power exercise (e.g. a back swing of a med ball prior to a med ball throw).
- Make sure the catcher is prepared for the throw and there are no obstructions (human or environmental) that could be in the way, or could get in the way at any point of the throw.

Additional, specific technique points for powerful jumps and hopping movements:

- Ensure there is sufficient clear, free space available to facilitate a full, safe repetition of the power exercise.
- Brace the core to maintain stability.
- Prepare for the explosive movement by eccentrically loading the muscles briefly prior to performing the power exercise (e.g. briefly dropping down into a half squat position prior to a squat jump).
- Land softly, absorbing the impact by using soft joints and eccentric loading of the surrounding musculature.
- Stabilise and correct landing position prior to repeating the explosive, powerful movement.

**Jumping lunge****Specific technique points:**

- Adopt a split stance.
- Drop quickly into a flexed position.
- Drive upwards using the legs, hips and arms to propel the body.
- At the apex of the jump change the leg stance.

**Adaptations:**

- Perform quick lunges without jumping to regress.
- Perform continuous jumps to progress.
- Perform a number of repetitions with the same leading leg to progress.
- Introduce multiplanar options to increase complexity.

**Medicine ball Russian twist****Specific technique points:**

- Ensure the catcher is safely prepared and appropriately positioned to receive the throw.
- Prepare for the throw by shifting the weight onto the leg furthest from the direction of throw and rotating towards the closest leg.
- Rotate the body and release the medicine ball to throw.

**Adaptations:**

- Perform the movement without releasing the medicine ball to increase control.
- Sprint after the ball and repeat the exercise in the opposite direction to increase the cardiovascular challenge.

**Dumbbell push press****Specific technique points:**

- Start position: the dumbbells are vertically aligned with the hands and elbows at shoulder height.
- Drop quickly into a quarter squat position.
- With no pause, drive upwards at the hips, knees and shoulders.
- Finish position: Arms are fully extended above the head and the legs are extended, standing on the tiptoes.

**Adaptations:**

- Perform a quick shoulder press to increase the control.
- Perform with a single arm.
- Perform with a medicine ball, either releasing the ball (throwing upwards), or not.

# Advanced stretching techniques

## Proprioceptive neuromuscular facilitation (PNF) stretching protocols

### Contract-relax stretching protocol

1. The muscle is passively moved to the point of mild tension by the PT and held for 10-15 seconds.
2. The client then isometrically contracts the muscle being stretched against a counteracting resistance for a period of 5-10 seconds.
  - The contraction should not be maximal (approximately 20-40% effort) and the PT must ensure they are prepared for the force the client will apply by adopting a strong, stable and supported posture.
  - The stretch position should be maintained throughout the contraction.
3. The client relaxes the stretched muscle and the PT moves the limb further into the stretch.
4. The new stretch position is held by the PT for 10-15 seconds.
5. The protocol can then be repeated (usually up to three times).

### Contract-relax-agonist contraction stretching

- Points 1 and 2 of the contract-relax stretching are replicated.
- The client then relaxes the stretched muscle and contracts the opposing muscle group (the agonist) as the body part is moved into its new stretch position, using a combination of muscle contraction and PT assistance.
- Points 4 and 5 of the contract-relax stretching protocol are replicated.

## Assisted stretching techniques

The following assisted stretching techniques can be used to perform static developmental stretches, or when performing PNF protocols. For all techniques the PT must ensure that:

- Posture is neutral, strong and supported:
  - The PT will be supporting the client's body and if PNF stretches are being applied the isometric contractions will result in the client pushing against a PT's resistance. Although this contraction is light (20-40%), there is a risk of injury if the PT is not bracing the core and maintaining a strong, neutral posture.
  - There is an increased risk of overstretching, or inappropriate joint pressure being applied, therefore the PT must always be aware of a client's joint position to avoid this increased risk.
- Movements are slow and controlled to minimise the counteractive effects of the stretch reflex.

### Lying gastrocnemius



- The client lies in a supine position.
- The PT adopts a strong, split stance.
- The PT rests the client's heel on their hip, while the opposite leg rests on the floor in flexion.
- The PT places one hand around the client's heel and the other on the ball of the foot.
- The PT uses their body weight to ease the toes towards the shins, to incrementally increase ankle dorsiflexion.

**Lying hamstring**

- The client lies in a supine position.
- The PT adopts a strong, kneeling position.
- The client's leg is placed against the PT's body, with their heel on the PT's shoulder.
- The PT supports the client's knee (the leg should be straight but not locked) with one hand and the opposite hand is placed appropriately on the client's hip.
- Incremental increases in hip flexion are applied as the PT leans forwards.
- The PT uses the supporting hand to feel for a posterior pelvic tilt which would indicate the client has reached their end range of motion.

**Lying gluteals and piriformis**

- The client lies in a supine position.
- The PT adopts a strong, kneeling position.
- The client's knee and hip are flexed.
- The PT leans forwards and guides the client's knee towards their opposite shoulder, to incrementally increase hip flexion and internal rotation.

**Lying obliques, gluteus minimus and medius**

- The client lies in a supine position.
- The PT adopts a strong, kneeling position.
- The client flexes their knee and hip to a right angle and allows the hip to fall over the body.
- The opposite arm is placed at a right angle to the body.
- The PT places one hand on the flexed arm and one on the flexed knee.
- The client's knee is eased towards the floor and the arm is supported to maintain its position on the floor, to incrementally increase trunk rotation.

**Seated adductor**

- The client sits upright with the soles of their feet together.
- The PT adopts a strong, kneeling position, facing the client.
- The PT places one hand on each of the client's knees.
- The knees are eased towards the floor, to incrementally increase hip abduction and external rotation.

**Prone quadriceps**

- The client lies in a prone position.
- The PT adopts a strong, kneeling position.
- The PT places one hand on each of the client's knees.
- The client flexes one knee towards their bottom.
- The PT places one hand appropriately on the posterior hip and the other around the client's shin.
- The calf is eased towards the bottom, to incrementally increase knee flexion.

## Adaptation:

- To increase the stretch applied to rectus femoris, the client should be guided to push their hip into the floor by contracting their glutes.

**Ball side lying latissimus dorsi and obliques**

- The client adopts a side lying position on the ball, with both arms overhead.
- The client's lower knee supports the ball and the top leg remains straight with the foot fixed to the floor.
- The PT adopts a strong, standing position behind the client.
- The PT places one hand on the pelvis and the other on the underside of the shoulder joint.
- The PT eases the pelvis and shoulder downwards, to incrementally increase trunk lateral flexion.

**Seated pectoralis major**

- The client adopts an upright seated position on a chair, with their back supported.
- The PT stands behind the chair.
- The client lifts their arms so their shoulder and elbows are at right angles.
- The PT holds the anterior of both arms between the elbows and hands.
- The client holds the underside of the PT's elbows.
- The PT eases the arms backwards, to incrementally increase horizontal shoulder extension.

## Adaptation:

- The client can adopt a seated position on the floor and a stability ball can be used to support the client's back.

# References

- ACSM. (2011). Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal and Neuromotor Fitness in Apparently Healthy Adults: Guidance for Prescribing Exercise. *Medicine and Science in Sports and Exercise*. DOI: 10.1249/MSS.0b013e318213fefb.
- ACSM. (2014). *Guidelines for Exercise Testing and Prescription*. 9th edition. Philadelphia, PA: Wolters Kluwer/Lippincott Williams and Wilkins.
- BACR. (2015). Risk Stratification [online]. Available at [http://www.bacpr.com/pages/page\\_box\\_contents.asp?PageID=788](http://www.bacpr.com/pages/page_box_contents.asp?PageID=788) [Accessed: 15 August 2016].
- Balady, G.J. et al. (2000). *General Principles of Exercise Prescription*. In ACSM's Guidelines for Exercise Testing and Prescription. (Franklin, B.A. et al, eds) pp. 138. Lippincott Williams and Wilkins.
- Balke, B. and Ware, R. (1959). An experimental study of physical fitness of Air Force personnel. *US Armed Forces Medical Journal*, vol. 10, pp.675-688.
- Billat, V.L. et al. (1999). 'Interval training at VO<sub>2</sub>max: effects on aerobic performance and overtraining markers'. *Medicine and Science in Sports and Exercise*, vol. 31(1), pp.156-163.
- BHF (2010a). Exercise Referral Toolkit. UK. British Heart Foundation [online]. Available at <http://www.bhfactive.org.uk/sites/Exercise-Referral-Toolkit/downloads.html> [Accessed: 16 August 2016].
- Cooper, C.B. and Storer, T.W. (2001). *Exercise testing and interpretation: a practical guide*. Cambridge, Cambridge University Press.
- Chu, D. (1996). Explosive power and strength: complex training for maximal results. Champaign, IL, Human Kinetics.
- Department of Health. (2001a). Exercise referral systems: A national quality assurance framework (NQAF) [online]. Available at [http://webarchive.nationalarchives.gov.uk/+//www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH\\_4009671](http://webarchive.nationalarchives.gov.uk/+//www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4009671) [Accessed: 16 August 2016].
- Durnin, J.V. and Wormersley, J. (1974) 'Body fat assessed from total body density and its estimation from skinfold thickness measurements on 481 men and women aged from 16 to 72 years.' *British Journal of Nutrition*, vol. 32 (1), pp. 77-97.
- Fitts, P.M. & M.I. Posner. (1967). *Human Performance*. Brooks/Cole Pub. Co. Belmont, CA.
- Heyward, V.H. and Gibson, A.L. (2014) *Advanced Fitness Assessment and Exercise Prescription*, 7th edition. Human Kinetics.
- Jones, A.M. and Doust, J.H. (1996). 'A 1% treadmill gradient most accurately reflects the energetic cost of outdoor running.' *Journal of Sports Science*, vol. 14(4). Pp. 321-327.
- Leger, L.A. and Lambert, J. (1982). 'A maximal multistage 20-m shuttle run to predict VO<sub>2</sub> max.' *European Journal of Applied Physiology and Occupational Physiology*.
- McGill, S. (2002). *Low Back Disorders: Evidence-based Prevention and Rehabilitation*. Human Kinetics.
- NICE. (2011). 'Hypertension in Adults: diagnosis and management' [online]. Available at: <https://www.nice.org.uk/guidance/cg127/chapter/1-Guidance> [Accessed 17 June 2016].
- Pollock, M.L et al. (1976). 'A comparative analysis of four protocols for maximal treadmill stress testing'. *American Heart Journal*, vol. 92 (1), pp.39-46.
- Reeves, R.A. (1995). 'Does this patient have hypertension? How to measure blood pressure.' *Journal of the American Medical Association*, vol. 273, pp. 1211-1218.
- Rieger, T. Jones, B. Jiminez, A. (2016) *EuropeActive's Essentials for Personal Trainers*. Human Kinetics.
- Sandler, D. (2005). *Sports Power*. Human Kinetics.
- Solomon, E.P., Schmidt, R.R. and Adragna, P.J. (1990). *Human Anatomy and Physiology*. 2nd edition. Florida, USA: Saunders College Publishing.
- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, 12th edition, John Wiley & sons.

Van Itallie, T.B. et al. (1988). Body fat deposition in adult obese women. I. 'Patterns of fat distribution'. *American Journal of Clinical Nutrition*, vol. 47(2), pp.225-228.

Waugh, A. and Grant, A. (2014). *Anatomy and physiology in Health and Illness*. 11th edition. Churchill Livingstone, Elsevier.

Wulf, G. (2007). *Attention and Motor Skill Learning*. Human Kinetics Europe Ltd.

## Notes

# Delivering client consultations and health and fitness assessments – additional content

## Introduction

This section will support you with the assessment requirements for the *Delivering client consultations and health and fitness assessments* unit.

You will find information on:

- Pre-assessment guidelines
- Anthropometric measurements
- Muscular endurance tests
- Static posture and movement screening
- Motor skills tests
- Examples of how VARTEC should be used to evaluate the effectiveness of health and fitness assessments
- Communicating the results of health and fitness assessments to clients.

This content supports and adds to the information found in the *Encouraging positive health and fitness behaviours in clients* unit and the *PT toolkit*.

# Pre-assessment guidelines

Prior to administering any form of passive or active assessment on a client, it is vital that clear, non-negotiable pre-assessment guidelines are provided and adhered to. These will help to increase the validity, accuracy and reliability of the assessment.

It is important that pre-assessment guidelines are given to the client well in advance of the assessment to allow them to prepare appropriately. They normally come in the form of written instructions, but it is also recommended that a verbal explanation is provided (along with a rationale) to give the client the opportunity to seek clarification on anything they might be unsure of. Guidelines should remain consistent, to ensure repeat testing has the same preparation each time.

Guidelines will vary from one assessment to the next. However, the American College of Sports Medicine (2018) have some generic guidance for all assessments:

- Avoid ingesting food, alcohol or caffeine, or using tobacco products at least three hours before.
- Avoid significant exertion on the day of assessment and ensure you are well rested prior to assessment.
- Ensure clothing allows you to move freely and avoid wearing restrictive undergarments.
- Drink ample fluids at least 24 hours prior to assessment, to ensure normal hydration.



## ACTIVITY

Research and make a note of the specific pre-assessment guidelines for the following health and fitness assessments:

- Resting blood pressure.
- Body composition.
- One-rep max test.
- Any flexibility assessment.

# Height and weight

Height and weight tables provide guidelines for a healthy body weight. They are also a valid method of gauging body mass index (BMI).

These tables are not a measure of body composition – they do not assess the proportion of body fat – but are a reliable gauging method for the majority of the population. They can be compared with a waist measurement or body composition analysis if the participant is active or muscular.

Total weight indications are a useful starting point for assessing health status, but body composition must ultimately be taken into account. There is a difference between weight loss and fat loss.

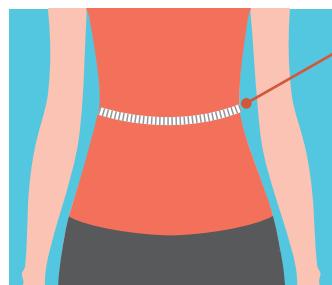
## Test guidelines

- |                          |   |
|--------------------------|---|
| <b>WEIGHT ASSESSMENT</b> | <ul style="list-style-type: none"> <li>Use calibrated scales, make sure the client removes shoes and heavy clothing and ensure all retests are scheduled for the same time of day.</li> </ul>                   |
| <b>HEIGHT ASSESSMENT</b> | <ul style="list-style-type: none"> <li>Make sure the client removes shoes and stands tall. Take the highest part of the head as the measurement (be aware that height decreases as the day goes on).</li> </ul> |



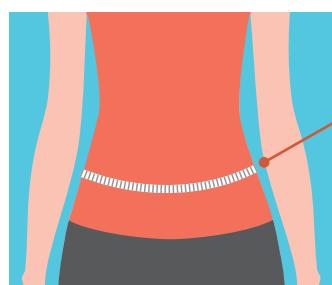
## Taking circumference measurements

Circumference measurements are quick, easy and straightforward to take. Measurement sites include the waist, thigh, hips, arm and chest.



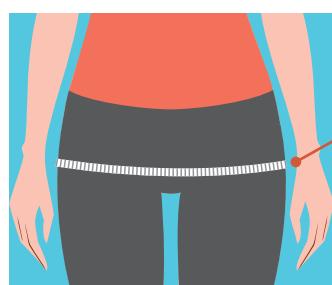
**Waist**

A horizontal measurement is taken (with the subject's abdomen relaxed) at the level of the narrowest part of the torso, above the iliac crest and below the 12th rib. The level of the umbilicus is also commonly used, but this is inaccurate for people with excess fat whose umbilicus has dropped, so above the bony marker of the iliac crest is the most consistent one to use. The measurement is taken after a normal expiration.



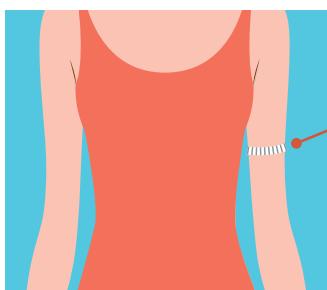
**Abdomen**

A horizontal measurement is taken (with the subject's abdomen relaxed) at the level of the umbilicus (the navel). The measure is taken after a normal expiration.

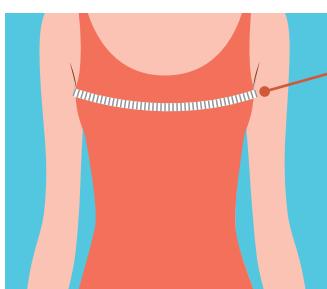


**Hips**

A horizontal measurement is taken at the maximum circumference with the person standing straight with feet together.

**Arm**

A horizontal measurement is taken (with the subject's arm relaxed) at the mid-point between the acromion process (shoulder) and the olecranon process (elbow).

**Chest**

With the subject standing erect, a measurement is taken at the maximum circumference.

NB: When taking this measurement on women, it might be appropriate to ask the client to place the tape in the correct position at the front of her body, with the instructor taking the measurement from the side or back.

## Muscular endurance fitness testing

There is a variety of tests for measuring endurance and strength. A person's fitness level and experience are key determinants for the tests you should choose.

It would not be advisable to test a beginner or newcomer to resistance training to the point of exhaustion at any number of reps. Muscular endurance tests are often preferable to strength tests because:

- An all-out (maximal) test is hard work and painful, and can put some clients off further resistance training.
- An all-out (maximal) test can result in delayed onset muscle soreness (DOMS), which is also likely to put some clients off.
- If the client focusses on working to the maximum, good form will almost certainly be lost. Good technique is much more important than maximal exertion in the early days of resistance training.
- A beginner is at particular risk of injury if they are exercising to maximum exertion – especially in their ligaments and tendons, which take longer to gain strength than muscles (this develops through training). Using heavy free weights before coordination is developed is potentially dangerous.

### Press-up test



#### Instructions

- The client assumes the normal press-up position with the body rigid and straight and the arms shoulder-width apart.
- The client must lower himself or herself to 90° of elbow flexion.
- The test is the total number of completed press-ups to exhaustion.
- An alternative press-up method, where the client raises from a position with the knees in contact with the ground, is available for those who cannot complete the normal version.

<b>Press-ups completed by age and sex</b>										
<b>Age</b>	<b>20–29</b>		<b>30–39</b>		<b>40–49</b>		<b>50–59</b>		<b>60–69</b>	
<b>Sex</b>	M	F	M	F	M	F	M	F	M	F
<b>Excellent</b>	36	30	30	27	25	24	21	21	18	17
<b>Very good</b>	35	29	29	26	24	23	20	20	17	16
	29	21	22	20	17	15	13	11	11	12
<b>Good</b>	28	20	21	19	16	14	12	10	10	11
	22	15	17	13	13	11	10	7	8	5
<b>Fair</b>	21	14	16	12	12	10	9	6	7	4
	17	10	12	8	10	5	7	2	5	2
<b>Needs improvement</b>	16	9	11	7	9	4	6	1	4	1

(CSEP in ACSM, 2017)

Table 1.9 Fitness categories for the press-up test

## Static posture assessment

**Procedure:** The client is instructed to stand in the anatomical position, palms of the hand facing forwards.

**Observations (what to look for):**

### Anterior

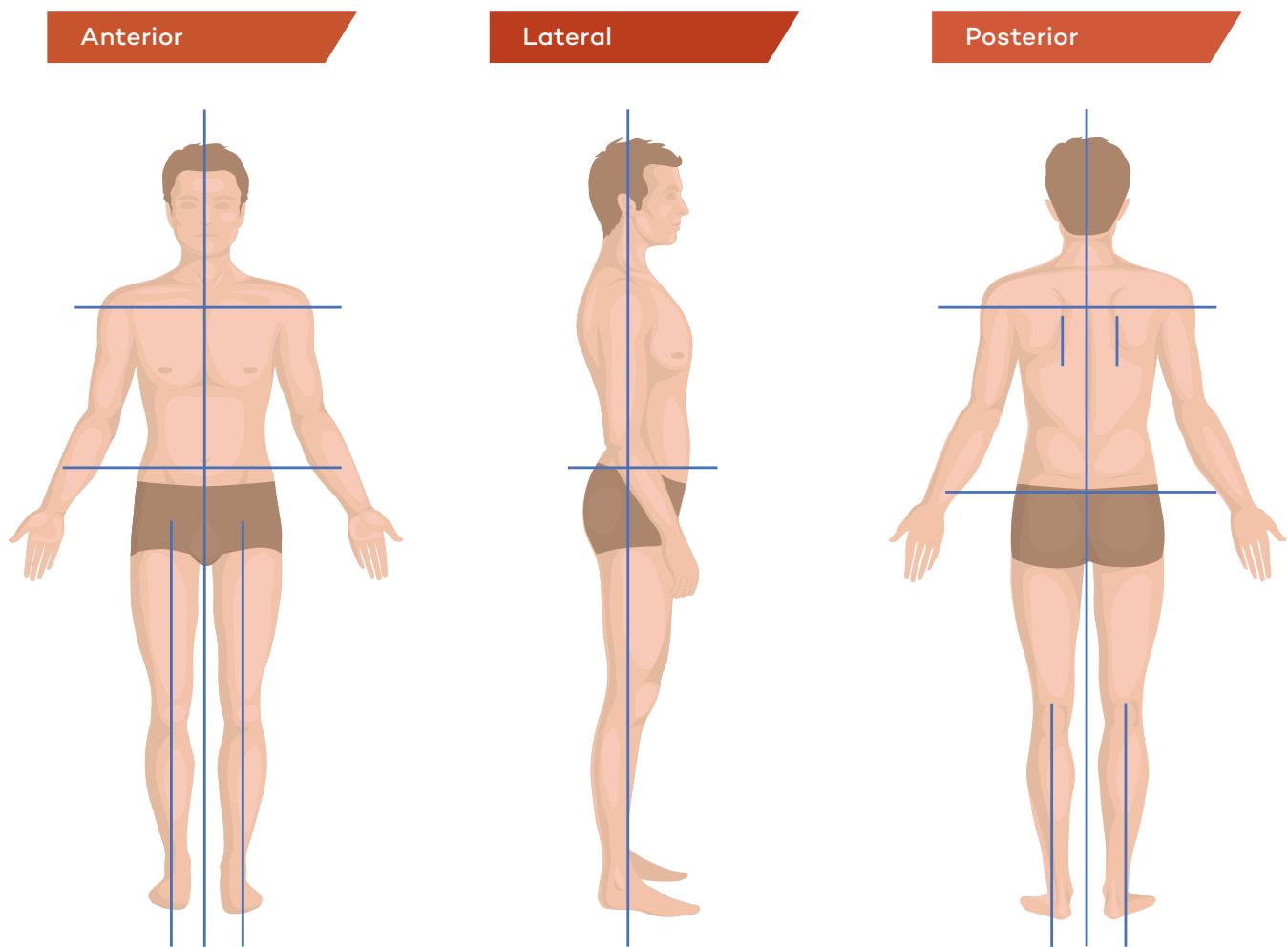
- Are the feet and ankles flattened or externally rotated?
- Are the knees pointing inwards or outwards, i.e. are they misaligned with the hips and ankles?
- Is one shoulder higher or more rounded than the other?
- Is the head tilted to one side or rotated?

### Lateral

- Are the feet and ankles out of neutral position, i.e. is the leg vertical at a right angle to the sole of the foot?
- Are the knees flexed or hyperextended?
- Is the pelvis anteriorly (lordotic) or posteriorly (kyphotic) rotated?
- Is there an excessive rounding of the shoulders?
- Is the head in excessive extension ('pokey' chin)?

### Posterior

- Are the heels overly pronated?
- Are the knees pointing inwards or outwards, i.e. are they misaligned with the hips and ankles?
- Is one scapula higher and / or more protracted than the other (medial borders essentially parallel and approximately three to four inches apart)?
- Is the head in excessive extension ('pokey' chin)?



## Overhead squat assessment

*Equipment:* None, although can be performed holding a wooden dowel or barbell.

*Procedure:*

1. Client removes socks and footwear and stands with feet shoulder-width apart, pointing straight ahead with arms raised above the head, in line with the torso and with elbows fully extended.
2. Keeping arms extended, the client performs a squat movement, sinking roughly to the height of a chair, then returning to the start position.
3. The client should perform a total of 15 reps to allow the trainer to view 5 reps each from an anterior, lateral and posterior position.

### KEY POINT



Some clients quite simply may not be able to perform an overhead squat assessment without losing balance and/or experiencing pain or discomfort. If this happens, the assessment could be modified by either placing the hands on the hips, or placing a slight rise underneath their heels, so their ankles are slightly plantar flexed throughout the movement. The second option would be to consider an alternative assessment.

*Observations (what to look for):*

#### Anterior

- Feet: Do the feet flatten and / or turn out?
- Knees: Do the knees move inwards or outwards, i.e. are they misaligned with the hips and ankles?



#### Lateral

- Spine and pelvis: Does the low back arch or round, i.e. does it move out of neutral position? Does the torso lean forward excessively?
- Shoulders: Do the arms fall forward?



#### Posterior

- Feet: Do the feet flatten? Do the heels rise off the floor?
- Spine and pelvis: Is there an unequal weight distribution between the left and right side of the body, i.e. does the body shift laterally to the left or right?



(Ref: NASM Essentials of Corrective Exercise Training, 2014)

## What do these findings mean?

Any movement compensations identified during an overhead squat assessment may be due to specific muscle imbalances, which could then be corrected by strengthening and stretching, as appropriate. The table below identifies likely muscle imbalances occurring as a result of compensatory movement.

View	Checkpoints	Compensation/ observation	Possible overactive muscles	Possible underactive muscles
Anterior	Feet	Turn out	Soleus Lateral gastrocnemius Biceps femoris (short head) Tensor fasciae latae (TFL)	Medial gastrocnemius Medial hamstrings Gluteus medius/maximus Gracilis Sartorius Popliteus
		Flatten	Peroneal complex Lateral gastrocnemius Biceps femoris Tensor fasciae latae (TFL)	Tibialis anterior Tibialis posterior Medial gastrocnemius Gluteus medius
	Knees	Move inward (valgus)	Adductor complex Biceps femoris (short head) Tensor fasciae latae (TFL) Vastus lateralis	Gluteus medius/maximus Vastus medialis oblique (VMO)
		Move outward	Piriformis Biceps femoris TFL/gluteus minimus	Adductors Medial hamstring Gluteus maximus
	Spine and pelvis	Excessive forward lean	Soleus Gastrocnemius Hip flexors Abdominals	Tibialis anterior Gluteus maximus Erector spinae
		Low back arches	Hip flexors Erector spinae Latissimus dorsi	Gluteus maximus Hamstrings Deep core muscles
		Low back rounds	Hamstrings Adductor magnus Rectus abdominus External obliques	Gluteus maximus Erector spinae Deep core muscles Hip flexors Latissimus dorsi
	Shoulders	Arms fall forwards	Latissimus dorsi Teres major Pectoralis major/minor	Middle/lower trapezius Rhomboids Rotator cuff
Lateral	Feet	Flatten	Peroneal complex Lateral gastrocnemius Biceps femoris TFL	Tibialis anterior Tibialis posterior Medial gastrocnemius Gluteus medius
		Heels rise	Soleus	Tibialis anterior
	Spine and pelvis	Uneven weight distribution (left to right)	Adductors TFL (same side of shift) Gastrocnemius / soleus Piriformis Biceps femoris Gluteus medius (opposite side of shift)	Gluteus medius (same side of shift) Tibialis anterior Adductors (opposite side of shift)

(Taken and adapted from NASM Essentials of Corrective Exercise Training, 2014)

### Trainer Tip

Some clients may present with postural imperfections and / or irregular movement patterns, yet they move pain-free and with no detriment to exercise technique or performance. If this is the case, it is probably not much use trying to correct the identified ‘issue’. Having said that, it is important to try and identify any muscle imbalances if you think they could be having a negative impact on your client’s performance (for example, they struggle performing a deadlift with proper technique) and / or if they feel discomfort when performing certain exercises. However, care must be taken to ensure corrective exercise does not become the main focus of programming and delivery, as this could impact negatively on the client’s main goals and aspirations, leading to a lack of motivation and eventually the loss of the client.

### ACTIVITY

Have a go at the overhead squat assessment with your friends, family members or work colleagues. Observe their overhead squat by completing the table below and identify any possible muscle imbalances.

View	Checkpoints	Compensation/observation	Yes/no
Anterior	Feet	Turn out	
		Flatten	
Knees		Move inward (valgus)	
		Move outward	
Lateral	Spine and pelvis	Excessive forward lean	
		Low back arches	
		Low back rounds	
Shoulders		Arms fall forwards	
Posterior	Feet	Flatten	
		Heels rise	
	Spine and pelvis	Uneven weight distribution (left to right)	



## Motor skills tests



### KEY POINT



Norms tables for motor skills tests have not been included because they are produced using high performing athletes and are therefore not reflective of an average client. For an average client, it is more important to compare his / her own improvements when retaking the test after a period of training. If you do wish to compare clients' scores to 'averages', the NSCA's Essentials of Strength and Conditioning book will provide you with this information.

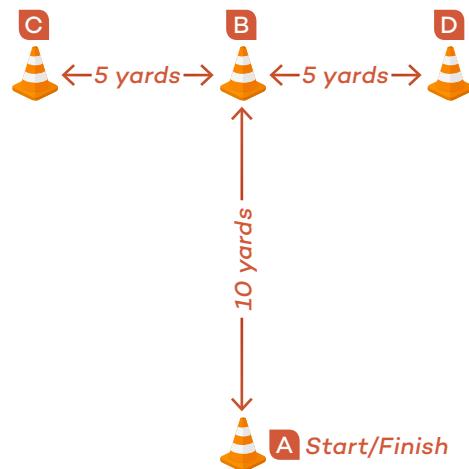
## Agility

### T-test

*Equipment:* Tape measure, four cones, stopwatch.

*Procedure:*

1. Arrange four cones as shown in the diagram opposite.
2. Ensure the client has warmed up prior to starting the test. This may include a sub-maximal attempt of the test.
3. The client starts at cone A.
4. On the command of 'Go!', the watch is started. The client travels as quickly as possible to cone B, touching the base with his/her right hand.
5. Keeping forward facing, the client then shuffles across to cone C, not crossing the feet, and touches the base of the cone with his/her left hand.
6. The client then shuffles all the way across to cone D, touching it with his/her right hand.
7. The client then shuffles back to cone B in the centre and touches it with his/her left hand, before running backwards past cone A, at which point the watch is stopped and the time recorded.
8. The test is repeated and the best time of two attempts is recorded to the nearest 0.1 seconds.



*Notes:*

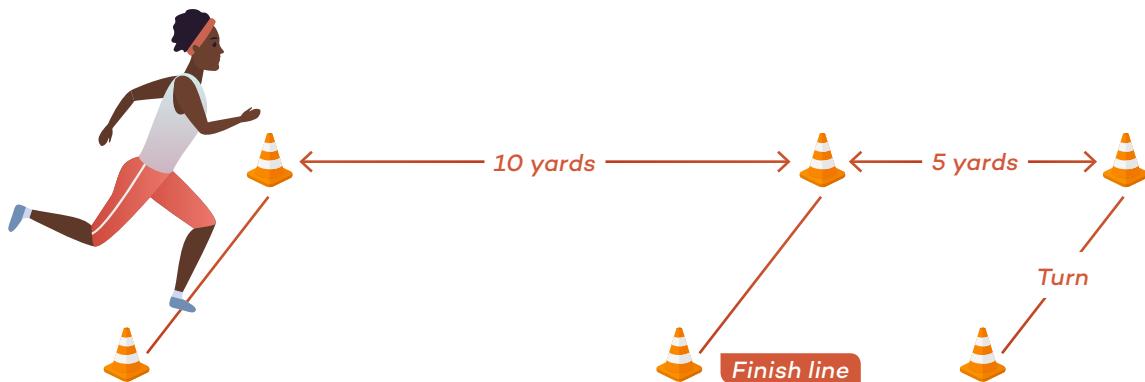
- To protect the safety of the client, a spotter and gym mat should be placed several feet behind cone A to catch them if they fall when running backwards.
- Reasons for disqualification include:
  - The client fails to touch the base of any cone.
  - The client's feet cross over each other, rather than shuffling.
  - The client fails to face forwards for the entire test.

## 505 agility test

*Equipment:* Six cones, tape measure, stopwatch.

*Procedure:*

1. Set up cones as shown in the diagram below.



2. Ensure the client has warmed up prior to starting the test. This may include a sub-maximal attempt of the test.
3. The client stands at the start line. On the command of 'Go!', the watch is started and the client sprints 15 metres to the turn line.
4. The client's foot must be on or over the turn line before he / she turns and sprints another 5 metres past the finish line.
5. The test is repeated and the best time of two attempts is recorded to the nearest 0.1 seconds.

## Speed

### Straight-line sprint tests

**Equipment:** Stopwatch, two cones, tape measure.

**Procedure:**

1. Set up two cones at a specified distance apart, e.g. 10 metres, 20, metres, 40 metres, etc.
2. Ensure the client has warmed up prior to starting the test. This may include a sub-maximal attempt of the test.
3. The client assumes a starting position using a three- or four-point stance.
4. On the command of 'Go!', the client sprints as quickly as possible from the start to the finish cone, only slowing down once they have passed the finish cone.
5. The test is repeated and the best time of two attempts is recorded to the nearest 0.1 seconds (allow at least 2 minutes of active recovery or rest between sprints).



## Balance

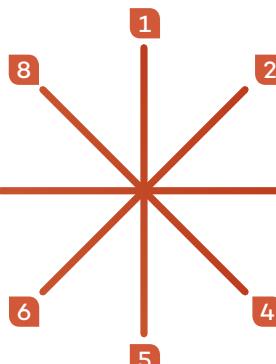
### Star excursion balance test (SEBT)

**Equipment:** Adhesive tape, tape measure.

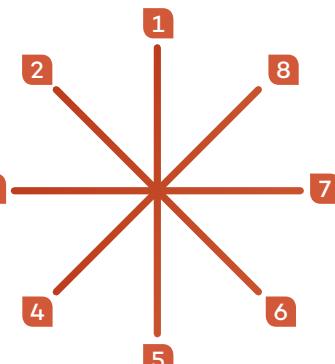
**Procedure:**

1. Set up a grid with eight lines, 120 cm long, crossing through a centre point at 45 degrees, as shown in the diagram opposite.
2. The client stands on one foot in the centre, always facing in the same direction.

*Standing on LEFT limb*



*Standing on RIGHT limb*



3. The client reaches as far as possible with their non-standing leg down each of the lines, before returning to an upright position.
4. The distance from the centre of the star to the touch position is measured. A 15-second rest is allowed between each 'reach'.
5. The starting direction and support leg are chosen randomly. Three trials are performed for each condition and averaged.

Notes:

- The client should be given a minimum of four practice trials before being tested.
- Reasons for disqualification include:
  - The client fails to touch the line.
  - The standing foot moves away from the centre of the grid.
  - The client loses balance.
  - The client does not maintain start and return positions for at least one second.
- Research suggests that lines 8, 7 and 6 on the left limb and lines 2, 3 and 4 on the right limb are sufficient for most situations.

## Reaction time

There are many fitness-related drills to develop reaction time. However, in terms of standardised testing, the assessments are more generic and could be applied to lots of different scenarios, e.g. the ability to drive safely.

One common reaction time test is the *ruler* test.

### Reaction time ruler test

*Equipment:* One-metre ruler or yardstick.

*Procedure:*

1. The client sits near the edge of a table, resting their elbow on the table so that their wrist extends over the side.
2. You, as the 'assessor', hold the ruler vertically in the air between the client's thumb and index finger, without touching either.
3. Align the zero mark with the client's fingers and ask them to confirm that they are ready.
4. Without warning, release the ruler and allow it to drop – the client must catch it as quickly as possible as soon as they see it fall.
5. Record (in metres) the distance the ruler fell.
6. Repeat several times and take the average score.



## Coordination

### Wall toss test

*Equipment:* Tennis ball or similar, smooth and solid wall, tape, stopwatch.

*Procedure:*

1. Place a mark on the floor, two metres away from the wall.
2. The client stands behind the mark and throws the ball underarm against the wall with one hand, then tries to catch it with the other hand.
3. This is then repeated using opposite hands, i.e. throwing with the hand that initially caught and catching with the hand that initially threw.
4. This is repeated for a set time, e.g. 30 seconds, with the total number of successful catches recorded at the end.

## Examples of VARTEC applied to health and fitness assessments

Resting blood pressure (manual)		
V	<b>Is it valid?</b>	Yes! The recording provides a blood pressure reading, which can then be used to inform current heart health and identify any underlying conditions that would put the client at risk.
A	<b>Is it accurate?</b>	It requires an experienced and skilled individual to take an accurate, manual blood pressure reading, therefore it is important to ensure lots of practice and confidence in application before using on real clients. Manual is more accurate than an electronic alternative, but only if the administrator is competent. If not, it may be better to use an electronic blood pressure monitor.
R	<b>Is it reliable?</b>	To ensure reliability, it is important that repeated tests remain consistent. For example, the same person should administer it using the same equipment, on the same arm (normally the left), at the same time of day with the same pre-test guidelines adhered to. By using different equipment or a different administrator, the reliability could be compromised.
T	<b>Is it time-efficient?</b>	Yes. One manual blood pressure reading can be taken in less than a minute; however, it is important to ensure the client is rested and seated for at least five minutes prior to testing.
E	<b>Is equipment needed and readily available?</b>	Some health and fitness clubs will have manual blood pressure equipment available for use. However, most personal trainers working in the industry will have their own. They are small and compact, therefore easy to transport from one place to another.
C	<b>Is it a costly assessment?</b>	A sphygmomanometer and stethoscope can be purchased for as little as £15 and as much as around £75 for both pieces of equipment. As with most things, the more expensive ones will be more robust, last longer and provide more accurate readings. It is also important to have a pack of wipes available to ensure good hygiene is maintained, which would incur a regular, but relatively small cost.

Cooper 1.5-mile run test		
V	<b>Is it valid?</b>	The test aims to provide an indication of a client's aerobic fitness, which it does by a calculation which can translate their time into a VO2 max score. It is important to consider how best to present information to a client about their performance to ensure they themselves consider it a valid assessment. For example, saying to a client '6 weeks ago, your VO2 max was 46.29; now it is 29.46' would be considered poor face validity, i.e. that information is not likely to be understood by the client, which could demotivate them. Better face validity would be to say: '6 weeks ago it took you 18 minutes to complete the 1.5miles; now it takes you 14 minutes 30 seconds, which is 3 ½ minutes quicker!'
A	<b>Is it accurate?</b>	The test does give a good indication of VO2 max and the protocol is straightforward enough for there to be limited variables that could affect the final result. Consideration does need to be made as to the client's fitness background, i.e. are they a regular runner? Are they more familiar with other modes of cardiovascular exercise? The reason why this is important is because of familiarity. For example, a cyclist is less likely to perform well in a running VO2 max test than in a VO2 max test on a bike.
R	<b>Is it reliable?</b>	The test can be easily repeated. However, one challenge is creating the exact same conditions if administering outdoors (due to wind direction and speed, temperature, humidity, etc.), i.e. on a running track. This can be easily overcome by administering on a treadmill. However, the VO2 max formula has been developed for track running, so the norms tables may be less reliable. Another variable of reliability is that of test experience: the first time a client attempts this assessment, they may not have any experience of running at a sub-max pace for this distance, so they may set off too quickly and 'burn-out' early, or set off too slowly, not giving themselves an opportunity for a good time. On re-attempting, they have more experience of how to complete the assessment quickly, and therefore an improved result may be as much due to experience as an actual improvement in aerobic fitness.
T	<b>Is it time-efficient?</b>	Depending on the fitness of your client, this test could take anywhere between 8 and 20 minutes, so it is quite a time-consuming test compared to most. Considerations must be made as to whether the additional time this takes is worth it, or if there is an equally or more accurate aerobic fitness test that can be completed more quickly.
E	<b>Is equipment needed and readily available?</b>	All that is needed is a stopwatch and access to a running track or treadmill.
C	<b>Is it a costly assessment?</b>	If personal training is in a gym, cost is not an issue as all equipment will be available for use.

<b>Overhead squat assessment</b>		
V	<b>Is it valid?</b>	This assessment has a multitude of purposes in that it can be used to analyse a client's dynamic flexibility, core strength, balance and overall neuromuscular control. Research suggests that this is a valid assessment in looking at both lower and higher extremity movement and identifying movement dysfunction and potential injuries.
A	<b>Is it accurate?</b>	There is an element of subjectivity to the assessment as the observer must decide on whether a particular compensation is indeed excessive. There is no scoring applied (e.g. 0–5); it either is, or is not, an excessive compensation, which means the assessor must be consistent and skilled in their ability to identify compensatory movements accurately.
R	<b>Is it reliable?</b>	The results can be used to identify possible under/reactive muscles. However, this does not guarantee that these are the reasons for the faulty movement patterns, as the issues could be referred from another area. The skill of translating the observations into meaningful information and then prescribing effective corrective exercise is one that requires a lot of experience and more training in the field of biomechanics. The assessment can be reproduced quite easily, with the main variable being the observer and the flooring.
T	<b>Is it time-efficient?</b>	Yes! The observation is very quick to complete, taking less than a couple of minutes.
E	<b>Is equipment needed and readily available?</b>	No equipment is needed and the assessment can be done anywhere, as long as there is a suitable floor to perform it on.
C	<b>Is it a costly assessment?</b>	There is no cost to this assessment as no equipment is necessary.

**ACTIVITY**

Select another health and fitness assessment and 'VARTEC' it by completing the table below.

<b>Assessment</b>		
V	<b>Is it valid?</b>	
A	<b>Is it accurate?</b>	
R	<b>Is it reliable?</b>	
T	<b>Is it time-efficient?</b>	
E	<b>Is equipment needed and readily available?</b>	
C	<b>Is it a costly assessment?</b>	

## Communicating the results of health and fitness assessments to clients

It is important to communicate the results of health and fitness assessments in a professional, honest and constructive manner, while showing empathy to the client throughout.

The use of appropriate language and terms is vital to ensure the client remains motivated and does not feel like they have ‘failed’ the assessment.

Examples of positive and negative communication:



Scenario	Negative feedback	Positive feedback
Client attempts the Cooper 1.5-mile run and their VO2 max value comes out as ‘poor’ for their age group.	<i>'Unfortunately, your VO2 max score puts you in the 'poor' category for your age-group. This is something you need to work on.'</i>	<i>'A great first effort today – the run took you 18 minutes, 33 seconds. I have no doubt that with some training, you can improve on that time!'</i>
Client has their height and weight recorded and their BMI classifies them as ‘obese stage 2’.	<i>'We have taken your height and weight, then from a calculation established that you are obese. You need to lose some weight.'</i>	<i>'From measuring your height and weight, we have established that you are in a high-risk category, which, if we don't act on this soon, could have some serious implications on your health.'</i>

## Interpreting and using health and fitness assessments to inform programme design

It is one thing carrying out appropriate health and fitness assessments on clients, but it is another using the information and data collected to inform exercise programme design and delivery.

Health-based assessments can help to:

- Identify any underlying health conditions, e.g. resting blood pressure.
- Provide a basic indication of fitness, e.g. resting heart rate.
- Provide a benchmark for the client to progress from and therefore be used as a motivational tool, e.g. reducing BMI from 30 to 24.

Fitness-based assessments can help to:

- Provide a good indication of a specific component of fitness, e.g. muscular strength.
- Provide a benchmark for the client to progress from and therefore be used as a motivational tool, e.g. improving 1 rep max from 80kg to 100kg on bench press.

The information collected during a consultation that you receive verbally from your client, e.g. past and present physical activity levels, perception of current fitness, etc. is useful information. However, it can be subjective; some clients may overestimate their fitness and think they are in much better ‘shape’ than they actually are, whereas other clients may underestimate their fitness levels.

Valid and reliable fitness assessments provide objective data which can inform programme design by outlining the baseline fitness of the client. This helps to ensure an appropriate volume and intensity of exercise is prescribed. For example, if a client achieved a ‘poor’ score for a VO2 max test, you would not then prescribe high-intensity intervals that would be more appropriate for an intermediate to advanced exerciser.

The same can be said of posture assessments. For example, if a client is struggling with an overhead squat and there are numerous compensatory movements identified, it would be advisable to avoid squats and deadlifts in the first sessions and instead look at some strengthening and stretching exercises to address the imbalances, and perhaps some additional core work.

**Notes**

# Personal training for individuals and groups in a range of environments – additional content

## Introduction

This section will support you with the assessment requirements for the *Personal training for individuals and groups in a range of environments* unit.

You will find information on:

- Planning considerations when working in alternative environments
- Exercise library for:
  - Bodyweight exercises
  - Portable equipment exercises
  - Exercises in alternative environments
- Sample programmes for alternative environments:
  - Car park workout
  - Park workout
  - Group personal training in alternative environments
- Sample programmes for group personal training:
  - Rig workout
  - Rowing workout
  - Bodyweight circuit
  - Portable equipment circuit
  - Core circuit
  - Muscular fitness circuit
  - Private group personal training
  - Older adult circuit
  - Pre and postnatal circuit
- Functional movement exercises and alternatives
- Matching client needs to specific group personal training sessions

This content supports and adds to the information found in the *Programme design and delivery for personal training* unit and the *PT toolkit*.

# Considerations when planning exercise sessions in alternative environments



In a gym environment, there are numerous health and safety factors that are controlled and fairly consistent, such as temperature, weather, lighting and available space.

In alternative environments, these factors, and others are out of the control of the personal trainer and could put the health and safety of your client at risk.

It is important to consider these when planning exercise sessions in alternative environments and put plans in place to minimise them.

- Warm-ups and cool-downs may need to be extended due to cool / wet conditions.
- Consider the time of year and potential lighting issues – for example, if planning a session in a park in the evening, is there adequate lighting to ensure the safety of yourself and your clients?
- Ensure ‘recovery periods’ in cold / wet conditions are kept to a minimum. This might mean that active recovery is at a higher intensity to ensure the client does not cool down too much and risk injury.
- Consider the use of portable equipment and whether it can be easily transported to, and during, the session. For example, heavy kettlebells would not be ideal for a session that also involves periods of running to various locations; a resistance band would be a better alternative in this scenario.
- Consider the space available. For example, if working in an office or a client’s front room, swinging a kettlebell around might not be safe or even achievable: body weight exercises may be more appropriate in this scenario.

# Body weight exercises and adaptations in alternative environments

Exercise	Progressions	Regressions
<b>Bench step-up</b>	Drop into deep eccentric squat Lateral step-ups Plyo jumps Faster pace	Smaller step Slower pace
<b>Bench dips</b>	Straighten out legs Lift one leg off the ground Add resistance onto legs	Shorten levers by bending the knees
<b>Bench push-ups</b>	Feet on bench, hands on floor Narrow grip Clap push-ups	Wall/tree push-up
<b>Bench Plank</b>	Increase duration of hold Lift one leg off the ground Create instability	Reduce duration of hold Perform on an incline

Exercise	Progressions	Regressions
<b>Walking lunges</b> 	Add resistance Plyo lunges Combine with upper body movement, e.g. torso twist	Static lunges Squats
<b>Squats</b> 	Add resistance Plyo squats Hold at the bottom of the movement Slower eccentric phase	Reduce ROM Widen foot position slightly Support with a bench or chair
<b>Bar pull ups/chins</b> 	Slower eccentric phase Muscle-up	Jump up to flexed arm position and just focus on eccentric phase Supine, narrower grip Perform less vertical and more horizontal, e.g. 45 degree angle

# Exercises using portable equipment and adaptations in alternative environments

Exercise	Progressions	Regressions
<b>Resistance band row</b>	Single-arm row with both handles Change position of band to increase resistance Resistance band straight-arm pull-down Resistance band reverse flye Slow down the movement	Change position of band to reduce resistance
<b>Resistance band chest press</b>	Resistance band pec flye Change position of band to increase resistance Narrow hand position to isolate triceps Slow down the movement	Change position of band to reduce resistance Wall / tree push-up
<b>Suspended squat</b>	Suspended overhead squat Suspended single-leg squat Suspended jump squat Single-leg Bulgarian squat	Wall squat with chair Reduce ROM
<b>Suspended row</b>	Increase impact of gravity Suspended single-arm row Suspended three-way row Suspended inverted row Suspended reverse flye	Reduce impact of gravity Narrow grip

Exercise	Progressions	Regressions
<b>Weighted bag overhead press</b> 	Alternating overhead press Combine with Saxon bend Clean and press Halos Heavier bag	Lighter bag
<b>Weighted bag lateral lunge</b> 	Plyo lunges Combine with wood chop Pistol squat	Lighter bag Static forward lunge Bodyweight lunge
<b>Medicine ball wood chop</b> 	Increase resistance of medicine ball Combine with Saxon bend Slow down eccentric phase	Reduce resistance of medicine ball Medicine ball torso twist Medicine ball squat
<b>Medicine ball push-up</b> 	Double medicine ball push-up Rolling push-up Feet on the medicine ball push-up Lying chest throw Increase impact of gravity	Standing wall press Reduce impact of gravity Bodyweight push-up

**ACTIVITY**

From the exercises listed in the tables above, and / or any of your own, plan a whole-body resistance workout for yourself or a friend. Use a range of portable equipment, features of the outdoor environment and body weight. You should include at least one exercise for the:

- Shoulders
- Chest
- Upper/ mid back
- Core
- Legs

Exercise	Reps/sets	Resistance	Adaptations	Notes

## Sample programme cards in alternative environments

<b>Park workout</b>				
<b>Warm-up</b>				
<b>Equipment/activity</b>	<b>Time</b>	<b>Intensity</b>		<b>Notes</b>
1. Walk to tree 2. Jog to tree 3. Sideways jog to tree 4. Bear crawl 5. Elbow / full plank 6. Lunge with rotation				
<b>Warm-up flexibility</b>		RPE 3–5, gradually increasing over 5 minutes.		Make use of the natural equipment in the park. Ensure you have permission from the park authorities to use the park.
<b>Main CV component</b>				
<b>Equipment/activity</b>	<b>Training system</b>	<b>Time</b>	<b>Intensity</b>	<b>Notes</b>
Tree intervals	Tabata	4 minutes	20 seconds @ RPE 9/10 10 seconds @ RPE 6	Ensure your client has the required fitness levels to complete the 8 intervals.
Steps ups on bench	Intervals	10 minutes, 5 x intervals	30 seconds @ RPE 8/9 90 seconds @ RPE 5/6	Ensure your client steps up onto bench with good technique as this is a HIIT exercise.
<b>Main resistance training section</b>				
<b>Equipment/activity</b>	<b>Equipment</b>	<b>Set/reps/intensity</b>		<b>Notes</b>
Bench squats	Bench	45 seconds work, 2 reps in reserve, 15 seconds rest		Use the pause at the bottom of the movement to encourage focus on concentric contraction and pelvic tilt.
Bench push-up/rotate	Bench	45 seconds work, 2 reps in reserve, 15 seconds rest		Push up with rotation ensure the hips do not drop and pivot on opposite leg.
Bench single-leg side lunge, each leg	Bench	45 seconds work, 2 reps in reserve, 15 seconds rest		Ensure heel is grounded and knees stay in line with toes.
Bench band row	Bench and Band	45 seconds work, 2 reps in reserve, 15 seconds rest		Soften knees and draw elbows towards spine, focusing on shoulder blade retraction.
Feet on bench, full plank	Bench	45 seconds work, 2 reps in reserve, 15 seconds rest		Ensure neutral spine and lateral postural alignment. Not suitable for clients with high BP.
Feet on bench, side Plank	Bench	45 seconds work, 2 reps in reserve, 15 seconds rest		Ensure neutral spine and lateral postural alignment. Not suitable for clients with high BP.
<b>Cool-down</b>				
<b>Equipment/activity</b>	<b>Time</b>	<b>Intensity</b>		<b>Notes</b>
Tree walks	5 minutes	RPE 5–3		Allow your client the time to gradually lower pulse, focusing on muscular pump.
<b>Cool-down flexibility</b>				
Latissimus dorsi stretch	Quadricep stretch	Hamstring stretch	Gastrocnemius stretch	

Carpark workout				
<b>Warm-up</b>				
<b>Equipment/activity</b>	<b>Time</b>	<b>Intensity</b>		<b>Notes</b>
1. Stair walking 2. Sideways stair walking 3. Stair plank 4. Stair push-up to row 5. Stair push-up to crawl 6. Stair squat. 7. Stair side lunge 8. Stair runs	5–10 minutes	Gradually increasing ROM and intensity throughout		This warm-up works on neural preparation and motor skills. A risk assessment of the facility must be completed prior to the session taking place. The equipment is small and portable. Ensure you seek permission from the owner before using the facility.
<b>Warm-up flexibility</b>				
Dynamic reverse lunge with overhead reach	Chest openers	Hamstring step/track stretch		Light band overhead push
<b>Main CV component</b>				
<b>Equipment/activity</b>	<b>Training system</b>	<b>Time</b>	<b>Intensity</b>	<b>Notes</b>
Stair runs	Intervals	10 minutes, 5 x intervals	60 seconds @ RPE 9 60 seconds recovery @ RPE 6	Ensure your client has the required motor skills from a safety perspective to run upstairs. Also ensure your client has appropriate footwear.
Stair mountain climbers	Intervals	10 minutes, 5 x intervals	60 seconds @ RPE 9 60 seconds recovery @ RPE 6	Ensure your client maintains a neutral spine.
<b>Main resistance training section</b>				
<b>Equipment/activity</b>	<b>Equipment</b>	<b>Set/reps/intensity</b>		<b>Notes</b>
Incline stair push-ups	RT Band	45 seconds work, 2 reps in reserve, 15 seconds rest		Ensure client remains in a neutral position and has a good Q-angle at the elbow.
Stair squat, step-down and squat	RT Band	45 seconds work, 2 reps in reserve, 15 seconds rest		Knees in line with talus joint. Load heels on descent, ensuring spine runs parallel to shins. Flex knees and hips to 90 degrees before returning to start position.
Bent over RT band row	RT Band	45 seconds work, 2 reps in reserve, 15 seconds rest		Stand in RT Band. Cross it over. Flex at hips to 90 degrees. Leading with elbows.
Stair push-up, rotate	RT Band	45 seconds work, 2 reps in reserve, 15 seconds rest		Incline push-up with rotation. Ensure the hips do not drop and pivot on opposite leg.
Transverse lunge	RT Band	45 seconds work, 2 reps in reserve, 15 seconds rest		Rotate before lunging, ensuring heel is grounded and knee stays behind toes.
Sling system wood-chop	RT Band	45 seconds work, 2 reps in reserve, 15 seconds rest		Opposite arm leads to engage internal and external obliques. Pivot on near-side leg, engaging gluteals and shoulders.
<b>Cool-down</b>				
<b>Equipment/activity</b>	<b>Time</b>	<b>Intensity</b>		<b>Notes</b>
Stair marching	4 minutes	RPE 5–3		Gradually reduce ROM. Use talk test with client and explain the importance of cool-down to avoid blood pooling.
<b>Cool-down flexibility</b>				
Trapezius stretch	Quadricep-hip flexor stretch	Chest stretch		Hamstring stretch

Group beach workout				
<b>Warm-up</b>				
Equipment/activity	Time	Intensity		Notes
1. Alternate leg crawl 2. Scapula push-ups 3. Squats 4. Hip hinges 5. Hip hinge row 6. Plank	5–7 minutes	RPE 3–5, gradually increasing in intensity over time		
<b>Warm-up flexibility</b>				
Squat-press	Hip openers	Marching to push-pull		Squat-rotate
<b>Main CV component</b>				
Equipment/activity	Training system	Time	Intensity	Notes
Partnered sprints	Intervals	60 seconds work, 60 seconds active recovery	RPE 9 when working	Place band around hips. Partner adds light resistance to encourage acceleration without working partner losing form.
Burpees	Intervals	60 seconds work, followed by 30 seconds recovery	RPE 9 RPE 6	Perform a push-up followed by a squat thrust before standing and jumping for height.
<b>Main resistance training section</b>				
Equipment/activity	Equipment	Set/reps/intensity		Notes
Band squats	Long RT band	60 seconds, varying load through band		Standing with feet shoulder-width apart, place band over shoulders before squatting to 90 degrees. Return to start position.
Band bent over row	Long RT Band	60 seconds, varying load through band		Cross band. Flex at hips until torso is parallel to floor. Pull elbows behind back, squeezing shoulder blades together.
Band push-ups	Long RT Band	60 seconds, varying load through band		Place band around hands. Perform a push-up with a neutral spine.
Band squat, overhead press	Long RT band	60 seconds, varying load through band		Standing with feet shoulder-width apart, place band over shoulders before squatting to 90 degrees. Return to start position, then perform a band shoulder press.
Partnered band pull-downs	Long RT band	60 seconds, varying load through band		Partner holds band to create resistance. Working partner flexes at hip until torso is parallel to the floor. Then working partner pulls elbows towards waist while squeezing shoulder blades together.
Leopard crawl through group in high plank position	No equipment needed	Performed once each		Groups of five. Four people enter high plank position. The fifth person crawls as fast as possible through the group's high plank. When reaching the end, the fifth person gets into high plank position and calls for the last person in line to begin their leopard crawl through.
<b>Cool-down</b>				
Equipment/activity	Time	Intensity		Notes
Body weight squats with pivot and rotation	60–120 seconds	RPE 5–3		This exercise is used to prevent blood pooling, gradually lowering pulse.
<b>Cool-down flexibility</b>				
Static lat stretch	Static chest stretch combined with standing calf stretch	Standing quadricep stretch	Standing hamstring stretch	

# Group personal training



## Gym floor classes/'fast classes'

Gym floor or 'fast classes' are an excellent way for personal trainers to build rapport and confidence with prospective new clients. They provide an opportunity for personal trainers to showcase their skills and personality, and to build up an extended list of contacts that can be followed up and hopefully converted into paying customers.

Gym floor classes can either be timetabled classes or 'spur of the moment', when a PT has a spare 45 minutes due to either a gap in their diary or a cancellation. The aim is to recruit as many gym members as possible to attend the class and deliver a quick, high-energy session that aligns (where possible) to their general health and fitness goals.

These classes are normally delivered in circuit format but can be structured differently, depending on the number of participants, space available, equipment being used and fitness / experience of the participants. It is important to consider the location of equipment and space available when delivering these sessions, so that all participants can be monitored and supported throughout.

Examples of gym floor classes include:

Rig workout

CV machine workout

Bodyweight workout

Portable equipment workout

Core workout

Muscular fitness workout

Functional movement workout

## Sample sessions

Notes: these samples do not include warm-ups and cool-downs.

### Rig circuit

Station duration: 30 seconds, with 15 seconds recovery between stations. Repeat x3.

Progressions	Regressions
Suspended low row	Increase/decrease impact of gravity, single-arm row, narrow/widen elbow position
Battle rope slams	Burpees, squats, good mornings
Box jumps	Step-ups, jog on the spot, increase/decrease height of box, squats
Bar dips	Box push-ups, add resistance to feet
Kettlebell swing	Kettlebell deadlift into upright row, sumo squat into upright row
Monkey bars	Weight bag push-up
Hanging leg raises	Supine leg raises, single-arm hanging leg raises
Burpees	Burpee push-ups, squat thrusts, mountain climbers



### CV – Rowing workout

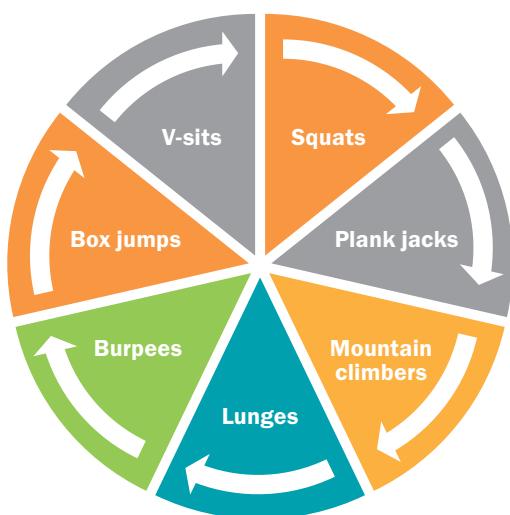
Station duration: 30 seconds, with 15 seconds recovery between stations. Repeat x3.

#	Time/distance	Speed
1	30 seconds	25 spm
2	30 seconds	30 spm
3	30 seconds	35 spm
4	30 seconds	Max speed
5	60 seconds	Active recovery
Repeat 1–4 in reverse order (4–1)		
6	500 metres	30 spm
7	30 seconds	Active recovery
8	1000 metres	30 spm
9	60 seconds	Active recovery
10	1500 metres	30 spm
11	2 minutes	Active recovery
12	2000 metres	30 spm



### Bodyweight circuit

45 seconds on each station, with 15 seconds active recovery between stations. Repeat x3.

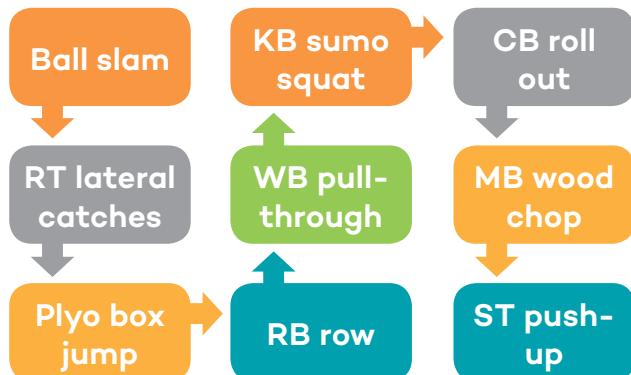


## Portable equipment circuit

45 seconds on each station, 15 seconds active recovery between stations. Repeat x3.

Key -

**RT:** resistance tube. **RB:** resistance band.  
**WB:** weighted band. **KB:** kettlebell. **CB:** core ball.  
**MB:** medicine ball. **ST:** suspension training.



## Core circuit

1 4 sets 12 reps



2 3 sets 10 reps



3 4 sets 15 reps



4 20 bicycle crunches



5 3 sets 12 reps



6 20 climbers



7 4 sets 14 reps



8 3 sets 20 reps



9 4 sets 14 reps



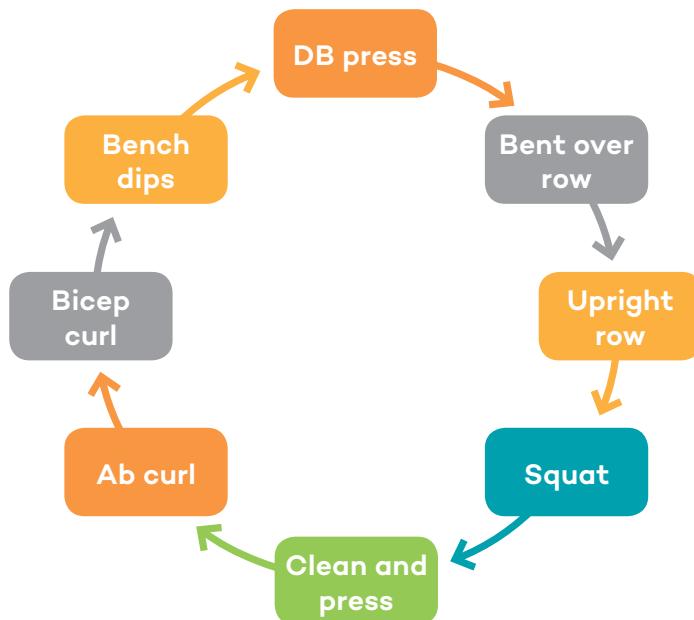
10 3 sets 10 reps



## Muscular fitness

8–12 reps on each station, with 30 seconds rest between exercises. Repeat x3.

Note: consider group size and experience for this type of circuit; it would be very difficult to monitor participants effectively on every station, especially if they are less experienced using free weights. The space and equipment available also needs to be considered, especially if the participants' strength differs, and therefore a range of resistance needs to be readily available.



## Functional movement

The definition of 'functional movement' differs from one person to another, dependent on what movements they require more efficiency for in their job, everyday movement, sport or exercise. This could be as simple as picking up your child or more complex movements such as a golf swing.

For most individuals looking to improve general movement efficiency, a good place to start is with the following key movements:

**SQUAT**



**LUNGE**



**HINGE**



**PUSH**



**PULL**



**ROTATE**



**GAIT**



*Progressions and movement add-ons for functional movement*

<b>SQUAT</b>	Squat + upright row	Squat + shoulder press	Squat + lateral raises	Overhead squat + Saxon bends	Sumo squats
	Pistol squats	Overhead squat	Bulgarian split squat	Single-leg squats	Goblet squats
<b>LUNGE</b>	Lunge + torso twists	Lunge + wood chops	Lunge + lateral raises	Lunge + shoulder press	Lunge hops
	Plyo lunges	Walking lunges	Backward lunges	Lateral lunges	Overhead lunges
<b>PUSH</b>	Bench press	DB chest press	Alternate-arm DB chest press	Shoulder press	Push-ups
	Alternate arm DB shoulder press	Core ball DB chest press	Core ball alternate-arm DB chest press	Core ball shoulder press	Spiderman push-ups
<b>PULL</b>	Assisted pull-ups	Pull-ups	Resistance band row	Single-arm row	Face-pulls
	Supine grip pull-ups	Lat pull-downs	Horizontal pull-ups	Wide grip row	Around the world pull-ups
<b>ROTATE</b>	Torso twists	Wood chops	Reverse wood chops	Cable torso twists	Rotational medicine ball pass (with partner)
	Hammer swings	Rotational lunges	Rotational deadlift using landmine	Russian twists	Lateral ball throw

ACTIVITY

Design a group functional movement session that can be done on the gym floor with a small group.

Exercise	Alternatives/progressions/regressions

Gait

Walking efficiently is often overlooked as part of any training routine. While walking may not be planned into a high-energy session (even though it could be used as active recovery), it is important to observe your clients/participants walking and to coach them towards a healthier gait pattern. Important areas to observe include the head, shoulder girdle, arm swing, hip and knee movement and planting of the feet.



## Private group personal training (general fitness)

#	Client 1	Client 2	Client 3	Duration / reps
1	Push-ups	Bodyweight squats	Ab curls	30 seconds
2	Bodyweight squats	Ab curls	Push-ups	30 seconds
3	Ab curls	Push-ups	Bodyweight squats	30 seconds
4	Rest	Rest	Rest	30 seconds
Repeat 1–4				
5	Bent over row	DB shoulder press	Rest	12 reps
6	DB shoulder press	Rest	Bent over row	12 reps
7	Rest	Bent over row	DB shoulder press	12 reps
Repeat 5–7				
8	Battle rope slams	Burpees	Shuttle runs	30 seconds
9	Burpees	Shuttle runs	Battle rope slams	30 seconds
10	Shuttle runs	Battle rope slams	Burpees	30 seconds
11	Rest	Rest	Rest	2 minutes
Repeat 8–11				
12	Medicine ball wood chops	Plank	Rest	12 reps (plank lasts as long as it takes for client to complete 12 reps)
13	Plank	Rest	Medicine ball wood chops	12 reps
14	Rest	Medicine ball wood chops	Plank	12 reps
15	V-sits	Leg raises	Rest	12 reps
16	Leg raises	Rest	V-sits	12 reps
17	Rest	V-sits	Leg raises	12 reps
Repeat 12–17				

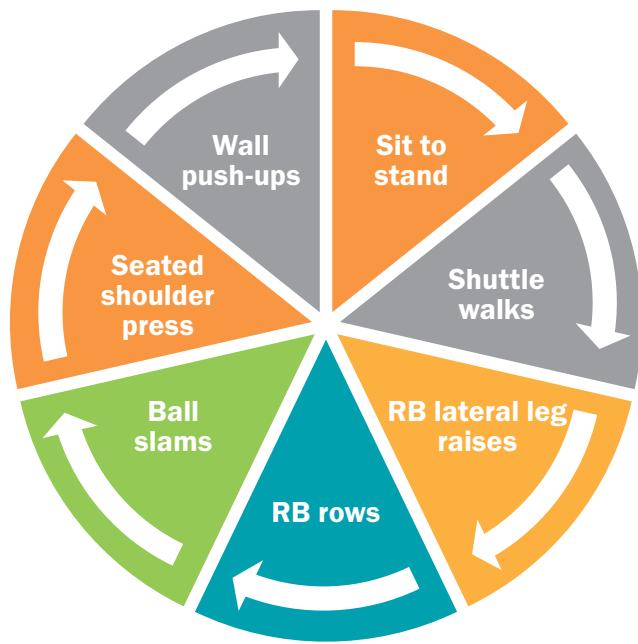
## Group training in alternative environments (general fitness)

#	Client 1	Client 2	Client 3	Duration / reps
1	Tree sprints	Bench band row	Bench push-ups	30 seconds
2	Bench band row	Bench push-ups	Tree sprints	30 seconds
3	Bench push-ups	Tree sprints	Bench band row	30 seconds
4	Rest	Rest	Rest	60 seconds
Repeat 1–4				
5	Burpees	Bodyweight squats	Bench full plank	30 seconds
6	Bodyweight squats	Bench full plank	Burpees	30 seconds
7	Bench full plank	Burpee	Bodyweight squats	30 seconds
8	Rest	Rest	Rest	60 seconds
Repeat 5–7				
9	Steps running	Steps mountain climbers	Band wood chops	30 seconds
10	Steps mountain climbers	Band wood chops	Steps running	30 seconds
11	Band wood chops	Steps running	Steps mountain climbers	30 seconds
12	Rest	Rest	Rest	60 seconds
Repeat 8–11				
13	15-minute fartlek running as a group.  Use landmarks, e.g. lamp posts, street corners, trees, etc. to work at various intensities for various durations. If the fitness of clients varies, send the more advanced clients through a more intense session, e.g. doubling up on distances, looping back, etc.			

## Older adult circuit

30 seconds on each station, with 60 seconds rest between each exercise. Repeat x3.

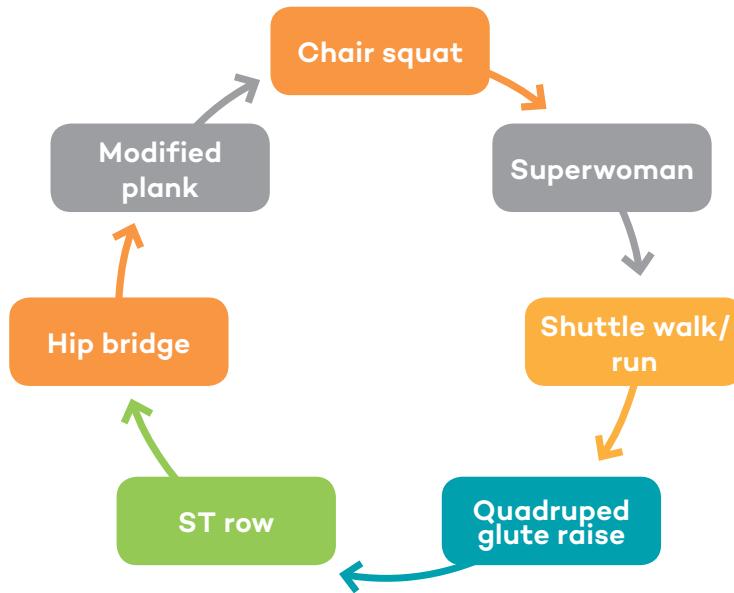
Please note that this is designed for older adults who have a lower level of general fitness, including functional movement. Many older adults would be more than comfortable attending a generic group exercise session.



## Pre- and postnatal circuit

30 seconds on each station, with 60 seconds rest between each exercise. Repeat x3.

Please note that it is important to consider the stage of pregnancy of the group, their general fitness levels and if there have been any complications during the pregnancy. If there is any doubt about the safety of exercise, it is important to refer any clients considered at risk to another appropriately qualified health or fitness professional.



*Exercise library for exercising in alternative environments.*

**BAND BEACH BENT OVER ROW**



**START ►**



**FINISH ■**

**BAND PUSH UP BEACH**



**START ►**



**FINISH ■**

**BEACH BURPEE**



**START ►**



**MIDDLE >>**



**FINISH ■**

**BENCH BAND ROW**



**START ►**



**FINISH ■**

*Exercise library for exercising in alternative environments.***BENCH PRESS UP****START ►****FINISH ■****SIDEWAYS RUNNING****SLING SYSTEM WOODCHOP****START ►****FINISH ■****STAIR CRAWL****START ►****MIDDLE ➤****FINISH ■**

*Exercise library for exercising in alternative environments.*

**STAIR MOUNTAIN CLIMBERS**



**STAIR PRESS UP (ROTATE)**



**START ►**

**MIDDLE ➤**

**FINISH ■**

**STAIR PRESS UP**



**START ►**

**FINISH ■**

**STAIR RUNNING**



*Exercise library for exercising in alternative environments.***STAIR SQUAT****FINISH ■****START ▶****TREE SPRINTS****START ▶****FINISH ■**

## Matching client needs to specific group personal training sessions

It can be a daunting experience when embarking on something new and, in this situation, clients with a goal based around making a change to their health and wellbeing may feel overwhelmed, or even confused, with so many options to choose from. It is important that personal trainers are aware of how they can support clients in finding group training that is suitable for them and their needs.

Find out:

- What the client's main goal is.
- What activities they have enjoyed in the past.
- What intensity they are looking to work out at.

ACTIVITY	Match the following client profiles to one or more group training sessions that would suit their needs and goals.
Client 1	<p>Wants to get fit for a 100-mile charity bike ride. Enjoys cycling, swimming and running. Is not so keen on dance-based exercise. They would like to make the most of their time when exercising and work towards their goal.</p> <p><b>Group exercise session/s:</b></p>
Client 2	<p>Wants to lower stress levels, and to improve overall wellbeing and posture. In the past, they have enjoyed pilates classes, but want something that will help them move better while also improving their strength and endurance.</p> <p><b>Group exercise session/s:</b></p>
Client 3	<p>Hates machines, enjoys the great outdoors and loves to be pushed hard when exercising. They have always maintained a good level of fitness but would also like to develop some social connections while exercising.</p> <p><b>Group exercise session/s:</b></p>

## Notes

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