



# CAMBRIDGE Health and Movement Science

Stage 6 Year 11

Gareth Hawgood  
Rachel James  
Andrew Ponsen



Shaftesbury Road, Cambridge CB2 8EA, United Kingdom  
One Liberty Plaza, 20th Floor, New York, NY 10006, USA  
477 Williamstown Road, Port Melbourne, VIC 3207, Australia  
314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India  
103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

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## About the authors



### Gareth Hawgood

Gareth is currently Head of PDHPE at Hunter Valley Grammar School in Maitland. He has been a specialist PDHPE teacher for 27 years, working in both primary and secondary schools. He has co-authored an HSC Study Guide for PDHPE and is a long-term member of ACHPER and PDHPETA. As an educator he is keen to see students achieve their personal best and to develop a love and passion for lifelong movement.



### Rachel James

Rachel James, BA (Human Movement), Grad Dip Ed is a PDHPE teacher with more than 15 years of experience and has been a contributing author on multiple published PDHPE textbooks. She has led curriculum programming across all secondary stages, including adapting these for online and BYOD learning. She is the Head of Sport at William Carey Christian School and is the long standing secretary to the CSSA Committee of Management, which consists of over 80 schools. Rachel is passionate about curriculum and is leading program and resource development for the implementation of Health and Movement Science at WCCS.

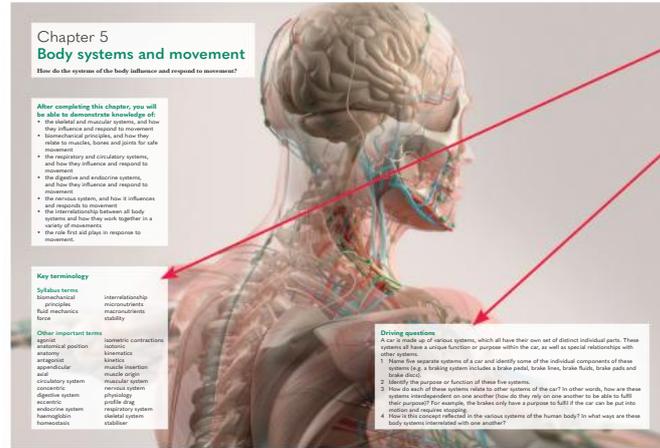


### Andrew Ponsen

Andrew Ponsen, BA Teaching (BA HPE) (Hons) is currently Director of Active Learning and Lead Educator (PDHPE) at St Philip's Christian College (Newcastle Campus). He has over 20 years of experience as a specialist PDHPE teacher across junior, middle and senior years, and has coached a range of individual and team sports. He is passionate about helping students develop a deep value of lifelong health, facilitating movement opportunities that lead to holistic and meaningful athletic development and strives to help all students achieve their academic potential. He has extensive experience in HSC marking, and has co-authored the Cambridge PDHPE Textbooks and Checkpoints Study Guide.

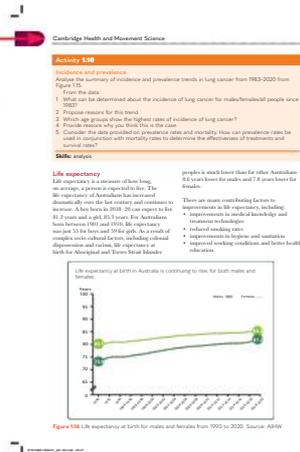
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# How to use this resource



Chapter openers include a list of **key terminology**, and some **driving questions** to introduce the topic.

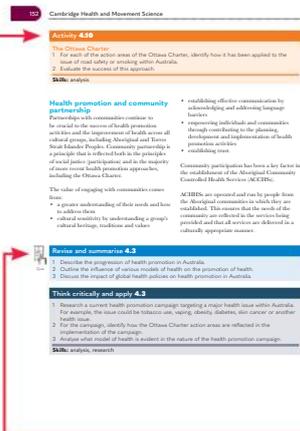
A variety of **Activities** encourage engagement with the content and the skills that underpin the syllabus (collaboration, analysis, communication, creative thinking, problem-solving and research). The skills addressed in the activity are listed at the end of the activity.



As required by the syllabus, **Practical applications** and **Case studies** are integrated throughout the chapters. The skills addressed are listed at the end.



At the end of each chapter subsection, you can check your recall and understanding of the material by completing an autemarked **Quiz** in the Interactive textbook, as well as a set of **Revise and summarise** questions, which you can answer in your notebook or in the Interactive Textbook platform.



The **Revise and summarise** is followed by a **Think critically and apply** activity, which encourages you to engage more deeply with the content. The skills addressed are listed at the end.

**Chapter 7 Acquiring, developing and improving movement skills**

**Thinking of feedback: consequence (instant) or delayed feedback**

**Knowledge of results (KR) or knowledge of performance (KP) feedback**

**Revise and summarise 7A**

**Think critically and apply 7A**

**Research skills 7B**

The Revise and summarise is followed by a **Think critically and apply** activity, which encourages you to engage more deeply with the content. The skills addressed are listed at the end.

Another syllabus requirement is to complete two depth studies and a collaborative investigation. Throughout the book, the authors have included icons to indicate activities, case studies, and general content, that they feel could be meaningfully extended into a depth study or collaborative investigation.

**Chapter 5 Study systems and movement**

**5.3 The respiratory and circulatory systems**

**Respiratory system**

**Structure and function**

**Figure 5.46** Structure of the respiratory system

**Figure 5.47** Tubes in the respiratory system

Where appropriate, **videos** have been included in the Interactive Textbook. These can also be accessed directly from the print book by scanning the **QR code**.

**Chapter 1 Understanding and measuring Australian health**

**Chapter summary**

**Multiple-choice questions**

**Exam-style questions**

Each chapter finishes with a **summary**, a set of **multiple-choice questions** and some **exam style questions**. The Interactive Textbook also includes a **Scorchers challenge** at the end of each chapter.

# Introduction

## To the student

Congratulations on choosing the Cambridge Year 11 Health and Movement Science textbook. This textbook has been written to meet the requirements of the current Stage 6 Health and Movement Science Syllabus in New South Wales. It also aims to make your life easier by following the syllabus and providing relevant activities that will prepare you for the actual HSC examination.

Health and Movement Science has evolved from the previous PDHPE syllabus. Students who study Health and Movement Science enjoy a challenging yet rewarding subject and gain knowledge that will benefit them as athletes, professionals and people, now and into the future.

Health and Movement Science allows you to explore your own health and the health of Australians and to develop an understanding of social justice. It explores the issues that can contribute to improved performance, for you personally or within a guiding role such as coach, personal trainer, PDHPE teacher or health professional.

This book is a comprehensive resource that extends on the knowledge and skills introduced in the compulsory Stage 4 and 5 course. It covers all content areas of the Year 11 course.

You will discover a wealth of engaging material that critically examines the focus areas of Health for Individuals and Communities and The Body and Mind in Motion. You will gain an insight into various issues with relevant and engaging activities, case studies, practical applications and research tasks. The revision and application questions at the end of each chapter section, and the exam-style questions in each chapter, will give you the best opportunity to succeed in your exam. There is also support material for the Depth studies and Collaborative Investigation, which are new components in the Health and Movement Science syllabus.

Good luck in your studies and we hope you enjoy Year 11 Health and Movement Science!

Gareth Hawgood

# Health for individuals and communities



<b>Chapter</b>
Chapter 1: Understanding and measuring Australia's health
Chapter 2: Young people's meanings of health
Chapter 3: Key health issues that affect young people
Chapter 4: Developing and promoting young people's health

# Chapter 1

## Understanding and measuring Australia's health

### After completing this chapter, you will be able to demonstrate knowledge of:

- the meanings of health and the reasons that people give different meanings
- the dynamic nature of health including:
  - dimensions and how they interact
  - good health as a concept
  - the health continuum
  - changes over time
  - how health is affected by circumstances
- epidemiology as a way of explaining the health status of Australians
- social justice principles and their role in health status
- determinants of health and their role in the health status of Australia.

### Key terminology

#### Syllabus terms

Aboriginal and/or Torres Strait Islander Peoples  
community  
culturally and linguistically diverse populations  
culture  
determinants of health  
dimensions of health  
disability  
diversity

drugs  
environmental factors  
epidemiology  
equality  
equity  
health  
health behaviours  
health literacy  
health status  
incidence  
infant mortality  
interrelationship

life expectancy  
Medicare  
morbidity  
mortality  
older people  
personal biomedical factors  
physical activity  
prevalence  
salutogenic model of health  
social justice principles

social model of health  
socio-economic factors  
sociological causes  
Sustainable Development Goals (SDGs)  
World Health Organization (WHO)

#### Other important terms

Australian Bureau of Statistics (ABS)

Australian Institute of Health and Welfare (AIHW)

COVID-19  
dynamic health  
multidimensional health

multimorbidity  
relative health



### Driving questions

- 1 Who is the healthiest young person you know and who is the healthiest older person you know? Why do you consider them to be healthy? How did this assessment of health change when you considered a younger person and an older person?
- 2 If you were to take 10 adults and rank them in order of most to least unhealthy, what criteria would you use to decide this?
- 3 Compare how health is measured by individuals and governments. Do these measurements apply equally to the physical, mental/emotional and social dimensions of health?
- 4 How healthy do you think Australians are in comparison to the rest of the world?
- 5 What are the most pressing health issues in Australia today? How does this differ for different age groups and population groups?
- 6 To what degree do you think health is solely the responsibility of the individual?
- 7 What are the most powerful forces that seem to influence a person's ability to maintain good health?

# Introduction

Health is important. It impacts every area of life from the ability to perform daily tasks and maintain healthy relationships to the ability to pursue goals and experience a high quality of life. Health is multifaceted and complex and influenced by countless different factors.

It is a valuable resource essential for the sound functioning of a nation.

Australia is known for having relatively good health outcomes, but like any country, there are still health disparities and challenges that exist.

## 1.1 Meanings of health

### Learning objective 1.1

COMPARE the meanings of health  
EXPLAIN the reasons why people give different meanings to health

The meaning that people and organisations have attributed to the word ‘health’ has changed significantly over time.

### Historical meanings of health

Prior to the twentieth century, health was viewed as the body’s normal state of function; that is, the opposite of illness. This simple, one-dimensional view of health reflected the experience of health

at the time as a somewhat fragile physical state, easily disrupted by infectious disease, injury and inadequate nutrition.

While people had some understanding of anatomy, little was known about the transmission of disease and environmental hygiene. In the 1800s, infectious diseases such as cholera, smallpox, influenza and scarlet fever were major causes of death and disease, and the transmission of disease was largely understood as a matter of inherited susceptibility, ‘bad air’, anger or abrupt changes of temperature.

Limited medication was available and treatments relied heavily on a ‘change of air’ and various

methods, such as bleeding by cup or the use of leeches, to clear ‘impurities’ from the body. Major breakthroughs in the understanding of environmental hygiene in the mid-1800s and scientific and technological advancements in the early 1900s led to an increase in the knowledge of biomedical science and significantly greater control of infectious diseases. With greater control of infectious diseases and a greater understanding of their cause and treatment, life expectancy began to increase.



**Figure 1.1** A surgeon letting blood from a woman’s arm

## Modern meanings of health

With continued developments in the health sciences, especially in the area of mental health, there came increased recognition that the current definition of health as the absence of disease was inadequate. This narrow definition failed to take into account an individual's social, mental or spiritual wellbeing.

## World Health Organization

In 1946, this changing perception of health was encapsulated in the World Health Organization's (WHO) definition of health as: 'A state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity'. This innovative view of health acknowledged that health was more than just a physical state, but also incorporated a person's mind, their social interactions and emotional and spiritual wellbeing.

From this point, the understanding of health continued to evolve. It is now widely accepted that health is multidimensional, dynamic and relative, and is influenced by a broad range of factors.

## Australian Institute of Health and Welfare

One of the key bodies who monitor and evaluate the health of Australians is the **Australian Institute of Health and Welfare (AIHW)**. The meaning the AIHW attributes to health is modelled largely on the WHO definition and reflects the many influencing factors that interact to either strengthen or weaken an individual's level of health. It provides a comprehensive evaluation of the health of Australians in its 18th biennial report *Australia's Health 2022* based on a broad range of health indicators.

The report includes two publications – *Australia's Health 2022: In Brief* and *Australia's Health 2022: Data Insights* – as well as topic summary web pages and an overview video. They examine a range of influencing factors on health.

## Australian Institute of Health and Welfare (AIHW)

Australia's national independent agency on health and welfare data. AIHW provides information and statistics to inform and support policies and decision-making within health and welfare



Video 1.1 Australia's health 2022



Figure 1.2 Australia's Health 2022: In Brief and Australia's Health 2022: Data Insights

## Activity 1.1

### Australia's health

Go to the Australia's Health Snapshot website (<https://cambridge.edu.au/redirect/10278>).

- 1 Summarise the definition of health provided by the AIHW.
- 2 What measures are used to assess a population's level of health?
- 3 How do these measures create a picture of health?

**Skills:** analysis

## Why do meanings of health vary?

Aside from the technical definitions and statistical measures of health, the meanings that people attribute to health can vary greatly. Some people's focus may be on the physical dimension of health, and they consider being healthy to mean being physically fit, strong and free from illness. For someone who has a physical disability, their view may be significantly different, and they may place more of an emphasis on their mental health and their ability to function socially and maintain strong emotional health. These varying views of health reflect the idea that health is relative to each individual and their social context and is widely influenced by a number of different elements.

### relative health

the concept that an individual's level of health is determined in reference to others or to their own level of health at another time

The concept of **relative health** refers to the idea that a person evaluates their level of health in reference to others or to their own level of health at another time. Individuals' experiences of life are varied and these varied experiences are what shape their understanding and idea of

what it means to be healthy. Personality, past experiences of illness and injury, interactions with others, education, cultural background and religious views all play a role in a person's perception of health.

For example:

- a young man diagnosed with schizophrenia may describe his level of health as good because with the help of medication and physical activity, his psychotic episodes are under control. Yet, another person who has never experienced a mental illness may not consider this a good level of health.
- An 80-year-old man may consider himself to have a high level of health even though he needs a walking frame to get around. Given he still has an active mind and a degree of physical independence he may be comparing himself to those who are of a similar age but are confined to a nursing home or suffering dementia.
- A young woman with cystic fibrosis may consider herself to have a good level of health as she is able to manage her illness with the use of a home nebuliser, allowing her to maintain full-time work and play netball. However, others may see the fact that she must spend up to 1.5 hours every day on the nebuliser and take up to 30 tablets a day as a sign of a low level of health.

Although there may be variations in people's views on the meaning of health, it is widely accepted that health is a valuable resource and a major determinant in our quality of life.



Quiz

## Revise and summarise 1.1

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 In your own words, write a definition of health.
- 2 Explain why different people give different meanings to health.



**Figure 1.3** The meaning of health varies from individual to individual.

### Think critically and apply 1.1

- 1 As a class, compose a series of questions to be used to interview a variety of different people about their views on health. Your questions should aim to get an understanding of:
  - the individual's current definition of health
  - whether this view has changed over the past 10 years
  - whether they hold a different standard of health for others than for themselves
  - any other areas that you may find interesting.
- 2 Using these questions, interview three different people from a variety of ages and backgrounds.
- 3 Write a summary of your findings, highlighting any interesting differences between your three subjects.
- 4 Compare your findings with others in the class. Try to group the interviewees by age, gender, or other similarities in demographics.
- 5 Analyse your findings. Identify any similarities, differences and patterns among similar demographics.
- 6 Can you explain any of the similarities? Discuss this as a class.

**Skills:** collaboration, analysis, communication

## 1.2 Dynamic nature of health

### Learning objective 1.2

EXPLAIN the dynamic nature of health, including:

- dimensions and how they interact
- good health as a concept
- health continuum
- changes over time
- how health is affected by circumstances

Conversely, some changes may have a positive impact on social and mental health. For example, being selected for a sporting team, getting a new job or receiving a good result in an assessment that required a lot of effort can provide great encouragement, boost emotional health and improve confidence.

While some changes may be abrupt, generally fluctuations in health are slow and gradual. For example, a middle-aged man who used to play rugby, train frequently, eat well and have an active social life now has a young family and a job that is challenging and requires long hours. These changes in circumstance, while not negative in themselves, have led to some lifestyle changes that are negatively impacting his health. Lack of exercise, increased consumption of convenience foods and higher levels of stress have led to increased weight gain and the first stages of cardiovascular disease.

### Dimensions of health

One of the major aspects of WHO's definition of health that set it apart from previous definitions of health was that it presented health as a holistic concept, encapsulating all aspects of an individual. It is now widely recognised that health is **multidimensional** and that those dimensions interrelate to produce a level of health that is both relative and dynamic.

#### dynamic health

the concept that an individual's level of health is not fixed but rather constantly changing

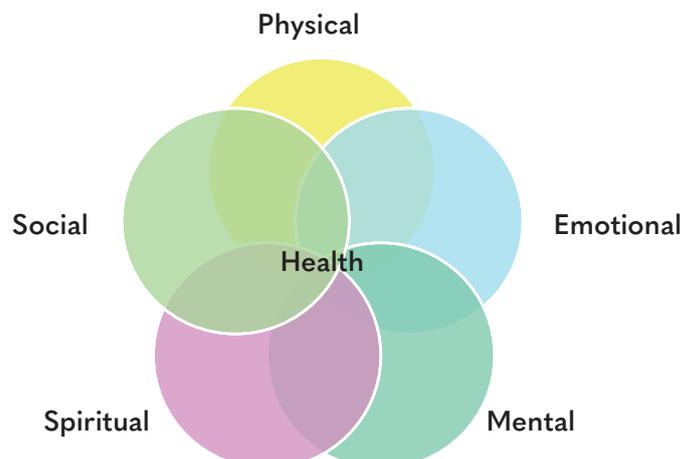
#### multidimensional health

health consisting of more than one dimension, incorporating the physical, mental, spiritual, emotional and social dimensions

As well as being relative, our health is **dynamic**; that is, it is in a constant state of fluctuation.

We may experience changes to our level of health from minute to minute, day to day or year to year. Changes to our level of health can occur suddenly, such as an injury, or slowly, such as the gradual development of a disease. These fluctuations are not just limited to the physical dimensions of health but can occur in all dimensions.

Dramatic changes in life circumstances or a traumatic event like the death of a loved one can have a significant impact on a person's emotional or mental health, as can a relationship breakdown, a rejection from a job application or receiving a bad result in an assessment.



**Figure 1.4** The dimensions of health

The dimensions of health include:

- Physical health:
  - refers to the biological functioning of the body
  - includes the normal functioning of organs such as the heart, liver and lungs, and the absence of disease.
  - is the product of factors such as nutrition, physical activity, fitness and physical capabilities.
- Social health:
  - is the ability to interact with others in a manner deemed acceptable by society
  - incorporates our relationships with others on all levels, including our ability to communicate our thoughts, feelings and emotions with others and our capacity to develop and maintain quality relationships, while retaining our own identity and individuality
  - varies significantly from person to person due to differences in personality.
- Mental and emotional health:
  - are often indistinguishable and relate to an individual's ability to understand their emotions, cope with everyday problems and handle stress in a non-destructive way
  - includes the notion that good mental and emotional health includes a strong sense of self-identity and the ability to cope well with changes and challenges.
- Spiritual health:
  - is closely linked with the sense that someone has of their place within the world
  - varies significantly from person to person. For some it may mean having a deeper sense of purpose and direction in life, while for others it may mean having a strong connection with a higher order
  - encompasses religious beliefs, social conscience and a sense of morality.

The dimensions of health are very closely connected, and a change in one dimension

will almost certainly lead to changes in other dimensions. For example, consider a student in Year 11 who plays representative football breaking their leg in an awkward tackle and having to wear a cast for six weeks. Aside from the physical pain associated with the break, the student will feel the impact of the injury in many other areas of their life. For example, due to the lack of mobility, they may find it difficult to participate in many social events, leading to a sense of isolation from their peers. They may find it more difficult to move around school and to concentrate in class due to pain and the awkwardness of the cast, resulting in lower grades at school. They may feel frustration at missing out on a significant portion of the football season and begin to feel excluded from their teammates. Also, their self-identity may be challenged as they evaluate who they are as someone without football. Alternatively, their religious views may be strengthened, as they have more time for reflection and contemplation of their place in life.

### The concept of good health

While there may be variations in the meaning that people give to health, it is widely accepted that good health is a valuable resource.

To the individual, good health means an improved quality of life, including less sickness and disability, a happier family and social existence, and the opportunity to make choices in work and recreation.

To the community, good health means a higher standard of living, greater participation in making and implementing community health policies, and reducing healthcare costs.

But what does good health actually mean? As we learned earlier, the meanings that people attribute to health are relative and so therefore is the concept of good health. The concept of good health is relative to individual circumstances and stage of life.

## Activity 1.2

### Good health

1 For each of the following people, infer what you think good health would mean to them.



2 Why do you think there are differences in the way they may perceive good health?

3 Debate: You cannot compare people's level of health.

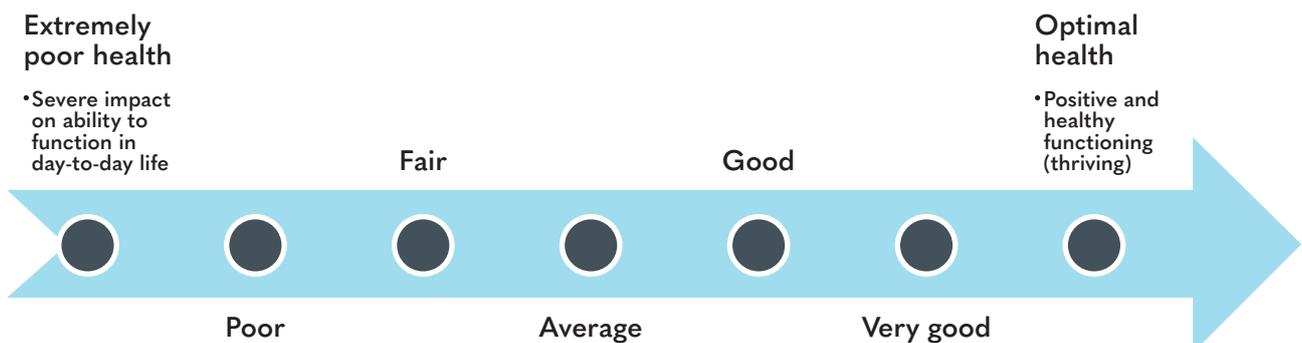
- Within your class, divide into three groups. Allocate one group as the affirmative team, one as negative and the third group as the adjudicators.
- Determine the number of speakers and assign speakers within each group. Groups prepare arguments for the affirmative and negative speakers. Adjudicators create a list of criteria they will use to judge the debate. This may include research.
- Conduct the debate. Adjudicators provide feedback.

**Skills:** collaboration, analysis, communication

## The health continuum

The idea of viewing our health on a continuum, with optimum health at one end and poor health at the other, can help us to understand its relative

and dynamic nature. Judging where we fit on the continuum at any one point in time is highly subjective and is the product of many varying factors.



**Figure 1.5** The continuum of health

### Activity 1.3

#### Health continuum

- Where would you place the following people on the continuum of health? Justify your answers.
  - Mia is a 45-year-old female who was diagnosed with breast cancer one year ago. Since her diagnosis she has undergone a mastectomy and is currently undergoing chemotherapy. She has lost all of her hair but seems to be responding well to the treatment. She is a strong Christian and has a positive outlook on life. Her family and friends are supportive of her in her situation.
  - Emily is a 23-year-old university student. She is very athletic and active. She has a large group of friends and is quite close to her family. Emily is bulimic and is quite preoccupied with her body weight and shape, and with controlling her food intake. Emily does not consider her bulimia to be a problem as her episodes of bingeing and purging occur only a couple of times a week.
  - Sascha is a 48-year-old computer consultant. They gave up smoking seven years ago. They are jovial and have many friends. Sascha is overweight and enjoys good food and wine when out socialising with friends. They are committed to their family and make spending time with their kids a priority. Sascha tries to exercise regularly.
  - Juan is lean and appears quite muscular. He is 29 and has smoked since he was 17. He works in an office and does very little exercise apart from the odd handyman job around the house. He played football every season until he was 23 and still looks fit. He has two children with whom he has little involvement and a wife with whom he frequently argues.
  - Ada is 27 and was made a quadriplegic in a car accident six years ago. She has no movement or sensation from the neck down and is bound to a wheelchair for life. She relies on her husband to do most things for her. After a period of severe depression and a lot of work with a counsellor, Ada has accepted her situation and is working on being content. She has learnt to paint and write with her mouth and is currently writing and illustrating a children's book.
- Using one of the above characters as an example, explain the relative and dynamic nature of health.
- Draw a timeline that represents your life. On the timeline plot your level of health, identifying any major setbacks that may have impacted your health (e.g. broken leg, death in the family).
- Using a specific example from your life, describe the interactions between the dimensions of health.

**Skills:** analysis

### Health over time

While we may experience significant life changes that can impact our health drastically and abruptly, many of the changes to our health occur slowly over time. As we experience different events and grow and develop we will experience changes in our mental and social health. This, combined with the physical ageing of our bodies and the possible development of things like lifestyle diseases can produce significant but gradual changes in our health.

For many older Australians these changes may go largely unnoticed. Changes in lifestyle



**Figure 1.6** The meaning that we attribute to health changes over time.

and increasing time pressures from things like family and work may limit the opportunity they have for exercise, or the preparation of healthy balanced meals. Increased snacking and consumption of convenience foods may also contribute to weight gain. Changes in social situations, work and lifestyle may also contribute to a lack of exercise and the establishment of some unhealthy habits.

For example, imagine a man in his early 40s, who used to play football on a regular basis and exercise several times a week, but is no longer as active as he used to be. Having children and promotions at work have led to less available time to exercise and an increase in stress leading to an increased consumption of snack foods, sugar and alcohol. He has gradually been gaining weight over the last few years and now has a waistline that places him in the overweight category.

## Activity 1.4

### Life changes

- 1 Create a timeline of potential major life changes (such as leaving school and entering full-time employment) and the lifestyle changes they may bring about.
- 2 For each change, identify the various health issues that could develop as a result.
- 3 For each major life change, identify a way that the negative impact could be reduced.

**Skills:** problem-solving

## NEWS REPORT

### Is gaining weight as you age inevitable?

Sarah Berry

*Sydney Morning Herald*, October 3, 2019

After turning 20, the average adult puts on between a half and a whole kilogram of weight each year.

Of course, many people become more sedentary with age and time pressures at work can mean we are more likely to turn towards energy-dense, nutrient-poor fast foods. But does middle-aged spread happen among those who don't change their diet or fitness habits?

New research from the Karolinska Institute in Sweden has found the rate at

which we store and remove lipids (fat) from our fat cells slows with age, which could explain why losing weight in middle age is less likely than gaining it.

The small study, published in the journal *Nature Medicine*, followed two groups: the first, which consisted of 54 men and women, for an average of 13 years; and the second, which consisted of 41 "morbidly obese" women who underwent bariatric surgery, for an average of five years.

The lipid turnover rate slowed among all participants with age, but some gained weight, some lost weight and some remained the same. Thus, researchers concluded it was not the lipid turnover rate that made the difference in their weight, but whether or not they adapted their lifestyle accordingly.

Researchers found those who didn't reduce their energy intake, improve the composition of their diet or increase their exercise output gained an average of 20 per cent of their body weight over the period in which they were studied.

Other factors influence our weight as we age, adds Professor Julie Byles, director of the Research Centre for Generational Health and Ageing at the University of Newcastle.

In a report published last year, Professor Byles and her colleagues noted there has been a rapid increase in the weight of women as they age. "Women are heavier in their 50s than in their 40s, and younger generations will be heavier than their mother's (and grandmother's) generations."

This is partly to do with social circumstances as well as lifestyle factors.

"Stress and life stage also played a role," Professor Byles explains. "Diet, physical activity and sitting are important health behaviours. However just telling people to exercise and eat better ignores the complexity of the factors that promote obesity, and is not likely to be effective across the population.

"We also need to pay attention to the social circumstances, and to the

broader social, physical and economic environment."

Given obesity is an issue affecting a growing number of the world's population (numbers have tripled over the past 30 years), understanding the processes at play is important, according to the Swedish researchers.

Although weight gain as we age is multifactorial and complex, and public health policies are needed to support and educate people, it is not inescapable, agrees Professor Peter Clifton of the Nutrition School of Pharmacy and Medical Sciences at the University of South Australia.

What we do does make a difference, regardless of our fat turnover rate or metabolism.

"Everything slows as we age so I am not surprised lipid removal did as well," he says, adding: "It is not inevitable we will put on weight as we age – we just need to reduce caloric intake and not store lipids."

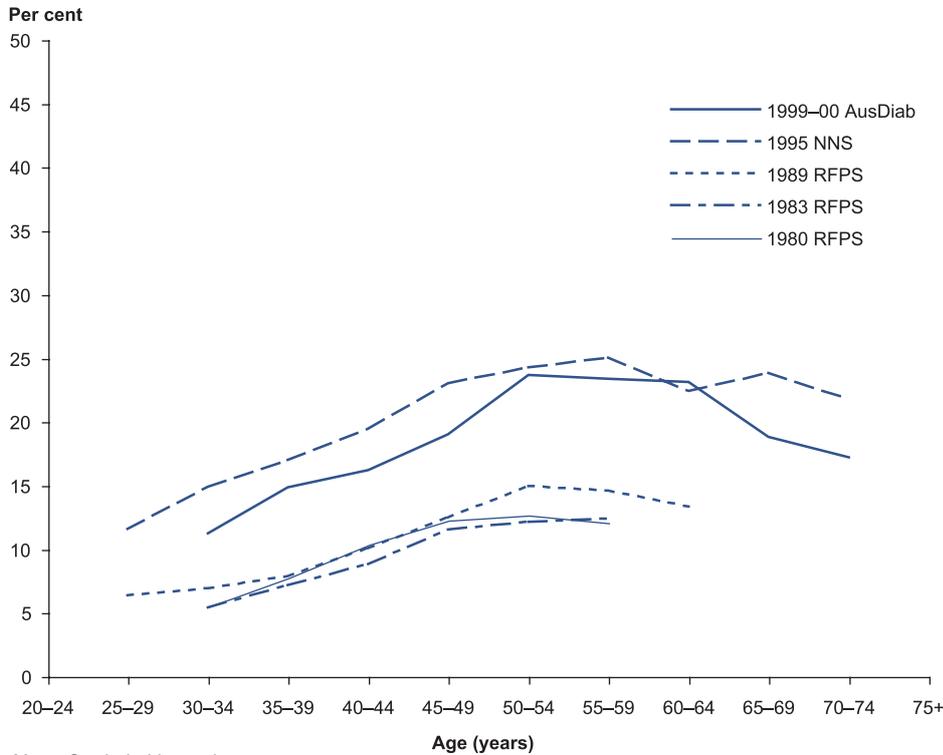
We do this through good nutrition and moving actively into old age, Clifton says: "Exercise will burn more lipids and stop accumulation in fat."



**Figure 1.7** Increasing exercise is only one of the factors that influences our weight as we age.

The following graphs come from an AIHW bulletin in 2004, and show obesity across the adult life span for men (Figure 1.8) and women (Figure 1.9). The data comes from the 1999-2000

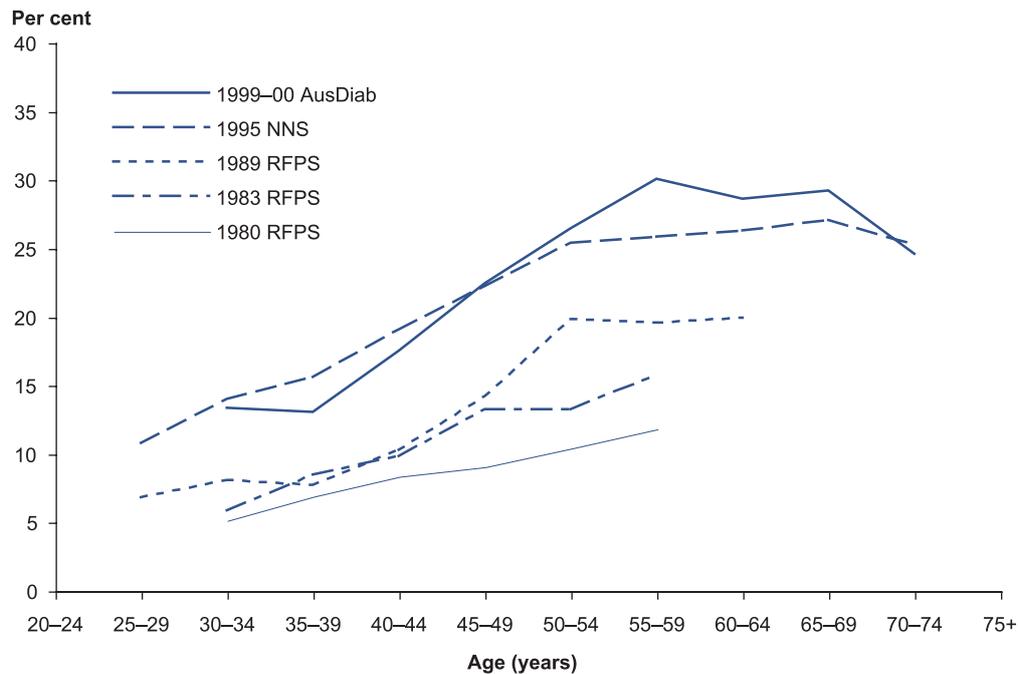
Australian Diabetes, Obesity and Lifestyle Study (AusDiab), the 1995 National Nutrition Survey (NNS) and the 1980, 1983 and 1989 Risk Factor Prevalence Surveys (RFPS).



Note: Capital cities only.

Sources: AIHW analysis of the 1980, 1983 and 1989 Risk Factor Prevalence Surveys; 1995 National Nutrition Survey; 1999-2000 Australian Diabetes, Obesity and Lifestyle Study (AusDiab).

Figure 1.8 Obesity across the adult life span, men, 1980 to 2000.



Note: Capital cities only.

Sources: AIHW analysis of the 1980, 1983 and 1989 Risk Factor Prevalence Surveys; 1995 National Nutrition Survey; 1999-2000 Australian Diabetes, Obesity and Lifestyle Study (AusDiab).

Figure 1.9 Obesity across the adult life span, women, 1980 to 2000.

## Activity 1.5

### Weight gain and obesity in older Australians

Read the article 'Is gaining weight as you age inevitable?' and perform the following tasks:

- 1 Identify the trends in weight gain and obesity in older Australians.
- 2 Create a mind map that illustrates the factors that lead to weight gain in older Australians.
- 3 Analyse the implications for the Australian healthcare system if the trend of increasing overweight and obese older Australians continues.
- 4 Create a poster or a brochure that could be distributed at a doctor's clinic that proposes some realistic and positive changes that older Australians could make to reduce their risk of weight gain as they age.

**Skills:** analysis, creative thinking

## Effect of individual circumstances on health

Your individual life circumstances can have a significant impact on health. Your surroundings, both physical, social, cultural and political, can not only influence your understanding of health but also directly affect all dimensions of health.

Physical and geographical surroundings can shape the dimensions of health. Having direct access to good sanitation, fresh clean water, fresh food and medical assistance provides a greater chance of achieving good health. In contrast, living in an area with political unrest and war, where access to medical assistance is limited and basic facilities like plumbing are inadequate, can have a negative effect on an individual's physical and mental health. Your location can also have a direct impact on your education and employment opportunities. For example, living in a remote community may result in limited opportunities and choice in relation to schools, tertiary education and employment opportunities.

Social circumstances can also influence your health. The presence of an established support network can assist in maintaining good mental, emotional, social and spiritual health. Having people to turn to for advice and assistance when needed can be extremely valuable in difficult circumstances. Conversely, changes in

social circumstances could also be the cause of some negative health. For example, a teenager whose parents are going through a divorce may struggle with depression or anxiety due to the pressure and tension within the family as they undergo this significant change. Friendship breakdown is another example of a change in circumstance that may lead to a negative health impact.

Financial circumstances have been shown to have a direct correlation with an individual's level of health. Low socio-economic groups are generally found to have lower levels of health. Low income can limit access to health services due to limited choices. For example, in Australia not being able to afford private health insurance means complete reliance on the public system which may involve longer waiting periods for treatment. In some other countries, the limitation of choices may be even more severe.

Resilience is the ability to bounce back after a difficult situation and may be something that is developed and strengthened as the result of a change in circumstance. For example, a young person who experiences a trauma such as a car accident may take a while to deal with the physical and emotional injuries sustained, but may come through with an increased appreciation for the opportunities they have.



Quiz

## Revise and summarise 1.2

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Explain the dynamic nature of health.
- 2 Outline the dimensions of health.
- 3 What is the continuum of health?
- 4 Provide an example of how the dimensions of health influence each other.
- 5 How does health change over time?
- 6 How can an individual's circumstances affect their health?

## Think critically and apply 1.2

Consider the following statement:

*You can be healthy without being physically active.*

For either the affirmative or negative view of the statement, construct an argument that you could use to convince someone who holds the opposite view to you, to change their mind. You can do this by writing an essay, creating a short video or recording a short podcast.

**Skills:** communication



**Figure 1.10** The presence of an established support network can assist in maintaining good mental, emotional, social and spiritual health.

## 1.3 Epidemiology and the health status of Australians

### Learning objective 1.3

DISCUSS how epidemiology is used to explain the health status of Australians

To establish a health profile for a population and its subgroups, various data need to be collected and compiled. This data collection is known as epidemiology: the study of health and disease in a population and subgroups over a period of time.

Epidemiology provides vital information for Australian governments and health organisations by showing the patterns of health and disease as well as the use of health services by the population in which they operate. Epidemiology is able to show trends in the prevalence (number of cases of disease in a population at a specific time) and incidence (number of new cases of disease in a population) of disease. It also provides insight into the apparent causes or determinants of disease.

### Activity 1.6

#### Epidemiologists

Watch Video 1.2.

- 1 What are the different areas of research that each of the epidemiologists is involved in?
- 2 What sorts of tasks do they perform as part of their role?
- 3 What is the importance of epidemiology in disease control and prevention?

**Skills:** analysis



**Video 1.2**  
What do epidemiologists do?

### Use of epidemiology

Epidemiology allows public health researchers, governments, health organisations, manufacturers of health products and professionals delivering health services to compare and contrast patterns of health in a population at different points in time and among different subgroups within a population. This allows those using epidemiological data to:

- identify health issues that may be specific to a particular group or area
- identify areas of inequity between population groups
- gain an overall picture of the health status of a population group or community
- allocate resources to effectively address specific health needs
- evaluate programs aimed at addressing illness and disease to gauge their effectiveness
- identify behaviours that may be contributing to the development of disease and take steps to change those behaviours
- promote behaviours that have a positive impact on the health status of the population.

Items commonly measured in epidemiology include:

- rate of births
- rate of deaths
- disease incidence
- injury incidence
- disease prevalence
- disability level
- financial cost
- use of hospitals and other medical services
- work days lost.

Health indicators are also used in epidemiological studies, including:

- vital statistics – illness, death, life expectancy
- population surveys – used to compare future and past data
- surveillance – data that can be monitored and reported – for example, by the National Injury Surveillance Unit
- health outcomes – change in health due to intervention – for example, prevention, diagnosis and treatment.

## Is everything about health status measured?

While epidemiology provides valuable data on health and disease trends in a population, it is important to acknowledge the limitations of such data. Epidemiology is limited in the following areas:

### Australian Bureau of Statistics (ABS)

Australia's national statistical agency that gathers and analyses statistics in a broad range of areas including economic, social, population and environmental statistics

- providing an accurate representation of the inequalities in health status between population subgroups
- providing reasons why these inequalities exist
- providing a measure of the impact a disease or injury can have on quality of life
- measuring the impact that sociocultural, environmental, socio-economic and individual determinants have on health.

Limitations in methods of data collection also exist, which can be due to:

- an insufficient sample size being used
- the unreliability of data, due to factors such as self-reporting
- whether or not standard measures are used
- multiple sources of information.

The **Australian Bureau of Statistics (ABS)** is a key body in the collection and analysis of data within Australia in relation to a broad range of topics, including health status. The data on health are collected through a variety of different mediums,

including vital statistics, population surveys, surveillance and the measure of health outcomes. Due to its gathering of information from such a broad range of sources, the ABS is generally able to create an accurate picture of the health of the nation.

## Statistics used in epidemiology

Statistics that are commonly used in epidemiology include mortality (death) rates, infant mortality, morbidity, and the incidence and prevalence of disease.



**Figure 1.11** Epidemiology provides valuable data on health and disease trends in a population, but it is important to acknowledge the limitations.

## Activity 1.7

### The Australian Bureau of Statistics

Go to the ABS website (<https://cambridge.edu.au/redirect/10279>) and look at the statistics menu page.

- 1 What kind of health-related information does the ABS collect?
- 2 What are the most recently produced reports on health from the ABS?
- 3 Find an example of how statistics from the ABS have been used by a government or non-governmental agency.
- 4 The integrity of the data collected by the ABS is of the utmost importance. Read the extract, on the following page, from the ABS website concerning the collection of data for the National Health Survey (NHS).
- 5 Describe the concerns that the ABS has about the collection of the data from the 2021–20 NHS.
- 6 The report *AIHW Australia's Health 2022* frequently refers to data from 2020, 2019 and earlier. Propose reasons for this.

**Skills:** research

Because of the impact of **COVID-19**, the ABS has issued an advisory notice about recent statistics collected:

#### *Impact of COVID-19 on survey estimates*

The 2020–21 NHS data should be considered a break in time series from previous NHS collections and used for point-in-time national analysis only. The survey was collected during the COVID-19 pandemic, which significantly changed the data collection. To maintain the safety of survey respondents and ABS Interviewers, it was collected via an online, self-complete form. Non-response is usually reduced through Interviewer follow up of households who have not responded. As this was not possible, there were lower response rates than previous NHS cycles, which impacted sample representativeness for some sub-populations. Comparisons to previous health data over time are not possible.

In addition to the changes resulting from the pandemic and data collection via an online form, there were a number of other changes made to the 2020–21 NHS. This survey had a planned change to sample design and only nationally representative estimates are available – State and Territory estimates have not been produced. There have also been various changes to content, question modules, instrument design and output data items as detailed in Summary of content changes. This includes the exclusion of medications data being collected directly from respondents and a revision to the classification of long-term health conditions (refer to Health conditions for more details). Information on people's medication usage is provided via Pharmaceutical Benefits Scheme (PBS) data linkage.

Australian Bureau of Statistics,  
*National Health Survey: First Results  
Methodology*, 21 March 2022

## Mortality

The mortality rate means the number of deaths from a specific cause or in a specific population over a period of time (usually one year). Mortality

is a straightforward epidemiological measure that can be used to determine the major causes of death in a given population and the trends in causes of death; it can also be used to compare the causes of death across age, gender, time period and other population subgroups.

Recent statistics taken from ABS and AIHW reports indicate the following information:

- There were 171,469 deaths in 2021.
- The majority of these deaths were people aged 75 or above (66% in 2017).
- In every age group from 0–84 years there were more male deaths than female deaths.
- The leading cause of death in 2021 was ischaemic heart disease.
- Dementia, including Alzheimers disease was the second leading cause of death.
- Cerebrovascular disease, lung cancer and chronic lower respiratory disease round out the top five causes of death for 2021.
- Chronic disease accounts for more deaths in people aged 45 and over, while the major causes of death in people aged 1–44 are from external sources such as accidental poisoning, drowning, transport accidents and suicide.

From 2012 to 2021:

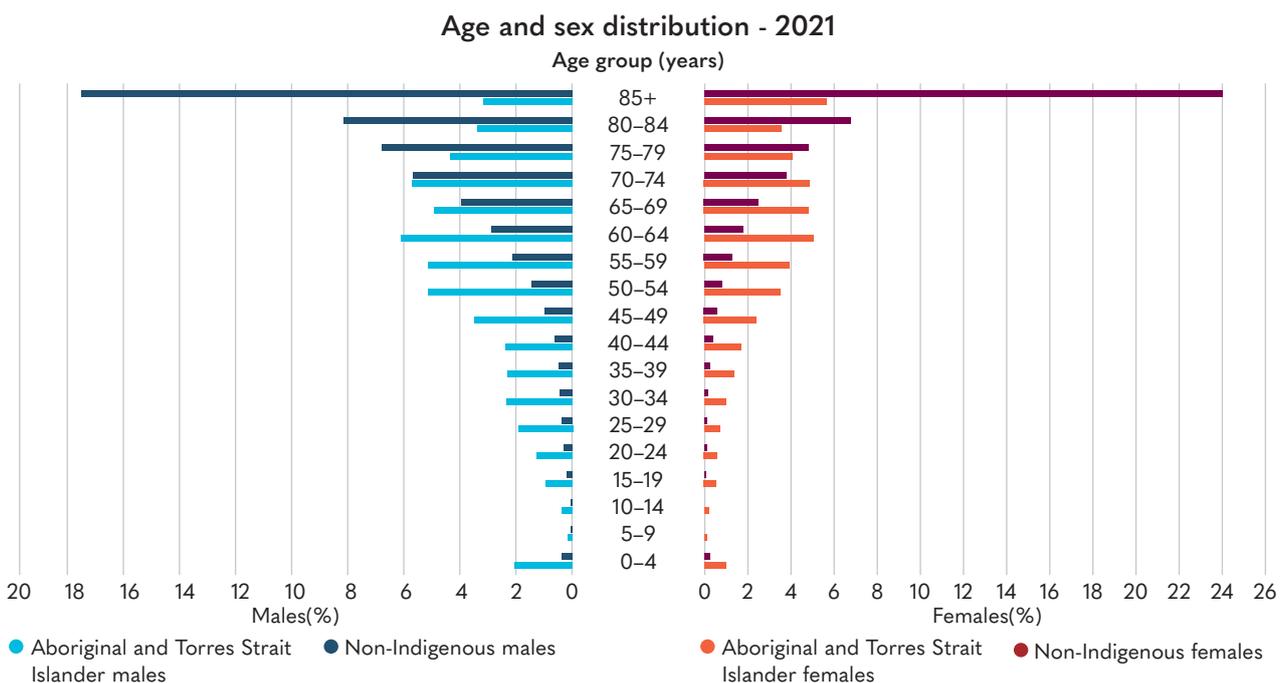
- Deaths due to ischaemic heart diseases and cerebrovascular diseases decreased by 13.8% and 9.1%, respectively.
- Deaths due to dementia, including Alzheimer's disease, increased by 53.8% (5573 deaths). As can be seen in Figure 1.12, the main causes of death vary between age groups.
- In the period of 2008–21, Indigenous death rates decreased in all age groups, however, as a result of complex sociocultural factors, including colonial dispossession and racism, and as can be seen in Figure 1.13 they still remain higher than other Australians in all age groups.

Once major causes of mortality have been identified, then factors that contribute to these deaths can be identified and addressed and thus improve the health status of Australians.

**COVID-19**  
**CO**rona**VI**rus  
**D**isease 2019.  
An infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which was first identified in Wuhan, China, in December 2019. It spread globally, and on 11 March 2020 the World Health Organization declared the outbreak to be a pandemic.

Age group (years)	Rank				
	1st	2nd	3rd	4th	5th
Under 1	Perinatal and congenital conditions	Other ill-defined causes	Sudden infant death syndrome	Selected metabolic disorders	Accidental threats to breathing
1-14	Land transport accidents	Perinatal and congenital conditions	Brain cancer	Other ill-defined causes	Suicide
15-24	Suicide	Land transport accidents	Accidental poisoning	Other ill-defined causes	Assault
25-44	Suicide	Accidental poisoning	Land transport accidents	Coronary heart disease	Other ill-defined causes
45-64	Coronary heart disease	Lung cancer	Suicide	Colorectal cancer	Liver disease
65-74	Lung cancer	Coronary heart disease	Chronic obstructive pulmonary disease	Colorectal cancer	Cerebrovascular disease
75-84	Coronary heart disease	Dementia incl. Alzheimer's disease	Lung cancer	Cerebrovascular disease	Chronic obstructive pulmonary disease
85-94	Dementia incl. Alzheimer's disease	Coronary heart disease	Cerebrovascular disease	Chronic obstructive pulmonary disease	Diabetes
95+	Dementia incl. Alzheimer's disease	Coronary heart disease	Cerebrovascular disease	Heart failure	Influenza and pneumonia

**Figure 1.12** Leading underlying cause of death in Australia by age group, 2018–20. Source: AIHW – *Deaths in Australia*



**Figure 1.13** Age and sex distribution of death rates for Indigenous and non-Indigenous Australians 2021. Source: ABS

## Activity 1.8

### Mortality

- 1 Describe the main differences that are evident in the causes of death between those under 44 and those over the age of 44.
- 2 Discuss how this data could be used in reducing mortality rates in each age group.
- 3 What does the spread of mortality rates among Indigenous Australians when compared to other Australians tell us?

**Skills:** analysis

### Infant mortality

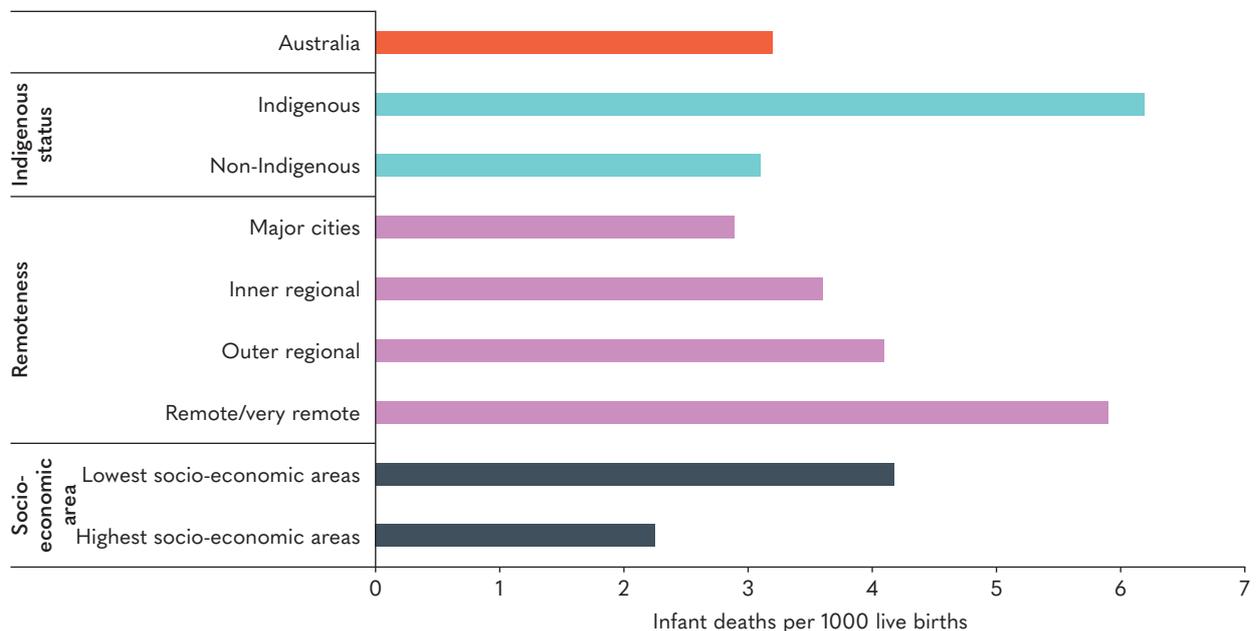
The infant mortality rate is the number of deaths in the first year of life per 1000 live births. It is commonly viewed as an important indicator of the general health and wellbeing of a population, and has a large influence on life expectancy at birth. A high infant mortality rate lowers life expectancy, while a low infant mortality rate contributes to increased life expectancy. This rate is continuing to decline in Australia: in 2001 it was 5.3, compared with 3.8 in 2011 and 3.3 in 2022. While Australia has one of the lowest infant mortality rates in the world, there are still some groups that experience inequality in this area.

As can be seen in Figure 1.14, infant mortality rates are higher among Indigenous Australians, remote and very remote Australians, and people from the lowest socio-economic areas. First Nations health disparities in Australia stem from various complex factors. The Lowitja

Institute acknowledges the influence of negative sociocultural forces like racism and colonial dispossession, which perpetuate poverty among First Nations people. Although statistics show that these gaps are decreasing, there is still much room for improvement.

Global infant mortality rates have also seen an improvement, decreasing from an estimated rate of 65 deaths per 1000 live births in 1990 to 35 deaths per 1000 live births in 2012 and then a continued decrease to 27 deaths per 1000 live births in 2020. This decline can be attributed to:

- improved education about antenatal and postnatal care
- improved support services for newborn babies and births
- improved sanitation
- improved technology
- improved diagnosis and treatment of illness
- immunisation programs.



**Figure 1.14** Infant and child deaths by selected population groups. Source: AIHW

## Case study 1.1

### Perinatal care for First Nations mothers

As Figure 1.14 showed, there are higher rates of infant mortality among First Nations babies than non-Indigenous babies. There is a greater risk of these babies being born preterm, underweight or needing special care: in 2019, 13% of Indigenous babies were born underweight AIHW. One of the Closing the Gap targets is to improve these outcomes, and an important area of focus is improved care during pregnancy, with an emphasis on Indigenous-led, community-based solutions, including the engagement of First Nations midwives.

A paper published in 2021 for the official journal of the Australian College of Midwives argued for improving care for First Nations women from the start of their pregnancies through to the first year of the baby's life. Dr Yvette Roe, one of the co-authors, and a Njikená Jawuru woman involved in Indigenous health research at Charles Darwin University, emphasised the importance of local solutions, developed with the engagement of local people who understand the context and history of the community.

A program near Brisbane found that pre-term births reduced by 50% once expectant mothers started following the 'Birthing on Country' model, which advocates for culturally appropriate and holistic Aboriginal maternity care.

Meanwhile, in Galiwinku, in the Northern Territory, local women received training to become doulas, so they could support women giving birth in their communities.



#### Video 1.3

An Aboriginal midwife program works to close the gap in infant mortality and birth complications.



**Video 1.3** An Aboriginal midwife program works to close the gap in infant mortality and birth complications. (Use the QR code to watch video.)

**Case study 1.1** *continued*

In Australia, about 10% of all mothers have a midwife throughout their pregnancy, but the rate has typically been much lower for mothers of First Nations babies.

The Baggarook program, established by Latrobe University and the Victorian Aboriginal Community Controlled Health Organisation, matches women giving birth to Indigenous babies to midwives who are either First Nations themselves, or who have undertaken cultural awareness training. The relationship with the midwife begins early in the pregnancy, and extends to the first days of the baby's life. La Trobe University professor Helen McLachlan said that women feel more trust in this system. There are a number of reasons why First Nations women may have felt a lack of trust in the system prior to engaging with this program, including:

- children have historically been removed from their mothers/families at hospitals at the time of birth
- language and communication differences, including Aboriginal English
- few First Nations midwives are medical professionals.

Three hospitals were involved in the study – The Royal Women's Hospital, the Mercy Hospital for Women and Joan Kirner Women's and Children's Hospital – which look after about 20% of First Nations babies born in Victoria. Storm Henry, one of the midwives working in the program at the Royal Women's Hospital in Melbourne, said:

**As an Aboriginal midwife, it's really nice to work with Aboriginal families. I get some of the challenges that they might face accessing the hospital and I also know how integral the mums and babies are to our healthy communities.**

Storm Henry, quoted in Nicole Asher, 'Aboriginal midwife program works to close the gap in infant mortality and birth complications', *ABC News*, 6 May 2022

The program has been very well received, to the extent that it cannot keep up with the demand, and some families have missed out. Those involved would like to see the program expanded, and also extended beyond these three hospitals. Professor McLachlan said:

**We want the other eighty per cent of women to get access to this culturally safe model of care, which we know is associated with better outcomes.**

Helen McLachlan, quoted in Nicole Asher, 'Aboriginal midwife program works to close the gap in infant mortality and birth complications', *ABC News*, 6 May 2022

- 1 Discuss the importance of a program like Baggarook in supporting Indigenous mothers experiencing inequities as a result of complex sociocultural factors, including colonial dispossession and racism.
- 2 Discuss the benefits of extending the program more widely across NSW and Australia.

**Skills:** analysis

**Activity 1.9****Infant mortality**

- 1 Research and explain why there is such a significant difference in the infant mortality rates between:
  - a Australians from higher socio-economic areas and those from lower socio-economic areas.
  - b Australians living in cities and those living in rural and remote areas.
- 2 Identify the major determinants that contribute to child mortality rates.

## Morbidity

Morbidity (sickness) refers to trends in illness, injury and disease that do not result in death in a specific population. The main morbidity measures used are prevalence and incidence data, which can give a much broader picture of Australia's health than mortality rates. Morbidity measures include:

- **Health surveys and reports.** One of these is the National Health Survey conducted by the ABS. It provides data on a range of health information and indicators. A limitation of health survey data is that it is often reliant on individuals self-reporting their health status.
- **Hospitalisation data** (number and cause of admissions to hospital). The cause of hospital admissions provides information on the patterns of serious health problems that need medical treatment (such as heart attacks). It does not accurately reflect trends in illnesses that do not require treatment and the impacts on quality of life associated with these conditions.
- **Medicare statistics.** These provide valuable data on the number of days absent from work, the reason or cause of visits to health-care providers registered with Medicare and the number of visits attended. These data do not always reflect ill-health – for example, they include visits to doctors for check-ups. Visits to some health professionals (e.g. those working in private practice) for ill-health are also not accurately reflected in these data, as these visits are often not covered by Medicare.
- **Disability and handicap.** These are measures of the level of disability experienced by people as the result of a particular illness or injury.

## Multimorbidity

**Multimorbidity** is the presence of two or more chronic conditions in the one person at the one time. For example, someone with diabetes may also have high

blood pressure, be obese and have coronary heart disease. Multimorbidity can create challenges for health professionals in terms of treatment and management of conditions and can have a significant impact on a person's quality of life. For example, during the COVID-19 pandemic, patients with existing cardiorespiratory conditions were at a greater risk of infection and often experienced the disease more severely. These risk factors increased with the number of chronic conditions that were present and required medical practitioners to take an individual approach to their treatment and management. Multimorbidity can also pose challenges for establishing the major cause of death.

## Incidence

Incidence is an important measure used in epidemiology and in the analysis of morbidity. Incidence is the number of new cases of a disease in a population during a specific time period. Incidence is helpful in determining:

- patterns of an illness in a population over a given time period
- the effectiveness of control measures such as vaccinations and health promotion campaigns
- the probability of a person being diagnosed with a particular illness during a particular period of time.

## Prevalence

Prevalence is another of the main measures used in analysing morbidity. Prevalence is the number of cases of a specific disease in a population at a specific time. This data can be used to:

- determine the extent of the health issue within a population
- identify priority health issues within population groups
- compare the health status of population groups to determine inequities
- compare the prevalence rates of certain illnesses across various time periods.

**multimorbidity**  
the presence of more than one disease or medical condition in a person

Select cancer site/type: Lung cancer  
 Select sex: (All)  
 Legend: Males (blue), Females (green), Persons (orange)

New cancer cases diagnosed  
 Select year: 2023

Figure 1: Age-standardised rates by sex, 1982 to 2023  
 Lung cancer  
 Select age-standardised rate: 2001 Australian Standard P...

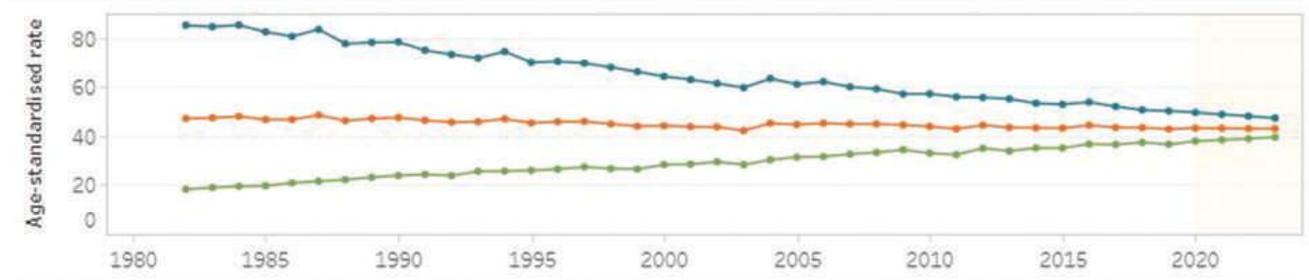


Figure 2: Age-specific rates by sex and age group, 2023  
 Lung cancer

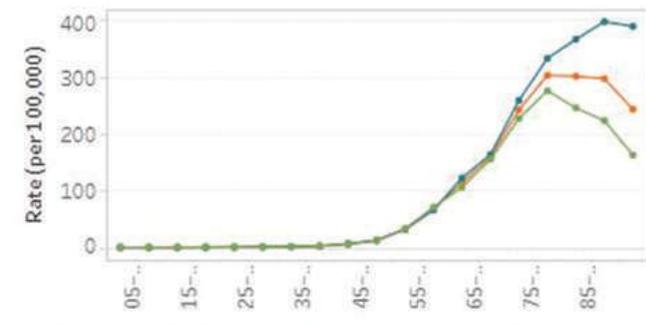


Table 1: Projected incidence statistics by sex, 2023  
 Lung cancer

	Males	Females	Persons
Number of new cases	7,696	7,086	14,782
Crude rate	59.0	53.4	56.2
ASR (2001 Australian Stand..)	47.2	39.4	42.9
ASR (2023 Australian popul..)	62.4	51.2	56.2
ASR (WHO Standard)	32.2	27.8	29.8
ASR (Segi Standard)	27.8	24.4	25.9

Rates are expressed as per 100,000 population.

### Survival and Prevalence

Figure 3: 5-year relative survival by sex, 1990-94 to 2015-19  
 Lung cancer

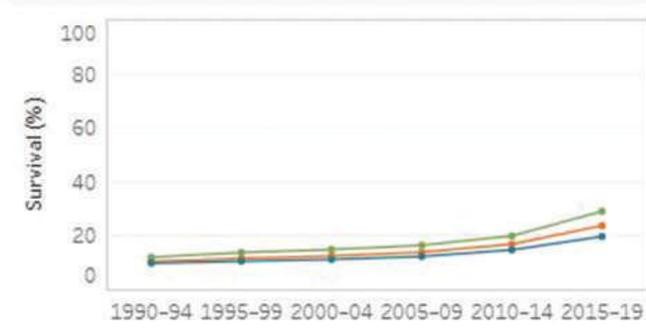


Figure 4: Prevalence by sex, as at 31 December 2018  
 Lung cancer

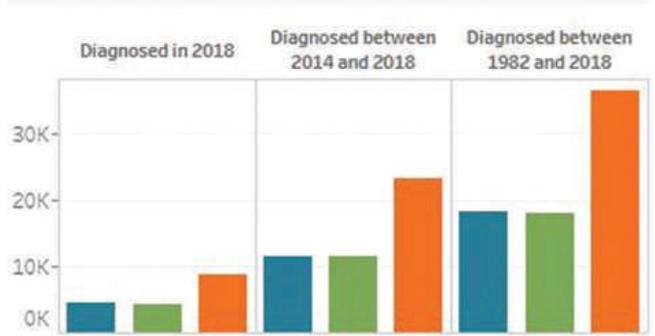


Figure 1.15 Summary of the incidence, survival and prevalence of lung cancer in Australia. These graphs come from the AIHW 'Cancer data in Australia' webpage (<https://cambridge.edu.au/redirect/10429>), which has an interactive tool that lets you adjust the settings to see graphs for different types of cancer.

## Activity 1.10

### Incidence and prevalence

Analyse the summary of incidence and prevalence trends in lung cancer from 1983–2020 from Figure 1.15.

From the data:

- 1 What can be determined about the incidence of lung cancer for males/females/all people since 1983?
- 2 Propose reasons for this trend.
- 3 Which age groups show the highest rates of incidence of lung cancer?
- 4 Provide reasons why you think this is the case.
- 5 Consider the data provided on prevalence rates and mortality. How can prevalence rates be used in conjunction with mortality rates to determine the effectiveness of treatments and survival rates?

**Skills:** analysis

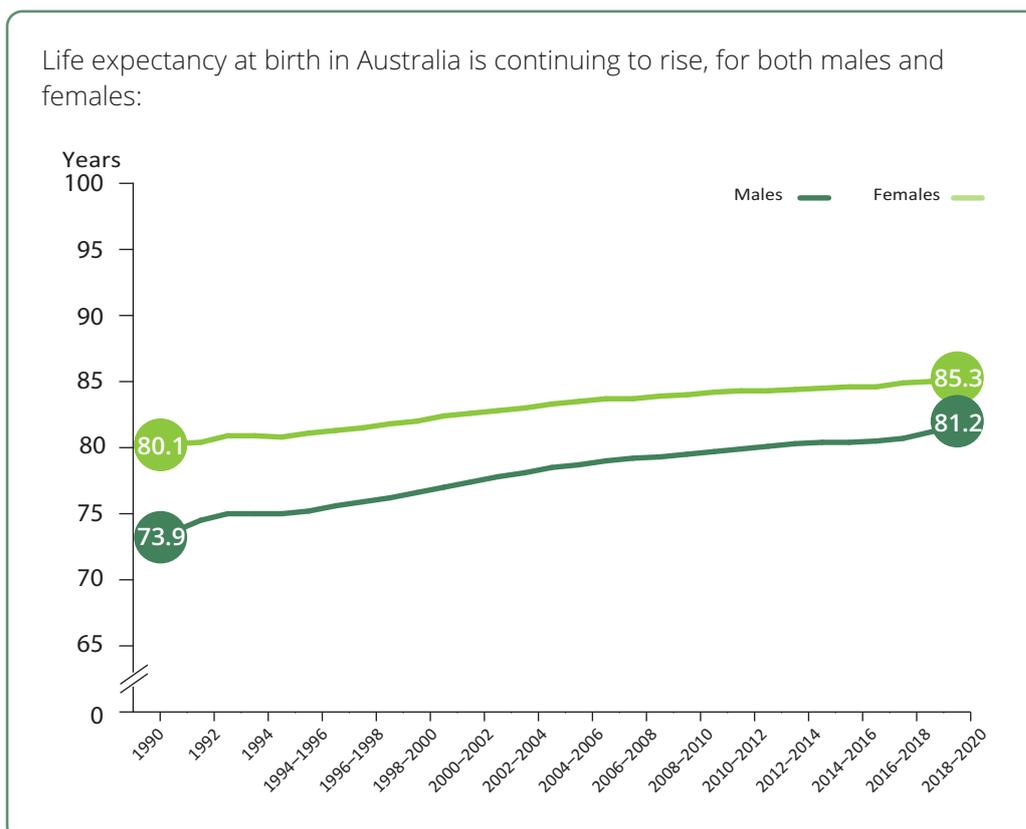
### Life expectancy

Life expectancy is a measure of how long, on average, a person is expected to live. The life expectancy of Australians has increased dramatically over the last century and continues to increase. A boy born in 2018–20 can expect to live 81.2 years and a girl, 85.3 years. For Australians born between 1901 and 1910, life expectancy was just 55 for boys and 59 for girls. As a result of complex sociocultural factors, including colonial dispossession and racism, life expectancy at birth for Aboriginal and Torres Strait Islander

peoples is much lower than for other Australians – 8.6 years lower for males and 7.8 years lower for females.

There are many contributing factors to improvements in life expectancy, including:

- improvements in medical knowledge and treatment technologies
- reduced smoking rates
- improvements in hygiene and sanitation
- improved working conditions and better health education.



**Figure 1.16** Life expectancy at birth for males and females from 1990 to 2020. Source: AIHW ISBN 978-1-108-95129-6 © Hawgood et al. 2024 Cambridge University Press & Assessment Photocopying is restricted under law and this material must not be transferred to another party.

## Practical application 1.1

### Epidemiology

As a class explore the Find an Expert page on the Australasian Epidemiological Association website (<https://cambridge.edu.au/redirect/10346>). What are the various areas of expertise represented?

For one of the areas of expertise, select one of the experts and investigate the work they are currently completing and any papers or articles they have completed. Discuss the application and importance of this work.

**Skills:** communication

## Case study 1.2

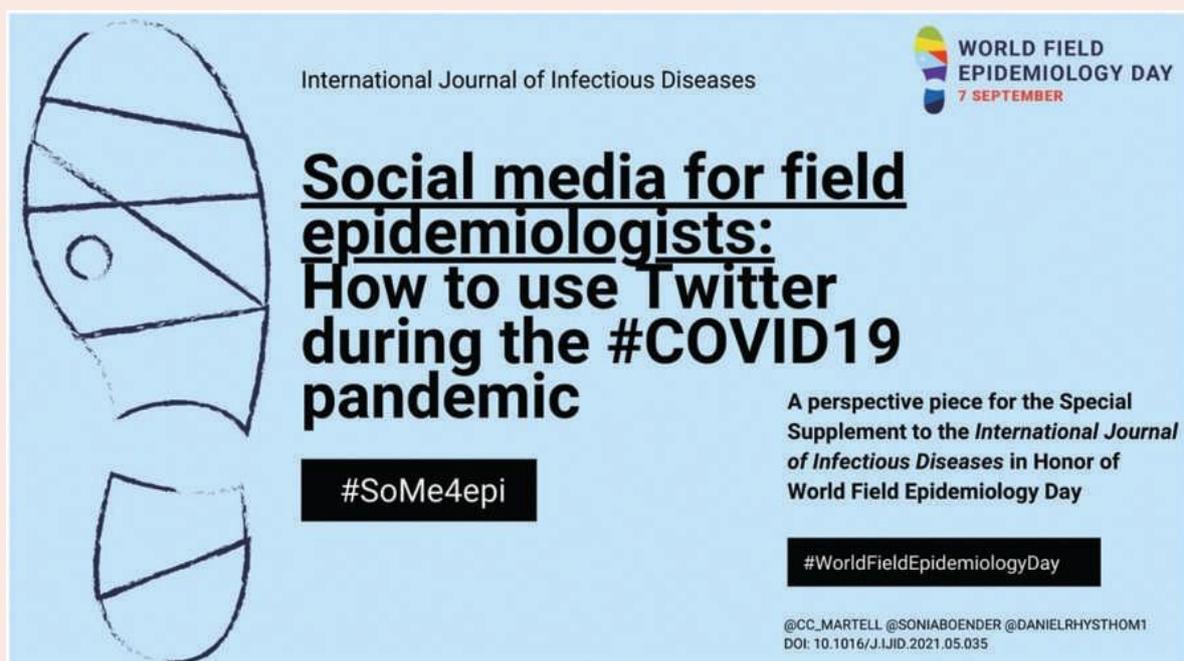
### The use of social media in epidemiology

Over recent years, the emergence of social media (e.g. Facebook, Twitter) has provided new and exciting avenues for epidemiologists and public health researchers to monitor outbreaks and the spread of diseases such as influenza and COVID-19.

These avenues are cost-effective, and are able to provide information far more quickly than more traditional methods such as hospital admission rates and health surveys. As the use of social media in epidemiology becomes more common and increasingly accurate, it has the potential to be a valuable tool for epidemiologists. The use of social media for epidemiology is not just limited to data collection but has also played a role in professional development, information distribution, science communication and public health advocacy. It has provided an important communication tool for the sharing of information and for networking.

Research the use of social media in public health surveillance, and do the following:

- 1 Outline the various forms of social media and how they are used.
- 2 Draw a timeline that shows the progress of the use of social media in epidemiology.
- 3 Describe how social media can be used to assist in health surveillance.
- 4 Analyse the effectiveness of social media in disease surveillance and epidemiology.



**Figure 1.17** During the pandemic, social media became an important tool for epidemiologists.

*continued*



Depth  
Study

Case study 1.2 *continued***Table 1.1** Summary of the uses of social media in public health surveillance

Application	Purpose and scenario	Public health information to retrieve, detect or predict	Data targeted	Function of social media	Examples
<b>1. Epidemiologic monitoring and surveillance</b>					
(a) Monitoring official information	To monitor official information	Disease incidence and other case details	Links to original sources of official data	News feed	Retrieval of official information via Weibo during the 2013 H7N9 outbreak
(b) Disease detection – syndromic surveillance	To detect outbreaks and to estimate disease incidence	Disease incidence and other case details	Self-reported symptoms	Syndromic surveillance	Twitter tweets of self-disclosed symptoms of influenza infection; self-reports of symptoms via specialised apps
(c) Disease detection – event-based surveillance	To detect outbreaks and to estimate disease incidence	Disease incidence and other case details	Media reports, unofficial information or rumours used as proxy measurable outcomes	Event-based surveillance (epidemic intelligence)	Unofficial information released on Weibo about an H7N9 patient; systems that pick up news related to health events (e.g. HealthMap)
(d) Timely estimates and forecasting of disease incidence	To provide timely estimates of current disease incidence or forecast future	Disease incidence start, peak and intensity	Social media text with keywords (diseases or symptoms) that correlate with disease incidence	As data sources for timely estimates or forecasts of disease incidence	US seasonal influenza estimates using Twitter data; disease estimation and forecasts using Wikipedia access log; US seasonal influenza forecast using Google Flu Trends

*continued*

Case study 1.2 continued

Application	Purpose and scenario	Public health information to retrieve, detect or predict	Data targeted	Function of social media	Examples
<b>2. Situational awareness</b>					
(a) <i>Surveillance for situational awareness</i>	Humanitarian crises, usually natural disasters (e.g. typhoons and earthquakes)	Reported needs (e.g. water supply and shelter)	Self-reported humanitarian needs	Information feed on humanitarian needs	Earthquake and tsunami in East Japan and earthquake in Haiti
<b>3. Communication surveillance</b>					
(a) <i>Global awareness</i>	To measure social media users' reactions to an outbreak situation	Media news reports, rumours, sentiments and awareness	User-generated data that reflect their knowledge, attitudes and perception of public health events	Monitoring of the general public's awareness and perception	Awareness of Ebola; sentiment towards influenza vaccine
(b) <i>Specific reactions</i>	To measure social media users' reactions to health promotion messages or events	Reception of particular public health messages	User-generated data that are reactions to particular public health messages	Monitoring of the general public's reaction to specific public health messages	Breast cancer awareness month

You could use these websites as a starting point for your research:

- <https://cambridge.edu.au/redirect/10282>
- <https://cambridge.edu.au/redirect/10283>
- <https://cambridge.edu.au/redirect/10284>

**Skills:** analysis, research



Quiz

### Revise and summarise 1.3

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 What is epidemiology?
- 2 What are the more common measures of epidemiology?
- 3 What is mortality?
- 4 What is infant mortality?
- 5 What is morbidity?
- 6 What is the difference between prevalence and incidence?
- 7 How do we use epidemiology to improve the health status of Australians?

### Think critically and apply 1.3

- 1 Analyse the importance of epidemiology in directing current government policies and the allocation of funding within Australia.
- 2 Evaluate the effectiveness of epidemiology in collecting accurate and reliable information.
- 3 Research and assess the role of epidemiology in monitoring and responding to the COVID-19 outbreak.



Depth Study

**Skills:** analysis, research



**Figure 1.18** Epidemiology is able to show trends in the prevalence and incidence of disease.

## 1.4 The role of social justice principles

### Learning objective 1.4

INVESTIGATE social justice principles and their role in health status:

- participation
- access
- equity
- rights

'The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition ...'

WHO Constitution

Social justice is the promotion of fundamental and universal human rights. Everyone has the basic human right to health, in addition to the rights to security, shelter, clothing, housing, medical care, social services and the resources necessary for health and wellbeing. However, the reality is that for a large proportion of the world's population, these basic rights are not upheld. Many health inequities exist within Australia and the rest of the world that are the result of the unequal distribution of income, goods, power, education and services, as well as the social and environmental circumstances in which people live. Social justice is concerned with addressing these inequalities and providing additional support to those who are in need.

The principles of social justice also reflect the fact that in order to achieve good health, communities and individuals must be able to have ownership over their own health and must be supported to achieve good health through empowerment and the provision of necessary resources and services.

The responsibility for good health is a shared one. Governments, organisations, communities and individuals all have a responsibility towards the achievement of good health. The WHO Commission on the Social Determinants of Health concluded that "the social conditions in which people are born, live and work are the single most important determinants of good health or ill health, of a long and productive life, or a short and miserable one". If communities and governments

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can provide the framework and necessary resources for the achievement of good health then individuals have a corresponding obligation to take personal responsibility for their health. The principles of social justice include participation, equity, access and rights (PEAR) and reflect this view.

### Participation

For individuals and communities to achieve good health they must be provided with opportunities to participate in decisions that relate to their health. Participation recognises the diversity that exists between population groups and is an effective way of ensuring that the specific needs of those groups are met. Enabling ownership of health decisions and input into the development of health policies ensures that differences in culture, religion, age, gender, sexuality, socio-economic status, history and language are not only acknowledged but also advocated for. In some instances, there may also be an element of distrust between those in governance and those experiencing disadvantage. By encouraging and facilitating ownership and involvement of representatives from those in disadvantaged groups, this trust can be addressed.

Participation has been one of the key factors in the Closing the Gap program to achieve health equality for Indigenous Australians. In the original Close the Gap Statement of Intent in 2008, the third statement of commitment was to participation:

'Accordingly we commit:

To ensuring the full participation of Aboriginal and Torres Strait Islander peoples and their representative bodies in all aspects of addressing their health needs'

Close the Gap Statement of Intent, 2008



Figure 1.19 Close the Gap Campaign

The importance of participation has been further highlighted by recent changes to the structure and management of the Closing the Gap campaign. Reviews of the implementation and progress of the campaign revealed the need for greater and more genuine partnerships between governments and Aboriginal and Torres Strait Islander peak organisations. As a result, the National Agreement on Closing the Gap was developed and came into effect in 2020. The National Agreement addresses all levels of government and seeks engagement across all levels of society. It emphasises the importance of First Nations people self-determining and driving their own outcomes, alongside governments. In response, each party to the National Agreement has developed their own implementation plan that outlines the actions that will be taken to achieve the outcomes of the agreement. These plans will undergo yearly review to determine effectiveness.

## Equity

Equity involves taking action to reduce the level of inequality in society. It seeks to ensure that resources are distributed in a way that gives all people the opportunity to achieve optimal health. In some cases, this may mean the allocation of more resources and support to a disadvantaged group in order to achieve fairness.

For example there are around 4.3 million Australians who have a disability that affects their ability to take part in everyday activities. The National Disability Insurance Scheme (NDIS) provides support and funding to those with a permanent and significant disability to enable them to fulfil their goals and potential and to lessen the impact of their disability on daily life.

Other national programs that aim to produce equity are Centrelink, Medicare and the Pharmaceutical Benefits Scheme.

## EQUALITY VERSUS EQUITY



In the first image, it is assumed that everyone will benefit from the same supports. They are being treated equally.



In the second image, individuals are given different supports to make it possible for them to have equal access to the game. They are being treated equitably.



In the third image, all three can see the game without any supports or accommodations because the cause of the inequity was addressed. The systemic barrier has been removed.

**Figure 1.20** Equality doesn't mean equity.

## Activity 1.11

### Equity

- 1 Research either Centrelink, Medicare or the Pharmaceutical Benefits Scheme and analyse how the program aims to achieve equity.
- 2 With reference to the cartoon in Figure 1.20, explain how equity cannot always be achieved through the equal distribution of resources.

**Skills:** analysis, research

### Access

This principle recognises the significant impact that access to basic necessities like fresh water, sanitation, food and health services has on the health of individuals and communities. Access should not be hindered by factors such as geographic location, language, socio-economic status and the availability of health services.

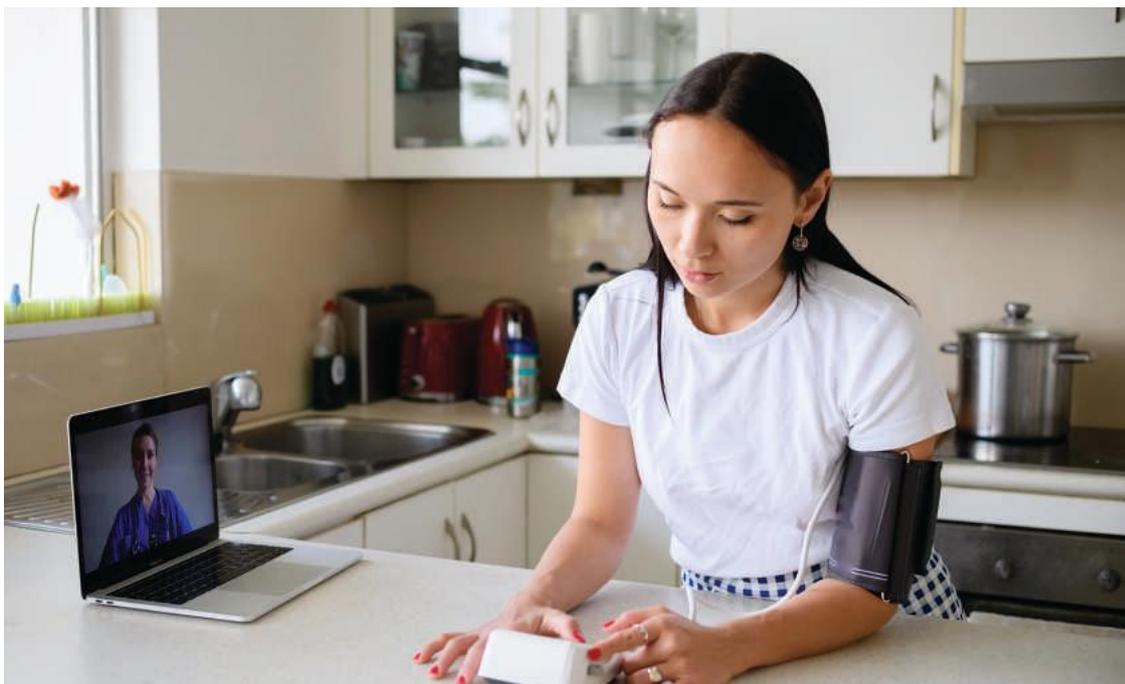
An example of this principle in action within Australia is the use of telehealth in rural and remote communities. Telehealth is a term that encompasses the use of various communication and information technologies to provide patients with care who may not otherwise be able to access these services or only do so with significant travel.

It enables access to services such as specialists, psychologists, support services and emergency support.

As well as being used in rural and remote areas, the use of telehealth in suburban areas has increased as a result of the COVID-19 pandemic. Telehealth was made available to all areas as a means to reduce the risk of transmission through face-to-face contact. Since the pandemic, use of telehealth for consultations has remained commonplace, increasing accessibility and convenience.

### Rights

Everyone has the basic human right to health, in addition to the rights to security, shelter, clothing, housing, medical care, social services and the resources necessary for health and wellbeing. But the reality is that for a large proportion of the world's population, these basic rights are not upheld. Social justice seeks to change this and to ensure that those disadvantaged individuals and groups are provided with the resources and support to take control of and improve their health.



**Figure 1.21** Telehealth in action



**Figure 1.22** Everyone has basic human rights, regardless of age, gender or background.

All levels of government within Australia have the responsibility of ensuring that human rights are protected. The government works to achieve this by introducing international human rights standards into domestic law. Reflected within the laws and policies of Australia are several international rights treaties to which Australia is a signatory. These include the Universal Declaration of Human Rights (UDHR), The UN Convention on the Rights of the Child and the Declaration of the Rights of Indigenous Peoples.

### The role of the social justice principles in promoting an individual and community's health status

When applied, the principles of social justice aim to achieve health equality for all individuals and communities. The principles reflect the right that everyone has to good health and recognise that some people are not able to achieve this as easily as others.

The principles provide an outline of the necessary elements to achieve good health for all.

Recognising these principles brings communities closer to ending discrimination by protecting all people's rights. It acknowledges the disadvantage that some people face and aims to address this disadvantage. Recognising the principles also encourages individuals and communities to be active participants in their health and to take responsibility in health-related matters. This provides an effective means to improve the health status of communities as the communities themselves have a unique and comprehensive understanding of their own needs and can best speak about them.

The principles of social justice work to ensure that all have access to the support and care that they need in a culturally appropriate manner. This once again reflects the idea that different people require different amounts of support and that support should be tailored to the needs of the communities and individuals.

If the principles are active and applied within society then good health for all is an attainable goal.

### Case Study 1.3

#### Waminda

Waminda is a holistic health service that addresses the needs of Aboriginal women and their families in the surrounding communities. The corporation focuses on empowering Aboriginal and Torres Strait Islander women to access health supports to improve all dimensions of their health. They achieve this through a range of programs that have been tailored to the needs of the local community, addressing a broad range of health issues.

The importance and success of Waminda and other First Nations-led health practices has been highlighted by a 2022 funding grant to the Birthing on Country program through which First Nations women will be supported with Aboriginal maternity models of care.

Explore the Waminda website (<https://cambridge.edu.au/redirect/10285>) and the blog post 'Strong Women, Strong Culture: Community Control Success Stories at Waminda' (<https://cambridge.edu.au/redirect/10345>) and answer the following questions:

- 1 Provide specific examples of how social and health inequities are being addressed by the programs at Waminda.
- 2 Examine how the dimensions of health are addressed by the programs offered at Waminda and provide examples.
- 3 Examine the Waminda model of care. Describe how the principles of social justice are reflected in the model of care.
- 4 What examples of collaboration with other agencies are evident in the way that Waminda is structured and funded and the way it runs its programs?

#### Participation

- 5 How does the Waminda health centre promote and support the participation of Aboriginal and Torres Strait Islander people in the service? Refer to the governance, management, running of the centre and further support.
- 6 Discuss the concept of self-determination and the importance of having the involvement of Aboriginal and Torres Strait Islander people in the running of the programs at Waminda.

#### Equity

- 7 Using one of Waminda's programs as an example, explain how the program works to achieve equity for Aboriginal and Torres Strait Islander women.

#### Access

- 8 Describe some of the barriers that First Nations women might face in accessing healthcare and other elements of care that they may require.
- 9 Using specific examples, describe how Waminda assists in overcoming these barriers.

#### Rights

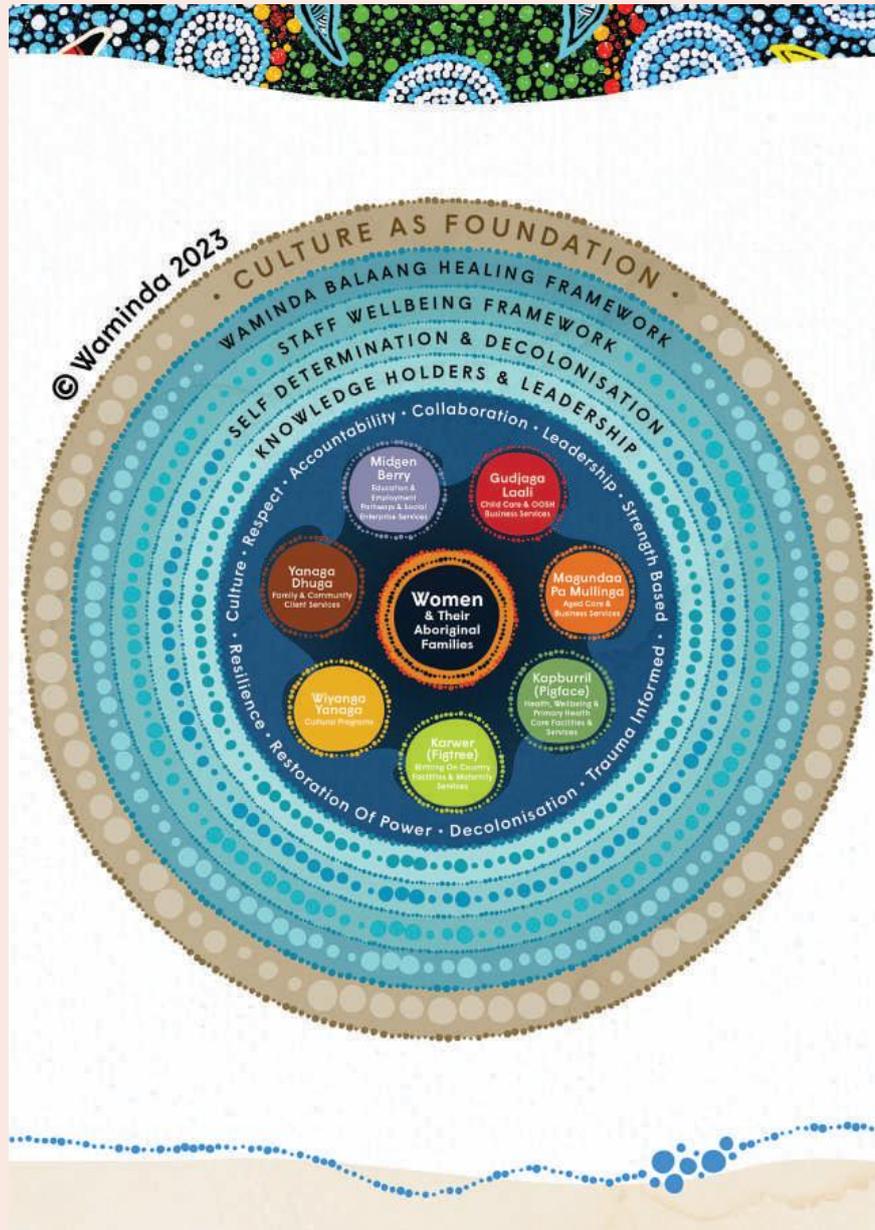
- 10 Examine how Aboriginal and Torres Strait Islander women's and children's rights are being supported through the programs of Waminda.



**Figure 1.23** Nowra. Waminda has a number of services based in Nowra, including a Health & Wellbeing Centre, Clinic Services & Nabu, and Case Management Services.

**Skills:** analysis, creative thinking, research

*continued*

Case study 1.3 *continued*

**Figure 1.24** Waminda model of care



Quiz

### Revise and summarise 1.4

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Outline the four principles of social justice.
- 2 Describe the role of the social justice principles in determining the health status of an individual and a community.

### Think critically and apply 1.4

Analyse a strategy where the principles of social justice have been applied to promote health.

**Skills:** research

## 1.5 Determinants of health

### Learning objective 1.5

DISCUSS the range of determinants that influence the health and wellbeing of Australians including:

- broad features of society
- environmental factors
- socio-economic characteristics
- health behaviours
- biomedical factors

There are many varying factors that influence a person's health status. These factors interact to determine the level of health that people experience. These influencing factors are referred to as determinants of health.

They include:

- broad features of society
- environmental factors
- socio-economic characteristics
- health behaviours and
- biomedical factors.

The determinants act in varying degrees and can have either a positive or a negative influence on a person's health. The things that increase our likelihood of experiencing poor health are referred to as risk factors and include things such as a high-fat diet, unemployment and physical inactivity. Eating a balanced diet, having a family that supports a healthy lifestyle, having vaccinations and having regular medical check-ups are all examples of protective factors that are likely to increase the level of health a person experiences.

Many of the determinants can be modified to a certain extent to improve health status or reduce the risk of ill health. Having an awareness of the impact that the determinants have on a person's level of health can assist in understanding trends in health. It can also help explain why some people experience poorer levels of health than others and can assist in creating effective health-promotion strategies to improve the health of communities and individuals.

It is important to note that the determinants do not act in isolation but rather interact to determine an individual's health. Often determinants are closely linked and changes in one area may impact on others. For example, having a high level of education means that you are more likely to have a better-paying job – resulting in a higher income and therefore more freedom to choose where you live and greater access to private health insurance.

The impact that a determinant will have on an individual's health will also vary depending on the time and intensity of exposure. For instance, an individual working in the mines where they are surrounded by heavy machinery and toxic chemicals increases the risk of illness or injury the longer they work there.

Determinants also differ in the degree to which they are modifiable. That is, how easily they can be altered by the individual. Determinants such as health behaviours can be modified in a much more straightforward way than factors such as employment and income, which are very closely linked to other factors, such as education and broader aspects of society, including job availability. Other factors, such as age and genetic make-up, are things people have no control over.

The most recent statistics from the ABS and the AIHW show that although there are some positive trends in the factors that influence good health, this is not the same for everyone.



**Figure 1.25** Having regular medical check-ups is an example of a protective factor that is likely to increase the level of health a person experiences.

## Broad features of society

Within any society there exist characteristics that can either have a positive or negative impact on the health and wellbeing of its members. These characteristics are referred to as sociological causes and can vary from community to community and include elements such as social interactions, social relationships, culture and the media.

### Social relationships and social interactions

The social environment in which a person lives and functions plays a significant role in shaping an individual's beliefs, values and habits, and their health behaviours. Family, peers, media, religion and culture are all part of the society in which we live, and influence the health practices that we adopt. As with many other determinants, these influences may be subtle and indirect, and have either a positive or a negative impact on a person's health-related behaviours.

Peers play an increasingly significant role in an individual's life as they develop from a child to an adult, and can have a considerable impact on health-related decisions and behaviours.

Often peers are the social group by which we gauge what is acceptable behaviour, and our desire to fit in may influence our decisions. These could include

negative health decisions such as engaging in risky behaviours, including smoking, drinking, dieting and unsafe sexual practices. Conversely, peer influence may be positive. For example, a person who is surrounded by people who are very supportive and encouraging of one another, and who place clear value on personality and relationships rather than physical attributes, is more likely to develop healthy self-confidence and have a strong sense of emotional connectedness and support.

Family is the earliest influence on an individual, and in many cases has a considerable impact on the development of a person's values and beliefs. Aspects of an individual such as their self-esteem, intrinsic ethics and attitudes are largely shaped during childhood and adolescent years. Family attitudes and practices towards physical activity, health and food can result in the formation of either positive or negative habits in these areas. For example, a child from a family with active parents, who include physical activities such as bike-riding or bushwalking in their lives, and place a clear value on eating a balanced diet and leading a healthy lifestyle, is much more likely to adopt at least some of these behaviours. On the other hand, another child whose parents who see physical activity as a chore, and have a diet high in salt, fat and sugar, is more likely to develop negative habits in these areas.



**Figure 1.26** Family is the earliest influence on an individual.

## Culture

Culture and religion are other areas that form the basis of many societies. Culture is often closely linked with family and in many cases is passed down from parents, grandparents and the extended family.

Culture can have a large influence in the formation of values and beliefs and assists in providing a sense of identity and belonging.

Health-related behaviours and choices can often be shaped by an individual's culture. Culture can influence perceptions of health, illness, death, acceptable methods of treatment and what activities may be acceptable for certain genders.

For example, some Muslim women take care exposing skin, which may limit the extent to which they can be physically active (although we are increasingly seeing activewear and sporting uniforms available with adaptations for cultural requirements). Another example is Jehovah's Witnesses, who don't accept blood transfusions as they believe it is against the teachings of the Bible.

## Media

Media saturates our society. Social media as well as the mass media can provide substantial influence on choices relating to health and can

shape individual identity. Media comments on all aspects of society, sending strong and sometimes conflicting messages on how we should think, act and behave. For example, young people who are continually presented with images of flawless men and women through Instagram, Facebook and print media may feel pressure to achieve a similar look. This can lead to unhealthy relationships with food, exercise and supplements.

However, media can also play an important role in the dissemination of positive health messages. Many health promotion campaigns are delivered to the Australian population through various forms of media, including social media. For example, during the COVID-19 pandemic, messages on how to remain safe, good hygiene practices and guidelines on restrictions were delivered through mediums such as television, Facebook, Twitter, print media, radio and websites.

## Government

The political climate in which we live can have a significant impact on health and health-related behaviours. If positive health outcomes are at the forefront of federal and state policy and funding, then positive outcomes for citizens are more likely. In a broad sense, the Australian government oversees and drives the health of Australians.

### Activity 1.12

For a health risk behaviour such as smoking, vaping, unprotected sex or binge drinking, create a mindmap that identifies the sociological factors that may cause an individual to engage in this behaviour.



**Figure 1.27** During the COVID-19 pandemic, health messages were delivered through a variety of media

## Environmental factors

Environmental factors refer to the social, cultural, natural and human-made environments in which we live. They are directly linked to climate, air quality, water quality, health behaviours and emotional health. By world standards, Australia possesses well-developed infrastructure and is modern and clean. We have access to clean running water, high-quality waste disposal systems, a climate of peace and relatively clean air; however, there is still a large variation in the living environments that people experience throughout the country and not all elements of our largely urbanised environments produce positive health effects.

## Rural and remote areas

People living in rural and remote areas have been found to experience lower levels of health than those who live in urban areas. The remoteness of location means that rural Australians may experience limited access to health services and technology and also limited options in relation to food and leisure. The remoteness of location may also contribute to a greater risk of death through injury as the response time of emergency services

is so much greater. The sense of isolation has also been found to contribute to mental health issues, with people in rural and remote areas experiencing higher rates of depression and suicide. Rates of drug use and alcohol abuse have also been found to be higher in rural and remote areas. This may be due, once again, to the sense of isolation or the limited options available for leisure and recreation.

Living in rural and remote areas is also closely linked with other determinants of health, with the proportion of Indigenous Australians increasing linearly with remoteness. Low socio-economic status, as well, has been linked with geographical location, with a greater proportion of people in rural and remote areas experiencing lower levels of education and income.

A positive shift in accessibility, however, has been seen recently with the increase in use of online health services and consultations such as telehealth. Being able to consult with medical practitioners, specialists and mental health services more readily will hopefully translate into positive health outcomes for Australians living in rural and remote areas.

**Table 1.2** Risk factors by remoteness

Risk factor	Major cities (%)	Inner regional (%)	Outer regional and remote (%)
Current daily smoker	12.8	16.5	19.6
Daily sugary drink consumption	8.3	10.9	14.4
Inadequate vegetable consumption	93.2	91.0	91.9
Overweight or obese	65.1	71.0	70.3
Insufficient physical activity	54.0	53.3	55.1
Inadequate fruit intake	48.2	52.7	53.2
High blood pressure	21.5	22.1	23.5
Exceed lifetime alcohol risk guideline	14.7	18.8	24.4

## Activity 1.13

### Environmental factors

- 1 Identify the health conditions that you would expect to find in Australians living in inner regional and remote locations as the result of the health behaviours identified in Table 1.2.
- 2 For the health conditions you identified in question 1 above, research the rates of these conditions in Australians living in rural and remote areas in comparison with those living in major cities. Discuss your findings.

**Skills:** analysis, research



**Figure 1.28** Fast foods are much more readily accessible in major cities.

### Urban environments

The built environment in which we live can shape our health behaviours. Living in a highly urbanised environment does not always produce a positive effect on health. Major cities with high population densities can have multiple effects on health: increased risk of the transmission of

communicable diseases such as COVID-19; increased car use and subsequent decreased physical activity levels; decreased green spaces for recreation and exercise; and increased access to fast foods. All of these factors can have a detrimental effect on health.

Planning communities that encourage people to be physically active is a key priority of most recent local council developments in an effort to address growing rates of overweight and obesity. Creating environments where people are able to safely and easily access physical activities supports individuals in making healthy choices. For example, the establishment of infrastructure that encourages physical activity such as the inclusion of bike paths can encourage individuals to change the way they get around and increase incidental activity. The installation of fitness equipment in local parks can encourage people of all ages to get out and get active, and ensuring that facilities are well maintained and safe promotes the incorporation of physical activity into daily life. This shift in town planning to promote healthy lifestyles is a positive change that will support individuals in making healthy choices.



**Figure 1.29** Geographical location has a significant impact on access to medical services.

## Socio-economic characteristics

Socio-economic characteristics such as income, employment, education and housing are all intricately linked to health. In many circumstances the link to health may be indirect, with the involvement of other influencing factors such as decision-making skills, peer influence and heredity also having an impact. Therefore, it can be very difficult to determine the influence that a single factor can have on health due to the complex and interwoven nature of some of the determinants.

Many studies have shown that people of lower socio-economic status (SES) generally experience lower levels of health. Those with lower levels of socio-economic status have markedly higher rates of diabetes, injuries and mental disorders than those with the highest SES. These particular ailments are all compounded by lifestyle-related risk factors such as smoking, drinking, drug use and a high-fat diet, which have also been found to be more common among lower SES groups.

It's important to recognise that socio-economic factors often interact and compound each other, leading to entrenched cycles of poverty and low socio-economic status for individuals and communities. Addressing these complex issues requires comprehensive and multi-dimensional approaches involving education, employment opportunities, social policies, and community development efforts.

## Education

Research has shown a direct link between an individual's level of education and literacy and their level of health. The higher a person's level of education and literacy, the better their health

is likely to be. This is because having a greater level of education carries better prospects of employment, occupation and income. People with higher levels of education are more likely to be in a position to increase their material resources and socio-economic position. A higher level of education also helps to develop skills, confidence and knowledge that can benefit health. Education can provide people with a knowledge and understanding of disease and the associated risk behaviours and can assist them in understanding and interpreting health messages. People who have an understanding of the potential harm to their health presented by certain behaviours (e.g. smoking and a high-fat diet) may be more likely to make health-enhancing choices.

Education also develops the skills required to access and analyse available health-related information and services and increases the confidence to access them.

School retention rates have been improving for both males and females since 2011 and the percentage of Australians attaining a university education has also increased more than threefold over the past two decades and this trend is continuing. The most recent census (2021) has revealed an increase in the number of people achieving TAFE qualifications (a 10.6% increase since 2016). There have also been increases in the number of people studying to gain non-school qualifications including business and management, security science and artificial intelligence.

Increasing the rates of Year 12 attainment for Indigenous Australians has been a target of the Closing the Gap campaign. According to the



**Figure 1.30** Education develops the skills required to access and analyse available health-related information and services.

2019 Closing the Gap report, progress in this area has been made with an increase in Year 12 attainment by around 21% over the past 10 years. Improvements in literacy and numeracy levels have also been seen over the past 10 years, although gaps still exist.

### Health literacy

Having an understanding of the way that different things impact our health and the importance of good health can encourage people to establish protective health behaviours. These include eating a nutritionally balanced diet and participating in regular physical activity, rather than risky behaviours such as binge drinking and smoking.

There is an assumption that possessing a good level of health literacy and having a knowledge of health and the consequences of risky behaviours will lead to better health choices, but this is not always the case. Choices are not the product of knowledge alone but are influenced by many other factors, including a person's underlying attitudes, beliefs, social environment and socio-economic status (SES). For example, the AIHW reports that there is a discrepancy between knowledge and behaviour in relation to smoking. It is a well-known fact that tobacco smoking is harmful to health. Numerous health-promotion campaigns have targeted tobacco in attempts to reduce the number of smokers in Australia. Information about short-term and long-term consequences of smoking have been presented on television and in print materials, as well as graphic and written health warnings placed on cigarette packets. Overall, these campaigns have been reasonably successful in increasing the amount of knowledge about the effects of smoking. Decision-making, communication, problem-solving and movement skills can all contribute to an increased likelihood of positive behaviour change and ultimately a higher level of health. For example, having the communication skills to be able to express your emotions and feelings in a productive and assertive way means that you are more likely to experience a higher level of emotional health, stand up for yourself in times of peer pressure and maintain positive relationships. Similarly, possessing movement skills means that you may be more likely to involve yourself in sport and physical activity, thus improving your physical health. As with knowledge, the possession of a good amount

of personal skills does not mean that a person will always make good health decisions but it does empower them to be able to do so.

### Income

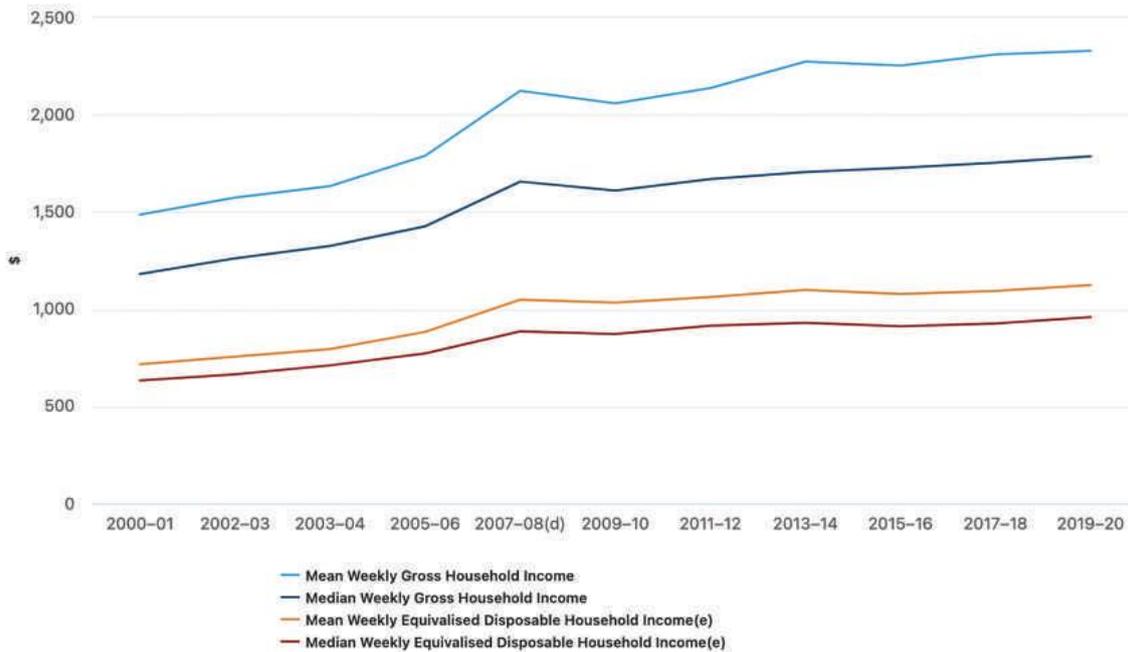
The level of income and wealth an individual has is linked to health in a number of ways. A lower level of income means that an individual may have fewer options available to them in terms of housing, food, leisure pursuits and healthcare. Financial limitations can place a great restriction on the areas and type of housing in which a person or family can live. A family experiencing poverty may not have access to adequate housing and may be forced to live in an environment that is overcrowded, unsafe and insecure. As well as the direct influence that living in an unsafe environment can have on health, having limited options can also contribute to a sense of powerlessness and stress.

The inability to afford private health insurance (Figure 1.31) also means a lower level of control over health. Reliance on the public healthcare system means limited choice in doctors and hospitals, longer waiting periods for treatment of non-life-threatening illnesses and limited access to other forms of treatments such as physiotherapy, occupational therapy, speech therapy, eye therapy, chiropractic services, podiatry, psychology services, glasses and contact lenses, and hearing aids. Since the mid-1990s all income groups have experience a growth in household income; however, the rate of increase has varied, as can be seen in Figure 1.32. The group experiencing the lowest level of growth is the low-income group. In terms of household net worth (including



**Figure 1.31** Private health insurance is not an option for many in low-SES groups.

Graph 1 - Weekly household income, Australia, 2000–01 to 2019–20(a)(b)(c)



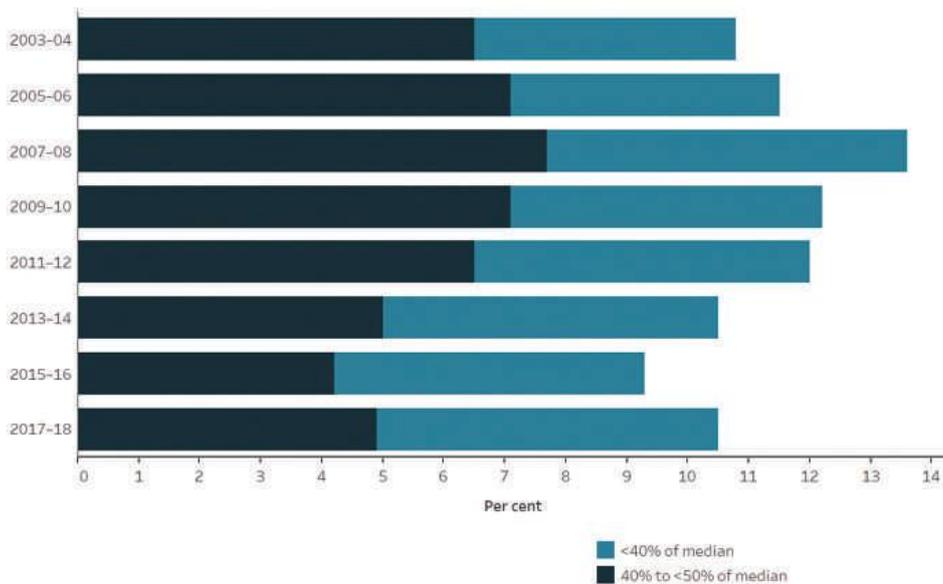
Source: Australian Bureau of Statistics, Household Income and Wealth, Australia 2019-20 financial year

Figure 1.32 Mean weekly income by income group 2000/1–2019/20

Figure 1: Selected social determinants of health, by disaggregation and period

Select disaggregation:  
Income

Proportion of persons living in households with an equivalised disposable household income less than 50% of the national median, 2003–04 to 2017–18

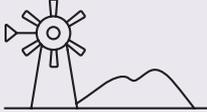


Notes:  
1. Equivalised disposable income is defined as gross income less income tax, the Medicare levy and the Medicare levy surcharge, adjusted for the number of people in the household including adults and children.  
2. Low income is defined as the proportion of people living in households with an equivalised disposable household income (that is, after-tax income, adjusted for the number of people in the household) that is less than 50% of the national median.  
Source: AIHW 2018, ABS 2019a.

Figure 1.33 Proportion of persons living in households with an equivalised disposable household income less than 50% of the national median 2003–04 to 2017–18. You can see an animated version of this graph at <https://cambridge.edu.au/redirect/10301> (you will need to select ‘Income’ as the disaggregation for the graph).

household assets such as housing) all groups saw an increase in net worth over the past 10 years except the low wealth household group, which saw a decrease.

The link between SES, rural and remote areas and Indigenous status can clearly be seen in Figure 1.34, with disparities evident in nearly all major health conditions.

			
Comparing age-standardised rates for:	Indigenous/ non-Indigenous	Remote and Very remote/ Major cities	Lowest/highest socio-economic areas
<b>Coronary heart disease (CHD)</b>			
Have CHD	2.0 ×	0.9 ×	1.6 ×
Be hospitalised for CHD	2.1 ×	1.5 ×	1.3 ×
Die from CHD	2.0 ×	1.5 ×	1.6 ×
Burden of disease (DALYs)	3.1 ×	2.0 ×	1.8 ×
<b>Stroke</b>			
Have stroke	n.a.	1.2 ×	2.3 ×
Be hospitalised for stroke	1.6 ×	1.4 ×	1.4 ×
Die from stroke	1.3 ×	1.0 ×	1.3 ×
Burden of disease (DALYs)	2.3 ×	1.2 ×	1.4 ×
<b>Chronic kidney disease (CKD)</b>			
Have CKD	2.1 ×	n.a.	1.6 ×
Be hospitalised for CKD	4.9 ×	2.7 ×	2.2 ×
Die from CKD	3.6 ×	1.9 ×	1.8 ×
Burden of disease (DALYs)	7.3 ×	3.7 ×	2.3 ×
<b>Diabetes</b>			
Have diabetes	2.9 ×	1.2 ×	2.0 ×
Be hospitalised for diabetes	3.9 ×	2.3 ×	2.0 ×
Die from diabetes	4.0 ×	2.1 ×	2.3 ×
Burden of disease (DALYs)	5.6 ×	1.8 ×	2.2 ×

DALYs = disability-adjusted life years

Note: More detail about the data can be found online in *Australia's Health 2020* snapshots, available at <https://cambridge.edu.au/redirect/10452>

**Figure 1.34** Rates of major health conditions by Indigenous status, geographical location and SES. Source: *Australia's Health 2020: In Brief*

## Case study 1.4

Effect of income and employment

**NEWS REPORT****Obesity rates are rising in Australia, but it's where you live that matters**

Olivia Willis

*ABC News, 11 October 2019*

If you're an adult in Australia, odds are you're overweight or obese.

At last count, two in three of us over the age of 18 are.

But that sobering statistic might come as a surprise to those in inner-city Perth or on Sydney's upper north shore – if they go by who they can see around them.

Just over 14 per cent of people in Sydney's Ku-ring-gai council area are obese. As a community, it has one of the leanest waistlines in the country.

Drive four-and-a-half hours north west to Wellington in regional New South Wales, however, and it's a different picture entirely.

There, like many other parts of outer-metropolitan and regional Australia, nearly half the adult population is obese, putting them at higher risk of diabetes, some cancers, heart disease and dementia.

On World Obesity Day, an Australian researcher is calling for a reset on how we tackle the issue.

"We are becoming a fat and inactive nation ... and it's almost entirely where you live that counts," says Rosemary Calder, professor of health policy at Victoria University (VU).

According to VU's Australian Health Tracker, obesity rates across Australia are hugely dependent on where

people live, and vary between regions by as much as 300 per cent.

"The proportion of people who are obese has risen 27 per cent in 10 years," Professor Calder said.

"We cannot ignore the influence of where people live – and where people live has a lot to do with their socio-economic status."

Professor Calder argued urgent action was needed to tackle Australia's burgeoning obesity epidemic where it matters most: among the country's most disadvantaged communities.

"Obesity is an issue of place," she said.

"We need governments to understand the best way to improve the nation's health is to really focus on the communities where health is at greatest risk."

**Wealthy communities, smaller waistlines**

In Australia, central Melbourne and Perth, as well as a handful of inner-city West Australian suburbs, top the league table of least overweight or least obese communities.

Wealthy city suburbs typically have the lowest rates of obesity because they are the most well-resourced, Professor Calder said.

*continued*

Case study 1.4 *continued**continued*

“These suburbs are usually green and leafy, with more space dedicated to parks, gardens and recreational facilities,” she said.

“They often are well-serviced by public transport, bike paths and are relatively close to where people work, which enables people to be physically active in their commute to work, rather than rely on the car.”

A greater density of shops selling fresh fruit and vegetables and fewer fast food outlets also means accessing healthy food is easier.

“People in our wealthier suburbs tend to have better access to information about healthy diet and the financial means to access healthy food options.”

In contrast, lower socio-economic areas, which are often new outer-metropolitan suburbs or regional communities, seldom have physical infrastructure that supports healthy lifestyles.

“Low income suburbs rarely have any of that, and if they do, they are highly dependent on cars, because of usually much less public transport,” Professor Calder said.

“They have a much higher rate of fast food outlets, much lower access to speciality fresh food outlets.”

**Obesity not a choice, experts say**

With this in mind, Professor Calder said it is time we stopped framing obesity as a problem of personal responsibility.

“We have spent too long as a nation expecting individuals to be able

to change their behaviour to reduce their weight,” she added.

“The evidence is very clear that this has little chance of success without a very strong focus on the environmental factors in the places where we live that contribute to poor nutrition and inactivity.

“We have to realise that individuals cannot make good choices when those good choices are not available to them, either because of their resources, or because of the resources in their community.”

According to the ABC's Australia Talks national survey, nearly a third of Australians have trouble making ends meet.

For Australians living on a low income, or in poverty, fast food is often the cheapest, most feasible food option, Professor Calder said.

“If you're a single parent with several children, it's going to be easier to feed your family a large serving of chips than it is to go and do a meal with vegetables and meat.

“Your choices are driven by your resources ... not by what's good for you.”



**Figure 1.35** Fast foods are a cheap and easy option, and sometimes the only option in lower-income suburbs.

*continued*

Case study 1.4 *continued**continued*

Jane Martin, executive manager of the Obesity Policy Coalition, agreed, and said although obesity is a population-wide problem, there needed to be a focus on low-income communities.

“It’s not easy when you’ve got plenty of resources and are well educated,” Ms Martin said, “it’s a lot harder when you don’t have the resources, money or skills.”

In her view, dismissing obesity as a personal problem for people to manage, or attributing blame to individuals, wasn’t going to solve the problem.

“The solution does not lie with the individual. It’s much greater than that.”

#### **‘Community responsibility, not individual responsibility’**

In June, Federal Health Minister Greg Hunt established plans for a National Preventative Health Strategy, which will include a focus on nutrition and obesity.

Professor Calder said this is a “step in the right direction” – so long as the government considers the impact of where people live on their health.

She said places with the highest rates of obesity also had higher rates of smoking, physical inactivity and chronic illness, and were largely low-socio-economic communities, highlighting the impact of poverty on all aspects of health.

“We have children entering schools in parts of Australia that don’t know what an apple is until they go to school.

“We have to change that. And we have to change it as a community responsibility, not an individual responsibility.”

In addition to creating environments that promote healthy eating and physical activity, Professor Calder said Australia needs to look more closely at its policies around salt and sugar content in processed foods.

Ms Martin suggested that stricter regulations around food labelling and junk-food advertising are also needed.

“Young people are heavily targeted through price promotion and the advertising of unhealthy foods,” she said.

“It’s outrageous that there’s not more oversight.”

Tackling the obesity epidemic, she said, requires effective action beyond targeted health interventions.

“Affordable housing and education are really important precursors for good health,” Ms Martin said.

“Many people are struggling to make ends meet ... and suffering poor health as a result.”

The Federal Government’s first National Obesity Strategy is in development and expected to be presented to the Council of Australian Governments (COAG) Health Council in June 2020.

*continued*

**Case study 1.4** *continued*

- 1 Summarise the trends and statistics on overweight and obesity presented in the article.
- 2 Discuss the importance of access to information about healthy diet in changing behaviours relating to diet and activity.
- 3 Describe the influence that the surrounding infrastructure can have on an individual's ability to make healthy choices. In your answer, consider goods and services, the physical environment and the positive and negative influences that each can have.
- 4 Analyse the role that income and employment have on the likelihood that someone will become overweight or obese.
- 5 Identify other lifestyle behaviours that may contribute to the development of poor health including overweight and obesity-related conditions.
- 6 'We have to realise that individuals cannot make good choices when those good choices are not available to them, either because of their resources, or because of the resources in their community.'

Consider the above quote from the article. Analyse the role of individuals, communities and governments on health relating to obesity and overweight conditions.

- 7 As part of the government's National Obesity Strategy you have been provided with a grant to tackle the issue of obesity in the NSW community of Wellington. As a group, develop an action plan that focuses on healthy lifestyle changes that would reduce the rates of obesity in this rural town. In your strategy, include one program that focuses on each of the following target areas:
  - a children and teens
  - b adults
  - c families.

Ensure that you consider the nature of the town and focus your strategies around their needs. Go to the council website (<https://cambridge.edu.au/redirect/10286>) and the ABS quickstats page (<https://cambridge.edu.au/redirect/10287>) to assist you with your planning.



**Figure 1.36** Wellington in regional NSW

**Skills:** collaboration, analysis, creative thinking, problem-solving

## Health behaviours

The choices that people make about health-related behaviours can have a direct and lasting impact on their health status. Decisions that we make every day about things like food, exercise and drug use can either increase or decrease the risk of developing a disease or ill health. Health behaviours are often closely linked to other factors such as knowledge, attitudes and beliefs, and are largely modifiable.

### Tobacco smoking and vaping

Tobacco smoking is the leading preventable cause of death and disease in Australia and contributes to the development of many chronic health conditions including cancer, heart disease, stroke, lung disease, diabetes and chronic obstructive pulmonary disease.

Fortunately, behaviours relating to smoking in Australia are showing positive trends:

- Daily smoking rates continue to decrease thanks to successful health-promotion campaigns and strategies. The rate of daily smokers has more than halved since 1991. In particular, the smoking rates of teenagers and young Australians continue to show improvement as fewer teens take up smoking and the age of initial uptake continues to increase. In 2019 almost all of 14–17-year-olds (97%) and 80% of 18–24-year-olds had never smoked.
- Those most likely to smoke daily are men and people in their 40s–50s. This is a shift from 2001 when those in their 20s and 30s were the most likely to smoke daily.
- Another positive trend is the reduction in the number of children exposed to tobacco smoke

in the home, decreasing from 19.7% in 2002 to 2.1% in 2019.

- Despite some improvements, groups that continue to show higher rates of smoking include people with low socio-economic status (SES), those living in outer regional, remote and very remote areas and those who are unemployed.

However, while cigarette smoking has decreased, there has been an overall increase in the number of people trying and using electronic cigarettes (e-cigarettes), which typically do not contain tobacco. We do not yet know what long-term effects e-cigarettes may have on health, but studies have shown that they emit harmful chemicals..



**Figure 1.37** The long-term health effects of vaping are not yet known.

## Activity 1.14

### E-cigarettes

- 1 The rate of e-cigarette use among children and young Australians continues to rise. You have been tasked with informing students at your school of the risks associated with vaping in an effort to reduce numbers of regular users and first-time users.
- 2 In groups, create an action plan to reduce vaping rates in high school students and to reduce rates of those who may try it in the future. Consider the students in your school and how you can effectively bring about change.

**Skills:** problem-solving

## Alcohol use

Alcohol use in Australia is often connected to social gatherings and is closely linked to the culture of celebration. Alcohol consumption in moderation is not deemed to be harmful to health, but drinking more than two standard drinks per day can lead to long-term health effects such as cirrhosis of the liver, liver failure, heart damage, fertility issues, increased risk of most types of cancer, increased risk of diabetes and weight gain, and increased risk of brain-related conditions.

While the majority of alcohol consumption among Australians is not at a risky level, there is still a large proportion of Australians who drink at a level that increases their risk of developing long-term health effects.

Positive trends in relation to alcohol consumption in Australians have shown:

- a decrease in daily and weekly drinking rates

- decreased rates of drinking among young people
- a decrease in the total number of people exceeding the lifetime risk guideline
- an increase in the number of adults abstaining from alcohol.

However, alcohol use increased for adults aged 51 and over, and there was little change seen in the behaviour of the over-55 age group in relation to the number exceeding lifetime risk.

Groups most likely to engage in risky drinking include:

- people whose main language spoken at home is English
- people living in the highest socio-economic areas
- people living in remote and very remote areas
- people who are employed.

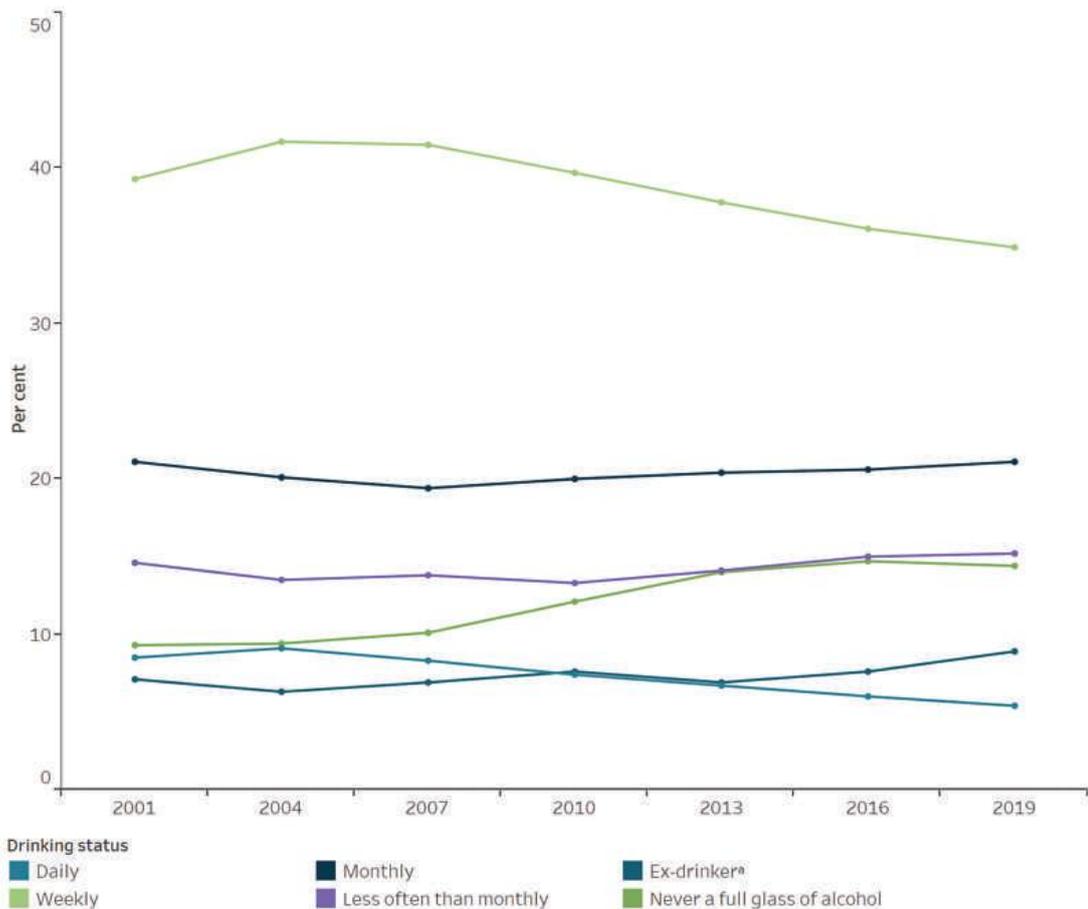


Figure ALCOHOL2: Alcohol drinking status, people aged 14 and over, 2001 to 2019 (per cent).

(a) Consumed at least a full serve of alcohol, but has not had an alcoholic drink in the previous 12 months.

Note: The calculation of drinking status and alcohol risk variables was updated for all years in 2019. Trend data may not match previously published results.

Source: AIHW 2020, Table 3.1.

**Figure 1.38** Alcohol drinking status, people aged 14 and over, 2001 to 2019 (per cent)

## Physical activity

Regular physical activity acts as a protective factor and reduces the risk of developing many chronic conditions such as type 2 diabetes, overweight and obesity, and heart disease. It also improves the body's ability to perform day-to-day activities.

The number of people meeting the recommended daily physical activity rates has shown some negative trends according to the *Australia's Health 2022* report. Overall, about three in ten Australians did not meet the recommendations for physical activity. Some variations were evident among population groups.

The number of people who recorded insufficient levels of physical activity was similar between people living in outer regional and remote areas and those in major cities. However, there was an improvement in activity levels for those in remote areas but a decrease for those in major cities.

Negative trends were also seen among socio-economic groups, with a decrease in those meeting recommended levels of activity in the highest socio-economic groups. There was little change in the lowest SES groups, which remained at a higher rate of physical inactivity than other socio-economic groups.

There was a reported difference of 4% between Indigenous Australian adults and other Australian adults.

### Physical activity guidelines:



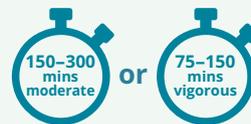
each day

2-5 years



each day

5-12 and 13-17 years



over 5 sessions  
per week

18-64 years



on at least 5 days  
per week

65 years and older

**Figure 1.39** Physical activity guidelines for Australians

## Practical application 1.2

### Physical activity

- 1 Form groups of four. Allocate an age bracket from the physical activity guidelines to each group member.
- 2 Create three physical activity plans that fulfil the recommendations of the guidelines. Each of the plans should target a different demographic within the age group. For example: full-time student, full-time worker, single mother, semi-retired person, person with a disability, and people in rural and remote areas. Share your plans as a group.
- 3 As a group, create a physical activity plan for your own age group for a week.
- 4 Participate in your created physical activity plan for the week and discuss with your group the positives and negatives of the plan. Make any further changes to the plan that might encourage you to implement it long term.

**Skills:** collaboration, problem-solving

## Diet

The food that we consume has a direct impact on our health. A balanced diet containing a variety of food from the five food groups provides our body with the necessary nutrients it needs to function at an optimal level.

The Australian Dietary Guidelines set out the recommended types and amounts of food that should be consumed to promote general health and reduce the risk of developing conditions and diseases such as diabetes, high cholesterol, obesity, cardiovascular disease and some forms of cancer.

Recent self-reported data from the ABS National Health Survey revealed the following in regard to certain aspects of the diets of Australians.

- In 2020–21, the majority of Australians did not meet the recommended serves of vegetables – 96% of men and 87% of women.
- In 2020–21, a higher proportion of Australians met the recommendations for fruit – 41% of men and 48% of women.
- Those living in low-SES areas were less likely to meet the fruit and vegetable recommendations than those in the highest SES areas; however, these differences were not significant.
- The daily consumption of sugar-sweetened drinks, however, was three times higher in low-SES areas than in the highest SES areas and over 1.5 times higher for those living in outer regional and remote areas than those in major cities.
- Men were almost twice as likely as women to consume sugary drinks every day.

While there has not been much change for the better in terms of dietary patterns of Australians, improving nutrition for all Australians is a key element of the National Obesity Strategy.

## Illicit drug use

Illicit drug use has a significant impact on both the health of the individual who uses the drug and on the broader community. The impact includes health conditions associated with drug use, overdose, death, mental health issues, crime, violence and trauma.

When considering the impact of illicit drug use and the trends associated with this use, it is important to consider the frequency of use as the potential for harm increases with frequency of use.

Listed below are the most commonly used drugs in Australia in 2019 and the trend in use when compared to 2016.

In 2019 increases were seen in the use of:

- cannabis (from 10.4% to 11.6%)
- cocaine (from 2.5% to 4.2%)
- ecstasy (from 2.2% to 3.0%)
- hallucinogens (from 1.0% to 1.6%)
- inhalants (from 1.0% to 1.4%)
- ketamine (from 0.4% to 0.9%).

While there has been an increase in the use of illicit drugs, many of these figures represent infrequent use, with the majority of people who used cocaine and ecstasy doing so only once or twice within a year. However, a higher frequency was seen in the use of cannabis and methamphetamines.

Groups that show higher rates of drug use include young people, people identifying as gay, lesbian or bisexual and those with a mental health issue.

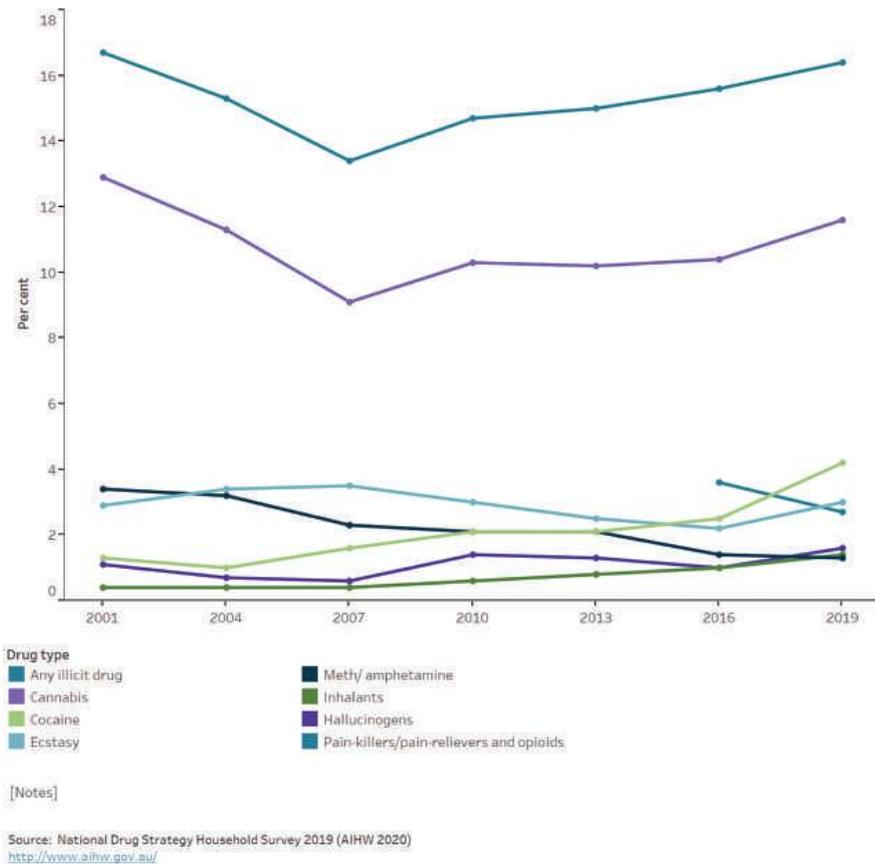
Trends in the use of some of the more commonly used drugs can be seen in Figure 1.40.

### Practical application 1.3

#### Diet

- 1 Look up the recommended dietary intake for Australian adolescents.
- 2 Create a meal plan that meets the recommendations, including meal suggestions for your household.
- 3 Implement your meal plan.

**Skills:** creative thinking



**Figure 1.40** Proportion of people aged 14 and over who recently used illicit drugs 2011–19. *Australia's Health 2022*.

## Biomedical factors

Biomedical determinants are risk factors relating to bodily conditions that can increase a person's risk of disease. Overweight and obesity, high blood pressure, abnormal blood lipids and impaired glucose regulation have all been associated with an increased likelihood of developing diseases such as cardiovascular disease, heart disease and diabetes.

Many of these biomedical conditions are strongly related to an individual's health behaviours and are therefore often strongly linked to the trends in behaviours discussed above. Many biomedical factors can be managed with lifestyle modifications.

## High blood pressure

Blood pressure is the measurement of the pressure of the blood on the artery walls as it is pumped out of the heart. High blood pressure or hypertension means that there is significant pressure on the walls of the arteries and this in turn can lead to an increased rate of plaque build-up on the walls of the arteries, weakening

them and causing increased pressure on the heart. High blood pressure is a risk factor for stroke, heart disease, cardiovascular disease and chronic kidney disease.

According to data from the 2017–18 ABS National Health Survey, about 1 in 3 people aged 18 and over (34%) have high blood pressure, which is a statistic that has remained unchanged since 2011–12. Men are more likely to have uncontrolled high blood pressure than women. In particular, 1 in 4 men (25%) had uncontrolled high blood pressure compared with 1 in 5 (20%) women and the rate of high blood pressure increases with age.

High blood pressure is caused by factors such as smoking, having a diet high in salt, living a sedentary lifestyle, diabetes, high alcohol consumption, high blood cholesterol, being overweight and genetics. Apart from the last factor, all others are able to be modified to reduce the risk of high blood pressure and its subsequent health issues.

## Abnormal blood lipids

Blood lipids are fats present in the blood, such as cholesterol and triglycerides. They play an important role in many bodily functions including the production of hormones, building cell membranes, maintaining metabolism and assisting in bile production in the liver. Blood lipids in the body can increase above normal levels as the result of a high fat diet or as the result of a medical condition, medication or genetic disorder. When blood lipids are above normal levels (dyslipidaemia) the risk of atherosclerosis increases, as does the likelihood of a build up of fatty deposits in the blood vessels, thus increasing the risk of disease such as coronary heart disease, cardiovascular disease and stroke.

Blood lipids can be controlled through reducing fat intake, regular exercise, weight loss (if necessary) and, in some cases, medication.

Estimations from the National Health Survey in 2017–18 showed a decrease in the number of people reporting high blood cholesterol levels from 2014–15 (from 9.1% to 7.8%). However, as this data is self-reported it may not be presenting the full extent of the issue as many people may not be aware that they have abnormal blood lipid levels. For example, studies conducted in 2011–12 with data from blood tests revealed that two in three Australians had abnormal blood lipid levels, which is significantly higher than self-reported data.

## Impaired glucose regulation

The inability to regulate the level of glucose in the blood is the key characteristic of diabetes. Impaired glucose regulation occurs when blood glucose levels are higher than normal but not high enough to be considered diabetes, and it is for this reason that it is commonly referred to as pre-diabetes. People with impaired glucose regulation are at a direct risk of developing diabetes and cardiovascular disease. Risk factors for pre-diabetes are similar to those for type 2 diabetes and include being obese or overweight, physical inactivity, abnormal blood lipids, high blood pressure and family history of type 2 diabetes and/or heart disease.

The most recent data for impaired glucose regulation is based on self-reported data and estimates that 0.5% of the population have impaired glucose regulation. However, as is the case with other biomedical risk factors this may be an underestimate. There are no symptoms of impaired glucose tolerance and so many people are unaware they have it. It is estimated that one in six Australians over the age of 25 have pre-diabetes and, of those, one in three will develop diabetes.

The importance of behavioural modifications is paramount to an individual diagnosed with pre-diabetes to reduce the risk of progression to type 2 diabetes and/or heart disease. Management strategies should be holistic and include diet modification, physical activity and psychological support to promote lasting behaviour change.

### Activity 1.15

#### Risk of pre-diabetes

- In groups, allocate a topic from the list below to each member and research the current trends in Australia for:
  - diabetes
  - physical activity
  - healthy eating
  - obesity rates.
- What is the link between each of these factors and pre-diabetes?
- From these trends, what can be inferred about the rates of impaired glucose regulation in the Australian population? Would you expect they are increasing, decreasing or remaining stable?
- Are there any groups more at risk of developing pre-diabetes and/or impaired glucose regulation?
- Nominate a spokesperson and discuss your findings and inferences with the rest of the class.

**Skills:** collaboration, analysis, research

## Overweight and obesity

Overweight and obesity both refer to excess body weight. Excess body weight is a risk factor in numerous conditions and diseases and is largely preventable. There are a number of methods for classifying overweight and obesity in adults. Two of the most widely used are body mass index (BMI) and waist circumference.

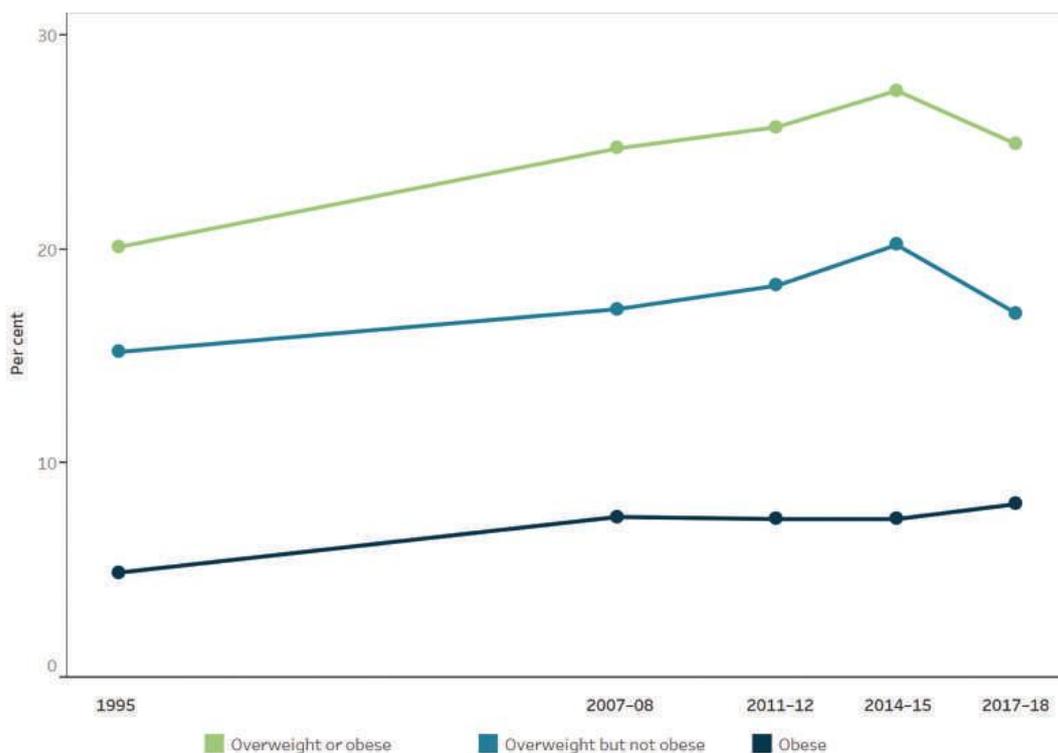
Body Mass Index is an internationally used index and is calculated by dividing a person's weight in kilograms (kg) by the square of their height in metres (m). Although BMI is a useful tool in assessing body weight, it does have some limitations in that it does not take into consideration the composition of the body – for example, BMI does not distinguish between fat-free mass and fatty mass, and is merely a measure of excess weight. As such, factors such as muscle mass can produce a distorted picture of BMI.

An alternative to BMI is waist circumference, which assesses the accumulation of excess body fat around the middle and the subsequent risks of obesity-related conditions.

Waist measurements provide an indication of the level of internal fat deposits around vital organs such as the heart, digestive organs, kidneys, liver and pancreas.

Overweight and obesity are major risk factors for health conditions, including cardiovascular disease, type 2 diabetes, high blood pressure, sleep apnoea, psychological issues, some musculoskeletal conditions and some cancers. Overweight and obesity contribute significantly to the burden of disease and are, in most cases, the result of negative lifestyle behaviours including physical inactivity and poor diet.

According to *Australia's Health 2022*, in 2017–18 it was estimated that 67% of Australians aged over the age of 18 were overweight or obese, reflecting an increase from 57% in 1995. As can be seen in Figure 1.41, trends in children and adolescents are also not favourable. The decline in rates of overweight children evident in the graph are not the result of a lower number of overweight and obese children overall, but rather the outcome of some children moving from being classified as overweight to being classified as obese.



Sources: ABS 2009b, 2013a, 2013b, 2015b and 2019e; see Table S11 for data and footnotes.  
<http://www.aihw.gov.au>

**Figure 1.41** Proportion of overweight and obese children and adolescents aged 5–17 years, 1995–2017/18.

Among population groups the following disparity can be seen:

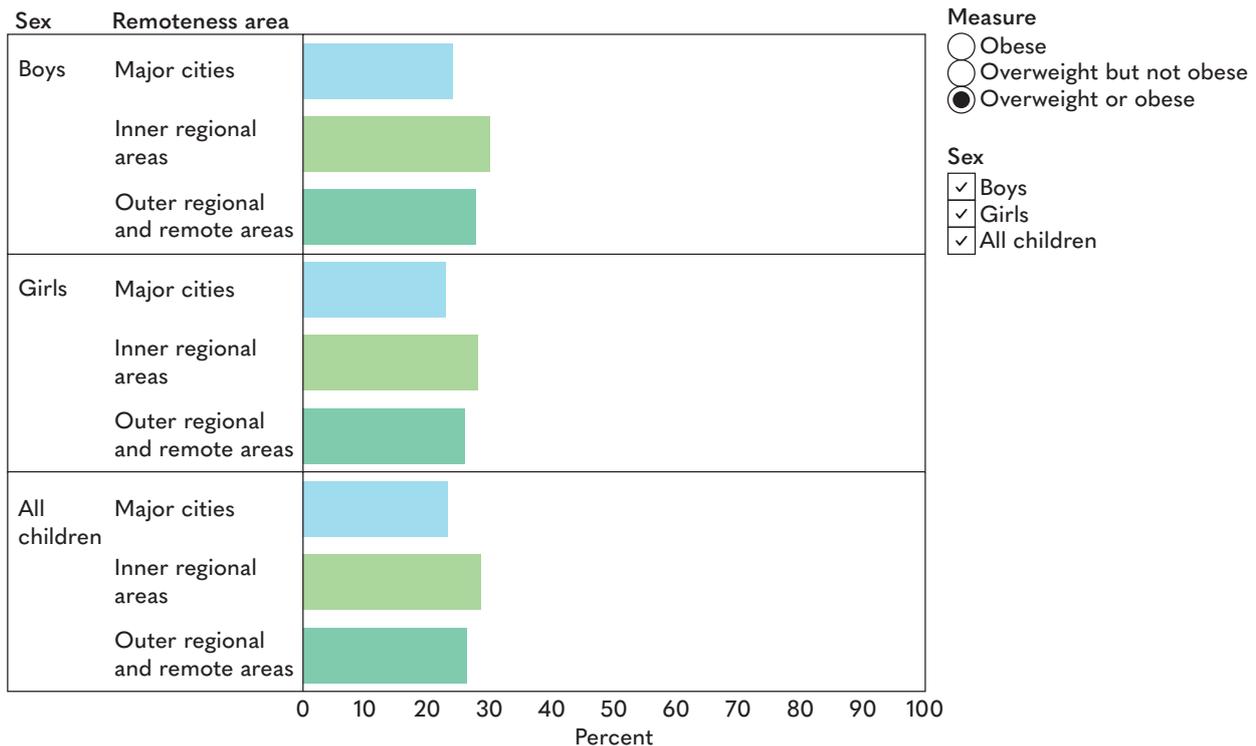
- The highest rates of overweight and obesity can be found in the lowest socio-economic areas.
- In the 2–17-year-old age group, rates of obesity were 2.4 times higher in the lowest SES area than the rate of those in the highest SES area.
- Children and adolescents aged 2–17 living in inner and outer regional areas and remote areas have higher rates of overweight and obesity than those living in major cities.
- The ABS reports that 38% of Aboriginal and Torres Strait Islander children and adolescents aged 2–17 are living with overweight or obesity, compared to 24% of non-Indigenous children and adolescents.

**Table 1.3** Strong evidence of direct associations between selected chronic diseases and behavioural and biomedical risk factors

	Behavioural: Tobacco smoking	Behavioural: Insufficient physical activity	Behavioural: Excessive alcohol consumption	Behavioural: Dietary risks	Biomedical: Obesity	Biomedical: High blood pressure	Biomedical: Abnormal blood lipids
Cardiovascular disease (CVD)	•	•	—	• (a)	•	•	•
Stroke	•	•	•	—	•	•	•
Type 2 diabetes	•	•	—	• (a)	•	—	—
Osteoporosis	•	•	•	• (b)	—	—	—
Colorectal cancer	•	—	•	• (c)	•	—	—
Oral health	• (d)	—	• (e)	• (f)	—	—	—
Chronic kidney disease (CKD)	•	—	—	—	•	•	—
Breast cancer (female)	—	—	•	—	• (g)	—	—
Depression	—	—	—	—	•	—	—
Osteoarthritis	—	—	—	—	•	—	—
Rheumatoid arthritis	•	—	—	—	—	—	—
Lung cancer	•	—	—	—	—	—	—
Cervical cancer (h)	•	—	—	—	—	—	—
Chronic obstructive pulmonary disease (COPD)	•	—	—	—	—	—	—
Asthma	•	—	—	—	—	—	—

• = Strong evidence in support of a direct association between the chronic disease and behavioural or biomedical risk factor.

— = There is either not a direct association or the evidence for a direct association is not strong.



**Figure 1.42** Proportion of children and adolescents aged 2–17 living with overweight and obesity, by remoteness area, 2017–18. Source: ABS. You can see an interactive version of this graph at <https://cambridge.edu.au/redirect/10302>.

## Activity 1.16

### Biomedical factors

- 1 Often biomedical risk factors are not present in isolation but rather in multiples. Discuss the difficulties that the presence of multiple risk factors could raise in terms of management from a treatment perspective.
- 2 Analyse the relationship between health behaviours and biomedical factors. Examine the impact health behaviours have on health and the likelihood of development of lifestyle diseases.

**Skills:** analysis

## Interaction of the determinants

Figure 1.43 provides a good illustration of the impact that one determinant of health or group of determinants of health can have on others and the flow-on effect that this can have on other areas of life. For instance, socio-economic status can have a direct impact on an individual's health behaviours. Unemployment can contribute to feeling a loss of control and a sense of hopelessness, which can lead to unhealthy behaviours such as high levels of alcohol consumption or illicit drug use in an attempt to escape these feelings. In turn, this can influence physical health, resulting in loss or gain of weight, changes in blood pressure,

or injury as the result of increased risk-taking. The broader political and social environment may also contribute to these behaviours. For example, an unemployed person who lives in a social environment where the unemployed are considered useless and where it is seen as their own fault that they can't get a job may be more likely to engage in these unhealthy behaviours compared to someone who is unemployed but receiving government support and training with the goal of getting a job.

While Figure 1.43 illustrates the influence of the determinants from left to right – upstream to

downstream – the direction of influence is not one-directional. The impact of the determinants on health can occur in reverse – for example, an individual's level of health can affect their ability to get a job, or participate in physical activity.

This diagram also highlights reasons why some population groups may experience lower levels of health than others and may need greater support to be able to achieve the same level of health as others.

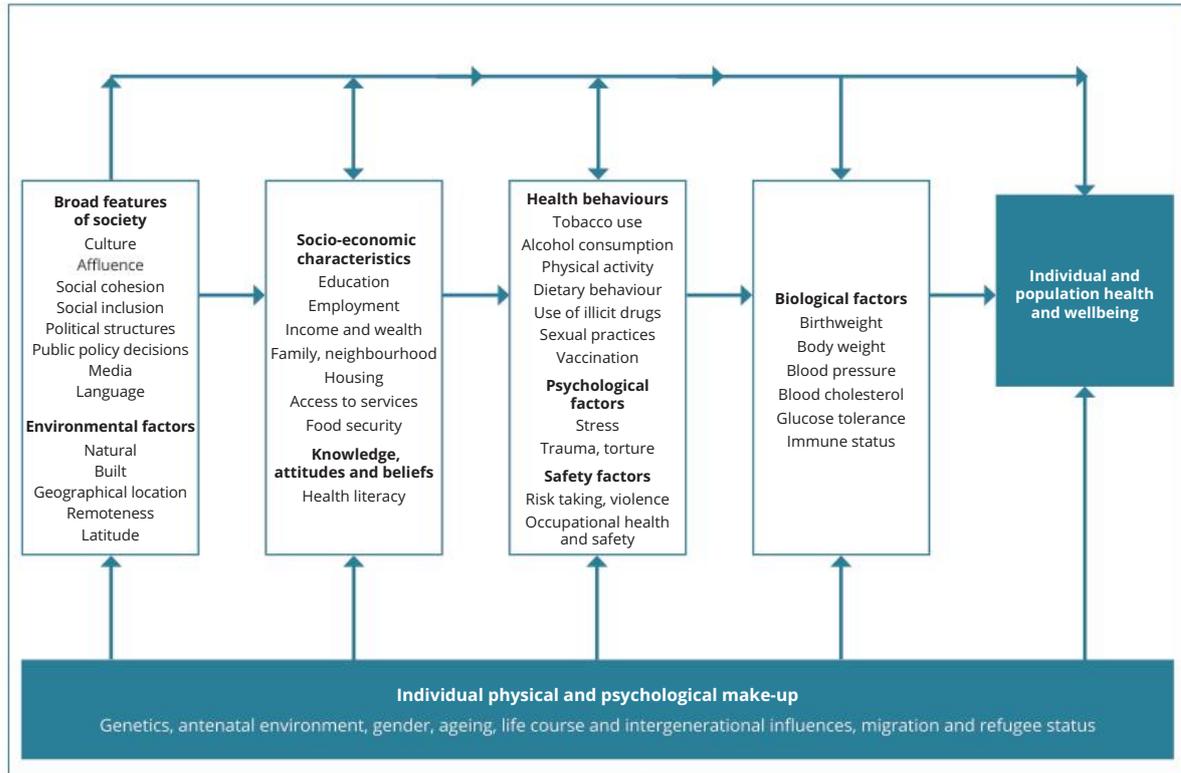


Figure 1.43 Interaction of the determinants of health

### Case Study 1.5

#### National Obesity Strategy

On World Obesity Day 2022, Australia launched its first National Obesity Strategy.

## NEWS REPORT

### Australia's first National Obesity Strategy launched on World Obesity Day

**Media release**

**4 March 2022**

To mark World Obesity Day, the Morrison Government is launching Australia's first National Obesity Strategy, which will help address overweight and obesity across the nation.

Australia's strategy has two ambitious goals—to halt the rise and reverse the trend in the prevalence of obesity in adults and to reduce overweight and obesity in children and

*continued*

Case study 1.5 *continued*

*continued*

adolescents by at least five per cent by 2030.

Obesity is a complex health condition. It is influenced by social, environmental, and economic factors which can impact a person's ability to maintain a healthy weight and, in turn, increase the risk of chronic conditions such as cardiovascular disease, type 2 diabetes and some cancers.

Making healthy choices is not always easy. The strategy recognises the importance of ensuring all Australians are empowered, enabled, and supported to make the best possible decisions about their health.

The Australian Bureau of Statistics' National Health Survey from 2017–18 revealed that 67 per cent of Australian adults were overweight or obese (12.5 million people), an increase from 63.4 per cent since 2014–15.

If the current trend continues, more than 18 million Australians will be overweight or obese by 2030.

Minister for Health and Aged Care, Greg Hunt, said the strategy will have a multi-faceted, community-wide approach, working with a range of initiatives, sectors, and organisations.

“Our primary focus is on prevention and the factors which contribute to this major health issue. It will also support the 14 million Australians living with being overweight or obesity, to live a healthier life,” Minister Hunt said.

“We know Australians in good health are better able to lead fulfilling and productive lives, and can

participate fully in their community, their jobs, and their education. COVID-19 has highlighted the importance of our health and the economic benefits health can bring.”

Consistent with the Government's National Preventive Health Strategy 2021–2030, no single action will be enough to prevent and reduce obesity, instead, a systems-based approach that tackles the environmental influences and empowers individuals will be critical.

Minister for Senior Australians and Aged Care Services, Richard Colbeck, said the strategy had been endorsed by the Morrison Government, as well as all state and territory health ministers.

“We will continue to work with our state and territory counterparts to identify key activities to drive the successful implementation of this strategy,” Minister Colbeck said.

Early consultation on the strategy included the Select Senate Committee Inquiry into the Obesity Epidemic (2018) and a National Obesity Summit (2019). This was complemented by two national public consultation processes (2019 and 2021) as well as additional targeted consultations.

The Morrison Government thanks the 2,750 individuals and organisations which participated in these consultations.

We also thank the Queensland Department of Health, which led the development of the strategy, supported by the Morrison Government and all state and territory governments.

**Case study 1.5** *continued*

Read the media release about the launch of the National Obesity Strategy, and have a look at the full strategy at <https://cambridge.edu.au/redirect/10288>.

- 1 In what ways does the strategy acknowledge the impact of the determinants of health on overweight and obesity?
- 2 How does the strategy aim to address these determinants to encourage positive change?
- 3 What trends could you expect to see in the behavioural and biomedical determinants if the strategy is successful? For example, trends in blood pressure, physical activity levels and nutrition.
- 4 How will the strategy address the needs of those identified as most at risk?

**Skills:** analysis, research

**Activity 1.17****Health condition**

- 1 For a health condition such as lung cancer, diabetes, overweight and obesity, or cardiovascular disease, create a diagram or flow chart that illustrates the causal pathway that the determinants can have on the development of that health condition. Include the various ways that the determinants may influence the health outcome of that condition and the multidirectional influence of the determinants.  
You can use Figure 1.43 as an example or create your own.
- 2 For each element of the causal pathway, propose ways that the likelihood of someone developing the condition may be reduced.

**Skills:** problem-solving

**Revise and summarise 1.5**

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 What health behaviours determine health?
- 2 What biomedical factors determine health?
- 3 What environmental factors determine health?
- 4 What socio-economic factors determine health?
- 5 How can an individual's health be determined by a range of different factors?
- 6 What determinants can be modified?
- 7 What determinants are difficult to modify or cannot be modified?
- 8 How do the determinants interact to affect the health of population groups?
- 9 What are the sociological causes of risky health behaviours?
- 10 Where do inequities exist and what can we do about them?



Quiz

**Think critically and apply 1.5**

- 1 Using the determinants as the basis of your argument, analyse why some individuals and groups have better health than others.
- 2 Using a specific example, illustrate how the determinants interact to influence an individual's level of health.
- 3 For one of the health behaviours where an inequity exists for a particular group (e.g. physical activity, smoking, alcohol use, diet and illicit drug use), perform the following tasks:
  - a Research the extent to which the inequity exists.
  - b Propose reasons for the inequity.
  - c Imagine you have been given a million-dollar grant by the federal government to address this inequity. Develop a strategy for how the grant could be applied to bring about change. Present an overview of your strategy as a poster, presentation or written submission.

**Skills:** analysis, research, problem-solving

## Chapter summary

- Prior to the twentieth century, health was viewed as the body's normal state of function; that is, the opposite of illness.
- In 1946 the World Health Organization (WHO) defined health as, 'A state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity'.
- The Australian Institute of Health and Welfare (AIHW) provided a comprehensive evaluation of the health of Australians in their 18th biennial report *Australia's Health 2022*.
- The concept of relative health refers to the idea that a person evaluates their level of health in reference to others or to their own level of health at another time.
- As well as being relative, our health is dynamic; that is, it is in a constant state of fluctuation.
- It is now widely recognised that health is multidimensional and that those dimensions interrelate to produce a level of health that is both relative and dynamic.
- The concept of good health is relative to individual circumstances and stage of life.
- The idea of viewing our health on a continuum, with optimum health at one end and poor health at the other, can help us to understand its relative and dynamic nature.
- Many of the changes to our health occur slowly over time.
- Individual life circumstances, including physical, social, cultural and political surroundings, can have a significant impact on health.
- Epidemiology allows us to compare and contrast patterns of health in a population at different points in time and among different subgroups within a population.
- Statistics that are commonly used in epidemiology include mortality (death) rates, infant mortality, morbidity, and the incidence and prevalence of disease.
- Social justice is the promotion of fundamental and universal human rights, and includes participation, equity, access and rights (PEAR).
- When applied, the principles of social justice aim to achieve health equality for all individuals and communities.
- The factors that influence a person's health status are referred to as determinants of health.
- Broad features of society, such as social interactions, social relationships, culture and the media, can either have either a positive or negative impact on the health and wellbeing of society members.
- Environmental factors refer to the social, cultural, natural and human-made environments in which we live.
- Socio-economic characteristics such as income, employment, education and housing are all intricately linked to health.
- The choices that people make about health-related behaviours can have a direct and lasting impact on their health status.
- Biomedical determinants are risk factors relating to bodily conditions that can increase a person's risk of disease.
- The determinants of health can affect each other, and have a flow-on effect on other areas of life.

## Multiple-choice questions

- 1 The idea that an individual evaluates their level of health in reference to others or their own level of health at another time is referred to as:
  - A relative health
  - B dynamic health
  - C personal health
  - D individual health
- 2 The dimensions of health include:
  - A social, emotional, mental, biomedical and spiritual
  - B social emotional, mental, physical and spiritual
  - C love, shelter, peace and nutrition
  - D media, income, culture, environment
- 3 The number of new cases of a disease in a population during a specific time period is referred to as:
  - A prevalence
  - B morbidity
  - C case numbers
  - D incidence
- 4 The broad features of society that influence an individual's level of health include:
  - A education, income and employment
  - B urban environments
  - C social interactions, culture and media
  - D friends, family and peers
- 5 The use of telehealth within rural and remote communities is an example of which principles of social justice?
  - A participation and environment
  - B socio-economic and equity
  - C access and equity
  - D rights and sociocultural

## Exam-style questions

- 1 Identify the limitations of using epidemiology to analyse population health. (2 marks)
- 2 Define these epidemiological measures: mortality, morbidity and infant mortality. (3 marks)
- 3 Outline the personal biomedical factors that influence health. (3 marks)
- 4 Using relevant examples, describe the concept of good health and the health continuum. (4 marks)
- 5 Explain how the dimensions of health interact to influence an individual's health status. Support your answer with specific examples. (5 marks)
- 6 Analyse how an individual's circumstances, such as socio-economic status, can affect their health outcomes. (4 marks)
- 7 WHO defines health as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity'. Compare and contrast this view of health with other sources and explain why individuals may have differing interpretations of health. (6 marks)
- 8 Assess how social justice principles, including participation, equity, access and rights, impact the health status of both individuals and communities. Provide examples to support your answer. (7 marks)
- 9 Justify the use of epidemiology as a key component in improving the health status of Australians. (7 marks)
- 10 For the determinants of health – environmental factors and health behaviours, critically analyse the current trends in these determinants, including the impact they have on the health status of specific groups of Australians. (8 marks)

# Chapter 2

## Young people's meanings of health

### After completing this chapter, you will be able to demonstrate knowledge of:

- the ways young people's lives are both similar to and different from previous generations
- the various meanings of health that young people have.

### Key terminology

#### Syllabus terms

Aboriginal and/or Torres Strait Islander Peoples community	mortality
culturally and linguistically diverse populations	older people
culture	personal biomedical factors
determinants of health	physical activity
dimensions of health	prevalence
disability	primary data
diversity	privacy
drugs	qualitative data
environmental factors	quantitative data
ethical	research method
health	salutogenic model of health
health behaviours	secondary data
health status	social justice principles
hypothesis	social model of health
interrelationship	socio-economic factors
life expectancy	World Health Organization (WHO)
Medicare	
morbidity	

#### Other important terms

autonomy  
generation  
Y2K



### Driving questions

- 1 In what ways do young people living today have better or worse health than previous generations?
- 2 What are the possible reasons for these changes?

# Introduction

Young people are a key part of Australian society. They are a highly diverse group and as such have a broad understanding of what health means to them. The meanings of health for young people can vary depending on a number of factors such as

their cultural background, individual experiences and personal beliefs. However, some common themes and perspectives on health among young people include physical health, mental health, social health, sexual health and spiritual health.

## 2.1 Young people today and in previous generations

### Learning objective 2.1

EXPLORE how young people's lives are both similar to and different from previous generations

**generation** members of a society who were born at approximately the same time; a generation tends to be approximately 15–20 years

It is often perceived that young people (those aged 12–24 years for the purposes of this chapter) are a very like-minded group who all have similar interests and face similar challenges. However, development and progression through adolescence can vary significantly between individuals, depending on several

internal and external factors. The progression through adolescence sees individuals make the transition from child to adult, and experience a rapid physical, emotional, intellectual, and social maturation.

### Developmental stages

As young people progress through adolescence, their ability to think, reason and make judgements develops. Recent studies have shown that brain development is not complete until the early twenties, with the area of the brain responsible for self-control and decision-making being one of the last to develop. Young people begin to feel that they are the best ones to make decisions about their behaviours and future, and the natural response to others (such as teachers, parents and governments) trying to implement rules or make key decisions on their behalf is often rebellion. This is a key factor behind the high level of risk-taking behaviours exhibited by many young people, such as taking drugs, engaging in unprotected sex or dangerous driving.

Many of these changes are the same as those experienced by young people of previous **generations**. However, over recent decades, social, technological and economic changes in Australian society have also introduced new issues and opportunities for young people.

CATEGORY	BUILDERS	BABY BOOMERS	GENERATION X	GENERATION Y	GENERATION Z	GEN ALPHA
	 We prefer proper English if you please Born: < 1946 Age: 73+	 Be cool Peace Groovy Way out Born: 1946-1964 Age: 54-72	 Dude Ace Rad As if Wicked Born: 1965-1979 Age: 39-53	 Bling Funky Dah Fashizz Whassup? Born: 1980-1994 Age: 24-38	 kik Legit Squad Totes Whatevs Born: 1995-2009 Age: 9-23	 Lit Fam Hundo Yas RN Lei Born: from 2010 Age: under 9
Social markers	World War II 1939-1945	Moon landing 1969	Stock market crash 1987	September 11 2001	GFC 2008	Trump / Brexit 2016
Iconic cars	Model T Ford Final, 1927	Ford Mustang 1964	Holden Commodore 1978	Toyota Prius 1997	Tesla Model S 2012	Autonomous cars 2020s
Iconic toys	Roller skates	Frisbee	Rubix cube	BMX bike	Folding scooter	Fidget spinner
Music devices	Record player LP, 1948	Audio cassette 1962	Walkman 1979	iPod 2001	Spotify 2008	Smart speakers Now
Leadership style	Controlling	Directing	Coordinating	Guiding	Empowering	Inspiring
Ideal leader	Commander	Thinker	Doer	Supporter	Collaborator	Co-creator
Learning style	Formal	Structured	Participative	Interactive	Multi-modal	Virtual
Influence/advice	Officials	Experts	Practitioners	Peers	Forums	Robo-advice
Marketing	Print (traditional)	Broadcast (mass)	Direct (targeted)	Online (linked)	Digital (social)	In situ (real-time)

**Figure 2.1** This infographic created in 2018 provides an overview of the generations. (Note that members of Generation Y are also referred to as 'Millennials'.)

## Influences on previous generations

Generations going back to the early twentieth century have been loosely categorised, as can be seen in Figure 2.1.

Baby boomers are born between 1946 and 1964, after World War II, and were in their teens and early twenties during the 1960s and 1970s. Baby boomers grew up in a time of great change and innovation. The post-war years saw significant economic growth, technological advancements and societal changes, such as the civil rights movement, feminism and the rise of youth culture. Many baby boomers grew up in nuclear families with a stay-at-home mother and a working father. Children spent a lot of time playing outside, riding bicycles and participating in organised sports. Television became more widespread in the 1950s, providing entertainment and education to children. In the 1960s, baby boomers started to challenge traditional values and norms, leading to countercultural movements and protests against the Vietnam War. The music of the Beatles and the Rolling Stones, as well as the rise of rock 'n' roll, became a defining aspect of baby boomer culture.



**Figure 2.2** A family watching television in the 1950s



**Figure 2.3** Fans greet The Beatles on their 1964 Australian tour.

The late twentieth century, when members of Generation X and the older Millennials were growing up, was marked by significant social, cultural and technological changes. During this time, the world experienced significant progress in the field of technology and communication. The personal computer was invented, and the internet became widely accessible, revolutionising the way people communicated and accessed information. For young people, this was often dependent on their family's ability to afford this new technology as most households only had one computer. It was also a time of economic prosperity, as well as being marked by social and political upheaval. The civil rights movement, the feminist movement and the LGBTQIA+ rights movement were in full swing and many young people were politically active and engaged. Popular culture during this time was heavily influenced by music, with the emergence of genres like indie rock, punk and hip-hop. Fashion also underwent significant changes with trends like grunge and neon-coloured clothing.



Figure 2.4 1980s handheld computer game



Figure 2.5 Young people in Sydney protesting against proposed French nuclear tests in the South Pacific, 14 July 1995.

The early 2000s were a time of further significant change and technological advancement. The world was recovering from the non-event of **Y2K** and the aftermath of the terrorist attacks of 11 September 2001 in the USA. In terms of technology, the rise of the internet continued, and the beginning of the social media revolution began. Platforms like MySpace were popular among teenagers and young adults, and instant messaging programs like MSN Messenger were widely used for communication. Reality TV shows such as *Survivor* and *Australian Idol* became popular among young people. Pop culture icons like Britney Spears and Justin Timberlake dominated the music industry. In terms of fashion, Von Dutch hats and sporting team apparel were popular.



**Figure 2.6** A Motorola flip phone from 2003, running MSN Messenger.

**Y2K** In the last years of the twentieth century, there were fears of widespread computer failures as the calendar ticked over to 2000, due to many programs representing the year by two digits, meaning they might interpret '2000' as '1900'. In the end, there were very few problems, probably because of the pre-emptive work done by computer programmers.



**Figure 2.7** The first season of *Australian Idol* aired in 2003, and was won by Guy Sebastian.

## Influences on young people today

### Family

Young people in Australia today are much more likely to be living in single-parent families, blended families, and families where both parents work full time. The influence family has on the development of young people differs significantly.

Some families allow adolescents a high degree of **autonomy** and freedom to experience new things, whereas other families may impose strict rules and responsibilities. Other examples of how family influences differ may be the approach towards adolescents' career choices. Depending on the situation, some families may encourage adolescents to leave school to work in the family business or

**autonomy**  
independence and freedom to be able to make one's own decisions



**Figure 2.8** Families are more diverse today than in the past.

contribute to the family financially, whereas others will place a higher value on education and encourage adolescents to pursue higher education through university. As young people move through adolescence, communication between parents and young people often becomes a challenge. Parents instinctively want to know what adolescents are doing in their spare time and how they are progressing at school. Due to adolescents' increasing independence, many adolescents find this too intrusive, and feel that their parents are 'on their back'. This situation often results in poor communication between parents and adolescents.

### Peers and youth culture

Peer influence increases significantly through adolescence. This influence may be positive, such as support and friendship, and the exertion of good influence through encouraging sport and exercise, or negative, such as peer pressure to engage in risky behaviours or through bullying and/or social exclusion. Youth cultural groups are often identified and distinguished by their clothing, appearance and musical tastes. Historically, many youth cultures have been portrayed negatively by the mass media. However, being involved in a particular youth culture often has very positive influences for adolescents and can play a key role in their development and self-esteem. The



**Figure 2.9** Peer influence increases significantly through adolescence.

rapid development of the internet and social networking is exposing young people to a diverse range of cultures and has facilitated new forms of communication that are replacing traditional face-to-face interaction. As a result, there are many more youth cultures in existence today, which means there is less pressure on young people to 'fit in' to any one cultural group.

In previous generations, there were far fewer dominant youth cultures, such as 'hippies' or surfers.

### Access to information and technology

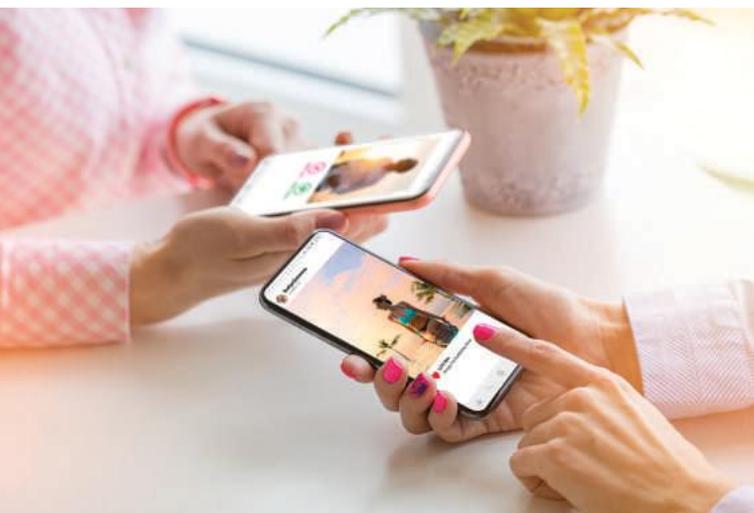
In Australia today, access to information is almost instantaneous, due to our modern communication systems, and this can have both positive and negative effects on young Australians.

**Table 2.1** Some key ways in which technology affects the lives of young individuals

	Positive influence	Negative influence
<b>1 Communication and socialisation</b>	Technology facilitates instant communication and helps young people stay connected with friends and family, irrespective of geographical distances. Social media platforms such as Instagram and Snapchat enable them to create and maintain relationships.	Excessive use of technology for communication may lead to reduced face-to-face interactions, impacting social skills and the ability to form deep, meaningful connections.
<b>2 Education</b>	Technology enhances educational experiences through online resources, e-learning platforms and interactive educational apps. It provides access to a vast amount of information, making learning more engaging and accessible.	Excessive screen time and dependence on technology for learning may lead to distractions and a lack of focus. It can also contribute to issues such as digital addiction.
<b>3 Entertainment and media consumption</b>	Technology offers a plethora of entertainment options, including streaming services, video games and social media. These platforms can be a source of relaxation, entertainment and creativity.	Overconsumption of digital media, especially content that is not age-appropriate or is excessively violent, can have negative effects on mental health. It may also contribute to sedentary lifestyles.
<b>4 Information access</b>	Young people have unprecedented access to information on a wide range of topics, promoting self-directed learning and critical thinking skills.	The abundance of information can lead to misinformation and the spread of fake news. It's crucial for young people to develop media literacy skills to navigate the online information landscape effectively.
<b>5 Health and wellbeing</b>	Wearable technology and health apps help young individuals track and manage their physical activity, sleep and overall wellbeing.	Sedentary behaviours associated with prolonged screen time, cyberbullying and the negative impact on mental health are concerns associated with excessive use of technology.
<b>6 Career opportunities</b>	Technology opens up new career opportunities, especially in fields related to STEM (science, technology, engineering and mathematics) and online influencers. It enables remote work and the gig economy.	The fast-paced nature of technology may contribute to job insecurity and the need for constant skill updates. The pressure to conform to certain technological standards can also be stressful.



**Figure 2.10** An overseas trend that has influenced Australia is the festival scene and the associated increased use of dangerous party drugs.



**Figure 2.11** There has been a rapid growth in the development and application of technology in recent decades.

There has been a rapid growth in the development and application of technology in recent decades, and young people are now engaging with technology in ways that were not available to previous generations.

Changes have been particularly rapid in the field of information and communications technology (ICT). There is widespread use of social media such as Facebook, Twitter, Instagram, Snapchat, TikTok and blogging sites among young people, which has revolutionised the way they interact with each other and the world around them. The development of technology has presented new and exciting job opportunities, such as work as social media influencers and roles in software development, marketing and webpage design, which are well suited to the skills of young Australians.

While there are many positives associated with the increased use of computer technology, it also poses several issues for young people. These include:

- ease of access to inappropriate/explicit content, which may desensitise young people to violence
- material encouraging risky behaviours, which young people may attempt after watching them online
- the cost of mobile phone plans and charges
- issues with cyber-bullying and cyber-safety
- increasing rates of sedentary time and a decrease in physical activity rates among young people
- development of injuries in the joints of the hands from excessive remote-control use associated with gaming.

## Activity 2.1

### Changing technology

Select one of the technologies from Video 2.1, or another technology of your choice, and discuss the impact the changes would have had on young people.

**Skills:** analysis



**Video 2.1** Changing technology

## Global events

Even though Australia is geographically isolated, all generations of young people are impacted by global events. For example, World War II had a profound effect on the Builder generation, Baby Boomers and Generation X saw the start of exploration in space, and the September 11 attacks changed the world for young people after 2001.

But a key difference across the generations is that in Australia today, access to information is almost instantaneous, and more detailed. During World War II, news came by way of radio broadcasts, newspapers, and letters from those serving in the war. Young people of today learn about world events through television and social media.

Global events can have a significant impact on young people, shaping their perspectives, attitudes and priorities. The influence of global events on young individuals can manifest in various ways, including the following:

### 1 Awareness and activism:

Global events often increase awareness among young people about pressing issues such as climate change, social justice, human rights and economic inequality. This heightened awareness can lead to increased activism and a desire to bring about positive change.

### 2 Political engagement:

Major global events, such as elections, geopolitical conflicts (Israel and Gaza, the war in Ukraine) or social movements, can inspire young people to become more politically engaged. They may develop a greater interest in civic participation, voting, and advocacy.

### 3 Social and cultural shifts:

Global events can contribute to shifts in societal norms and values, influencing the way young people perceive diversity, inclusion and cultural issues. This can foster more open-minded and globally aware individuals. The Women's FIFA World Cup has seen a substantial change in the way not only women's sport, but also women, are viewed in Australian society.

### 4 Mental health impact:

Some global events, particularly those related to crises or disasters, can have a profound impact on the mental health of young people. They may experience heightened levels of

stress, anxiety or depression as a result of uncertainty, fear or disruption.

### 5 Technological adoption:

The rapid advancement of technology and its role in global events can shape the way young people communicate, access information and engage with the world. It can contribute to the development of new skills and digital literacy.

### 6 Educational changes:

Global events, such as the COVID-19 pandemic, have led to significant changes in education systems worldwide. Remote learning, hybrid models and increased reliance on technology have become more prevalent, impacting how young people learn and interact academically.

### 7 Economic considerations:

Economic crises, such as recessions or global financial downturns, can influence the career choices and financial outlook of young people. They may face challenges in finding employment or planning for their financial future.

### 8 Environmental consciousness:

Events related to climate change and environmental issues can foster a sense of environmental responsibility among young people. They may be more inclined to adopt sustainable practices and advocate for policies that address environmental concerns.

### 9 Global connectivity:

Young people today are more connected globally through social media and the internet. They can engage with and be influenced by events from around the world, leading to a more interconnected worldview.

### 10 Resilience and adaptability:

Experiencing global challenges can help young people develop resilience and adaptability. They may become more adept at navigating uncertainty and change, skills that are increasingly valuable in today's fast-paced and dynamic world.

It's important to note that the impact of global events can vary based on individual experiences, cultural contexts and socio-economic factors. Additionally, young people themselves play an active role in shaping their responses to these events.



Quiz

## Revise and summarise 2.1

- 1 List the loose categories of generations since World War II, and identify one aspect of their life experience.
- 2 Identify a positive and a negative aspect of peer influence.

## Think critically and apply 2.1

- 1 Outline how global events influence the lives of young people.
- 2 Considering technology, compare the lives of young people today to those of young people in previous generations.
- 3 What aspects of a young person's life today make it different from the life of a young person in previous generations?

**Skills:** research, critical thinking



**Figure 2.12** Young people today have immediate access to information about world events. Photos show office workers listening to the radio during World War II; the 2023 FIFA Women's World Cup; the COVID-19 pandemic; and a protest against the war in Ukraine.

## 2.2 Meanings of health for young people

### Learning objective 2.2

INVESTIGATE the various meanings of health that young people have

In Chapter 1, you looked at different meanings of health, including the World Health Organization's definition, and explored the concept of relative health, and the idea that the meaning of health varies from individual to individual.

The syllabus requires you to undertake primary research into young people's meanings of health, including consideration of the effects of the determinants of health:

- broad features of society
- environmental factors
- socio-economic characteristics
- health behaviours
- biomedical factors.

You can complete the Research skills task individually, in small groups, or as a class.

### Research skills 2.1

Investigate the meanings of health for young people by completing the following:

- Create a research question.
- You will now need to collect data from young people on their meanings of health. What method or methods do you think would allow you to gather the information you need?
- Considering the determinants of health from Chapter 1 (broad features of society, environmental factors, socio-economic characteristics, health behaviours and biomedical factors), how might these impact on a young person's meaning of health?
- Once you have conducted your research, analyse the different ways young people define health and what is important to their own health.
- Are there any ethical considerations you need to consider when gathering this information? Discuss.
- How will you ensure that the data you gather is valid, reliable and credible?
- Once you have gathered your information, present your findings and draw a conclusion by providing a definition of health (based on your findings).
- Has this research into young people's meanings of health opened up any further research questions that could be explored?

*You may wish to refer to the research skills material in the Interactive Textbook when completing this activity.*

**Skills:** collaboration, analysis, communication, creative thinking, problem-solving, research

### Revise and summarise 2.2

- 1 What meanings of health do young people have?
- 2 How do the determinants of health impact on their meanings of health?
- 3 What is important to a young person's health?



Quiz

### Think critically and apply 2.2

- 1 Why do young people have different meanings of health?
- 2 Why is it important to consider ethical implications when planning research?

**Skills:** critical thinking

## Chapter summary

- Development and progression through adolescence can vary significantly between individuals.
- The progression through adolescence sees individuals make the transition from child to adult, and experience a rapid physical, emotional, intellectual and social maturation.
- As young people progress through adolescence, their ability to think, reason and make judgements develops.
- Young people begin to feel that they are the best ones to make decisions about their behaviours and future.
- Young people in Australia today are much more likely to be living in single-parent families, blended families, and families where both parents work full time.
- The influence family has on the development of young people differs significantly.
- As young people move through adolescence, communication between parents and young people often becomes a challenge.
- Peer influence increases significantly through adolescence.
- This influence may be positive, such as support and friendship, and exerting good influence through encouraging sport and exercise, or negative, such as peer pressure to engage in risky behaviours or through bullying and/or social exclusion.
- In Australia today, access to information is almost instantaneous, due to our modern communication systems, and this can have both positive and negative effects on young Australians.
- There has been a rapid growth in the development and application of technology in recent decades, and young people are now engaging with technology in ways that were not available to previous generations.
- Young people's knowledge and engagement with world events is increased through the use of technology.

## Multiple-choice questions

- 1 What has been a cultural shift of recent times?
  - A traditional family being the norm
  - B single-parent families becoming more common
  - C blended families no longer forming
  - D same-sex couples being unable to marry
- 2 The way people communicate has changed drastically due to:
  - A social media
  - B reality TV shows
  - C music streaming platforms
  - D international airfares
- 3 A difference from previous generations for young people is:
  - A importance of peers
  - B desire for independence
  - C risk-taking behaviour
  - D housing affordability
- 4 Which of the following was a popular social media platform during the early 2000s?
  - A Snapchat
  - B Dreamweaver
  - C MySpace
  - D Python
- 5 Small screen usage in young people has been impacted greatly by:
  - A streaming services
  - B smartphone development
  - C social media platforms
  - D all of the above

## Exam-style questions

- 1 How has ONE global event impacted young people? (3 marks)
- 2 Compare the lives of young people today with those of previous generations, making reference to the impact of technology. (5 marks)
- 3 What changes have occurred in the lives of young people over recent generations that have impacted their health? (8 marks)
- 4 Describe how the life of a young person today differs from the life of a young person in a previous generation. (12 marks)

# Chapter 3

## Key health issues that affect young people

### UNIT 1, AREA OF STUDY 2

#### After completing this chapter, you will be able to demonstrate knowledge of:

- the key health issues affecting young people, including Aboriginal and Torres Strait Islander young people
- how to construct an annotated bibliography on a health-related issue for young people
- how the skills for strengthening the individual can protect and enhance health and wellbeing
- how young people can enjoy good health and wellbeing.

#### Key terminology

##### Syllabus terms

Aboriginal and/ or Torres Strait Islander Peoples	health behaviours
annotated bibliography	health literacy
determinants of health	health status
environmental factors	personal biomedical factors
	socio-economic factors

##### Other important terms

burden of disease	self-efficacy
connectedness	self-esteem
resilience	self-identity
self-concept	self-worth



### Driving questions

- 1 To what degree to do all young Australians have the same ability to achieve good health?
- 2 Which population groups seem to have a different ability to achieve good health?
- 3 What factors seem to determine this ability to achieve good health?
- 4 You have just been appointed as the new Health Minister for Young People. What would be your first strategy to improve the health of young Australians?

# Introduction

**resilience** the ability to 'bounce back', recover and respond positively to challenging, stressful and traumatic situations

Young people are among the healthiest groups of people in Australia. This does not mean that young people are without health issues or concerns. These include mental health issues, substance use issues, sexual health, obesity, physical inactivity, sleep disorders and eating disorders.

There are many things that young Australians do to keep themselves healthy. These skills include their personal health literacy, help-seeking behaviours and their level of **resilience**. Many young Australians enjoy good health and positive wellbeing while facing a wide range of challenges

and developing many skills that will help them into the future.

This chapter considers the health status of all young Australians, but also includes some specific comments about Aboriginal and Torres Strait Islander young people, as the syllabus states that this subgroup must be examined. When looking at this data, you should bear in mind the extent to which differences may arise from complex sociocultural factors, including colonial dispossession and racism.

**Please note that this chapter deals with some sensitive topics, such as suicide.**

## 3.1 Key health issues: trends, causes and protective factors

### Learning objective 3.1

EXAMINE the key health issues affecting young people, including Aboriginal and Torres Strait Islander young people

As of 30 June 2022, there were approximately 3.2 million young people aged 15–24 in Australia. This represented 12% of the total population, with 52% male and 48% female. Indigenous Australians aged 10–24 represent 5% of the total Australian youth population. While most of these young Indigenous people live in non-remote areas, those that live in more remote areas represent a greater proportion of the youth population in those areas.

*Australia's Health 2022*, a biannual publication by the AIHW, reported that the death rate among young people has fallen from 41 deaths per 100 000 in 2009 to 38 deaths per 100 000 in 2021. Death rates were two and a half times as high among young males (53 per 100 000) than females (21 per 100 000).

The most recent AIHW report about young First Nations people is *Aboriginal and Torres Strait Islander adolescent and youth health and wellbeing 2018*. It reported that between 2005 and 2015, the death rate declined from 70 deaths per 100 000 to 67 deaths per 100 000.

Across young people generally, in 2020 injuries accounted for 69% of deaths in 15–24-year-olds, making this the leading cause of death for young people. Of these injury deaths, 52% were caused by intentional self-harm (suicide), with the rate being higher for males than females. Looking at the total number of intentional self-harm deaths in Australia, 14% were of young people. Other leading causes of deaths among young people were land transport accidents (28%) and accidental poisoning (8%).

The 2018 report on Indigenous youth health found that the majority of the deaths between 2011 and 2015 were accounted for by injury and poisoning, including suicides, land transport accidents and assaults.



**Figure 3.1** The COVID-19 pandemic had a significant effect on the health of young Australians.

From January 2020 through to June 2022 there were 30 deaths related to COVID-19 in people aged 10–29. In 2020 and 2021, there was a rise in mental health service use and an increase in severe psychological distress although it does not appear that the pandemic led to an increase in suicide deaths in the general population.

The leading **burden of disease** for young Australians is captured in Table 3.1.

**Table 3.1** Burden of disease for Australians aged 15–24

Male	Female
Suicide (14.1%)	Anxiety disorders (10.2%)
Alcohol use disorders (6.6%)	Depressive disorders (8.2%)
Road traffic injuries (5.1%)	Eating disorders (8.1%)
Depressive disorders (5.0%)	Asthma (6.2%)

**Source:** Australian Burden of Disease Study 2022, AIHW

The 2018 report on Aboriginal and Torres Strait Islander youth health identified 13% of the burden of disease for 18–24 year old Indigenous people was owed to suicide and self-inflicted injuries, followed by anxiety disorders (8%), alcohol use disorders (7%) and road traffic accidents (6%).

**burden of disease** the impact of living with injury and illness, and premature death; often measured in terms of how many years of healthy life were lost

The health of young people is important in establishing strong foundations for future wellbeing.

While most young Australians are healthy, some have disease risk factors that are preventable, as shown in various AIHW reports. Of young Australians aged 15 to 24:

- 30% drink alcohol at levels that put them at risk of harm
- 6.8% are daily smokers
- only 3% eat enough fruit and vegetables
- more than 1 in 4 15–17-year-olds and more than 9 in 20 18–24-year-olds are overweight or obese
- over 300 000 are estimated to have experienced high or very high levels of psychological distress.

## Activity 3.1

### Key health issues

- 1 Outline the key health issues facing young Australians.
- 2 Identify which health issues experienced by young people are showing:
  - a positive trend
  - a negative trend
  - no change.

**Skills:** research

## Physical activity

Regular physical activity has many benefits for health and wellbeing at all ages. The AIHW report in May 2023 made the following recommendations for 5–17-year-olds:

- **Physical activity:** At least 60 minutes of moderate to vigorous activity involving mainly aerobic activities per day.
- **Strength:** At least 3 days a week
- **Sedentary or screen-based activity [excluding screen time needed for school-work]:** No more than 120 minutes of screen use. Break up long periods of sitting.

AIHW, *Summary of Australian Physical Activity and Sedentary Behaviour Guidelines*

These recommendations were developed in acknowledgement of the fact that many of the leisure activities that are currently popular with young people, such as watching television, playing video games and using social media, involve very little physical activity. Many children and young people are now also driven to school or other places rather than walking or cycling. Following the guidelines and participating in regular physical activity produces many health benefits. As well as physical benefits such as weight management, increased bone strength, improved muscle development, increased cardiovascular fitness and mobility, there are also many social and emotional benefits. Physical activity can assist in the management of stress, help to improve self-confidence and provide opportunities for social interaction. Physical inactivity is a modifiable

risk factor for overweight and obesity and numerous other illnesses such as type 2 diabetes, cardiovascular disease and osteoporosis.

On 25 June 2021, the AIHW released a report on young people's physical activity, using data from 2017–18. For the 15–17 age group:

- only 11% were sufficiently active (similar to data from 2007–08)
- only 16% met the recommended muscle strengthening guidelines.

The situation was slightly better for the 18–24 age group:

- 55% were sufficiently active (an improvement on 2007–08)
- 36% met the recommended muscle strengthening guidelines.

### Causes and protective factors: physical activity

#### Causes

- lack of access to physical activity opportunities
- poor built environment
- individual factors such as health conditions, lack of time and limited motivation
- social and cultural factors

#### Protective factors

- access to physical activity opportunities
- supportive social and physical environment
- individual factors such as good health, available time and high motivation
- economic stability
- positive attitudes towards physical activity

## Intimate relationships

In 2021 the AIHW released a report on *Australia's youth: Intimate relationships*, (<https://cambridge.edu.au/redirect/10432>) dealing with relationships and sexual behaviours. Some key data sources were:

- *Longitudinal Study of Australian Children (LSAC)* from 2016, which reported on 16–17-year-olds
- *2018 National Survey of Secondary Students and Sexual Health*, which involved students in Years 10, 11 and 12
- *Australian Bureau of Statistics Personal Safety Survey 2016*, extracting data related to those aged 18–24
- *National Community Attitudes towards Violence against Women Survey (NCAS)* for 2017, looking at 16–24-year-olds.

When looking at the following data, bear in mind the differences in time and age of students between the various reports.

## Relationships and consensual sexual behaviour

The LSAC (2016; ages 16–17) reported that:

- 67% of males and 62% of females had been in at least one relationship.
- Around 20% of males and 25% of females had a boyfriend/girlfriend at the current time.

*The National Survey of Secondary Students and Sexual Health* (2018; Years 10–12) had slightly higher figures:

- 73.5% of males and 77.1% of females had been in at least one relationship.
- 33.6% of males and 41.6% of females had a boyfriend/girlfriend at the current time.

The LSAC also reported that of those who had a current boyfriend/girlfriend:

- 96% said their boyfriend/girlfriend was from the opposite sex.
- 51% stayed at their partner's place regularly.
- 84% considered their relationships to be committed and exclusive.

The *National Survey of Secondary Students and Sexual Health* reported that 47% of respondents had engaged in sexual intercourse. Of this group:

- 88% said they felt 'good' or 'happy' about their last sexual experience.

- Discussions before having sex included:
  - the decision to have sex (81%)
  - using a condom (77%)
  - avoiding pregnancy (62%)
  - sexual pleasure without intercourse (48%)
  - avoiding sexually transmitted infections (STIs) (36%)
  - avoiding human immunodeficiency virus (HIV) (30%).
- Regarding use of condoms in the past 12 months:
  - 24% often used condoms.
  - 38% always used condoms (44% of males, and 35% of females).

## Sexually transmitted infections

The AIHW report *Australia's youth: Infectious diseases* noted that the representation of young people in the number of notifications of sexually transmitted infections (STIs) is disproportionately high.

In 2020, the three main STIs notified by young people aged 15–19 were chlamydia, gonorrhoea and syphilis, with chlamydia having nearly five times as many notifications as other STIs:

- chlamydia: 37 500
- gonorrhoea: 7700
- syphilis: 871.

There were around twice the number of notifications from the 20–24 age group than from the 15–19 age group.



**Figure 3.2** In 2016, around two-thirds of young people aged 16–17 reported having had at least one relationship.

Figures 3.3 and 3.4 show the notification rates from 2009 to 2020, suggesting a drop between 2019 and 2020. However, the AIHW warns that: ‘it is difficult to determine how much the changes in notifications in 2020 reflect real changes in the number of cases occurring, and how much they relate to changes in health care seeking and testing associated with the COVID-19 pandemic’.

### Unwanted sexual behaviour

The *ABS Personal Safety Survey* (2018; ages 18–24) found that 27% of respondents (38% of females and 16% of males) had experienced sexual harassment in the past 12 months.

The LSAC (2016; ages 16–17) also reported on unwanted sexual behaviour:

- 49% of females and 31% of males had experienced some form of unwanted sexual behaviour over the past year, including:
  - pictures, stories or jokes (33% of females and 20% of males)
  - gestures, comments, body language, touching or looking at them (30% of females and 15% of males).
- 8% of females and 12% of males had engaged in unwanted sexual behaviour to another person, including:
  - pictures, stories or jokes (7% of females and 8% of males)
  - gestures, comments, body language, touching or looking at someone (3% of females and 7% of males).
- Of those males who had engaged in unwanted sexual behaviour to another person 24% had viewed pornography for the first time before the age of 13, while 7% had never viewed pornography.

The NCAS (2017; ages 16–24) found that very few people felt non-consensual sex to be justified:

- Regardless of whether the couple are in a long-term relationship, or have only just met, non-consensual sex was only felt to be justifiable by 4–5% of respondents.
- Around 14% felt that if a woman initiated intimacy, and then changed her mind, a man would be justified forcing sex.

### Gender equality and respect

The NCAS (2017; ages 16–24) asked about power in heterosexual relationships: it found little support for rigid gender roles, but a certain amount when it came to men making decisions.

- 5% felt it is not good for a relationship if the woman earns more than the man.
- 31% felt women prefer the man to be in charge of the relationship. (36% of males and 26% of females believed this.)
- 43% agreed with the statement ‘I think it’s natural for a man to want to appear in control of his partner in front of his male friends’.
- 22% felt it was not harmful for men to make sexist jokes with male friends. (30% of males and 14% of females believed this.)
- 4% found it acceptable for a man to joke about being violent towards women.

#### Causes and protective factors: sexual relationships

##### Causes:

- low levels of education
- negative peer pressure
- unprotected sex and binge drinking
- being sexually active from a young age
- multiple sexual partners
- females with mental health concerns
- victims of abuse and family breakdown
- being a homosexual male

##### Protective factors

- strong personal relationships and family support
- having a strong sense of self and personal values
- communication with sexual partners about contraception
- religious beliefs
- government legislation
- access to health services
- immunisation programs
- consistent and correct use of condoms during sexual activity
- abstinence from sexual activity
- being in a long-term, monogamous relationship with an uninfected partner
- regular STI testing and prompt treatment of infections
- limiting the number of partners and avoiding high-risk partners

Activity 3.2

Intimate relationships

What are the biggest issues facing young people in regards to their sexual health?

**Skills:** critical thinking

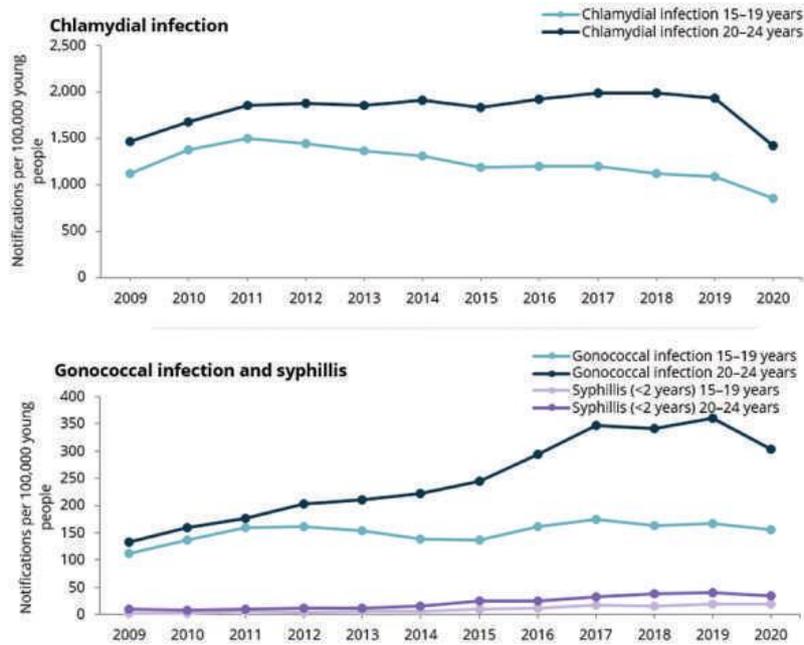


Figure 3.3 Rate of notifications for chlamydial infection among young people aged 15–19 and 20–24, 2009–2020

Source: AIHW, *Health of Young People*

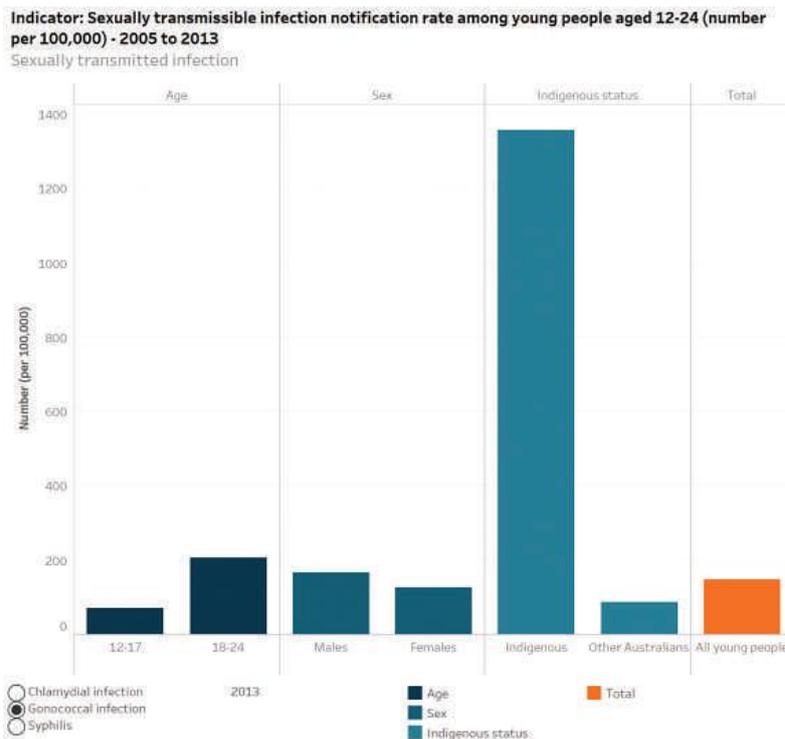


Figure 3.4 Rate of notifications for gonococcal infection and syphilis among young people aged 15–19 and 20–24, 2009–2020

Source: AIHW, *Health of Young People*

## Alcohol use

The AIHW report *Australia's youth: Alcohol, tobacco and other drugs* (<https://cambridge.edu.au/redirect/10431>) released in 2021, is an analysis of youth-related data from its *National Drug Strategy Household Survey* in 2019. Since this time, results from the 2022–2023 *National Drug Strategy Household Survey* have been released, but the AIHW has not yet extracted and analysed data relating to young Australians aged 14–24.

At the time this survey was conducted, the Australian Guidelines to Reduce Health Risks from Drinking Alcohol had two key definitions around drinking:

- 'single occasion risky drinking' was more than four standard drinks on a single occasion
- 'lifetime risky drinking' was averaging more than two standard drinks per day.

The guidelines were updated in 2020 (recommending a maximum of 10 standard drinks per week, and no more than four standard drinks in a single day), but the earlier guidelines are used in the analysis as they were current at the time of

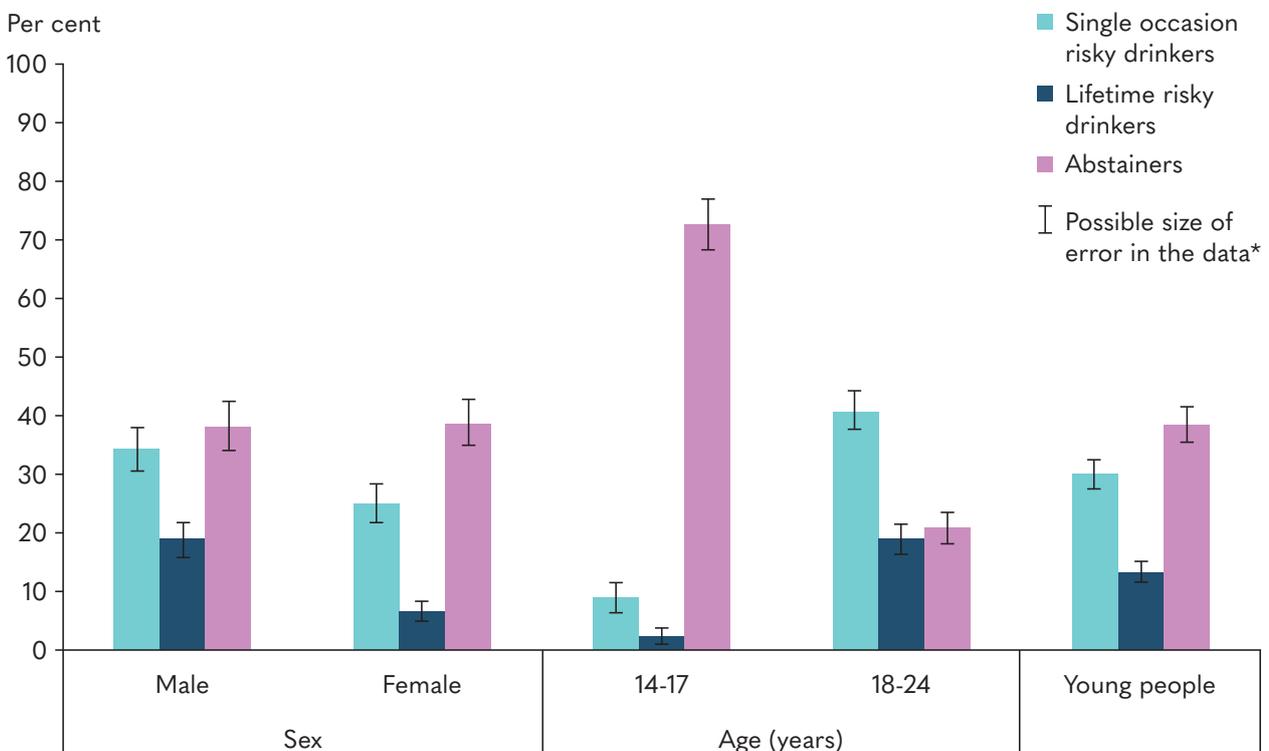
the survey. Both the 2009 and the 2020 guidelines recommend that young people under 18 should not drink alcohol.

The following data predominantly relates to young people aged 14–24, surveyed in 2019. Where available, data from the 2022–2023 *National Drug Strategy Household Survey* is also included.

On average, these young people had their first drink of alcohol at the age of 16.2: for males the average age was 16.1, and for females it was 16.3.

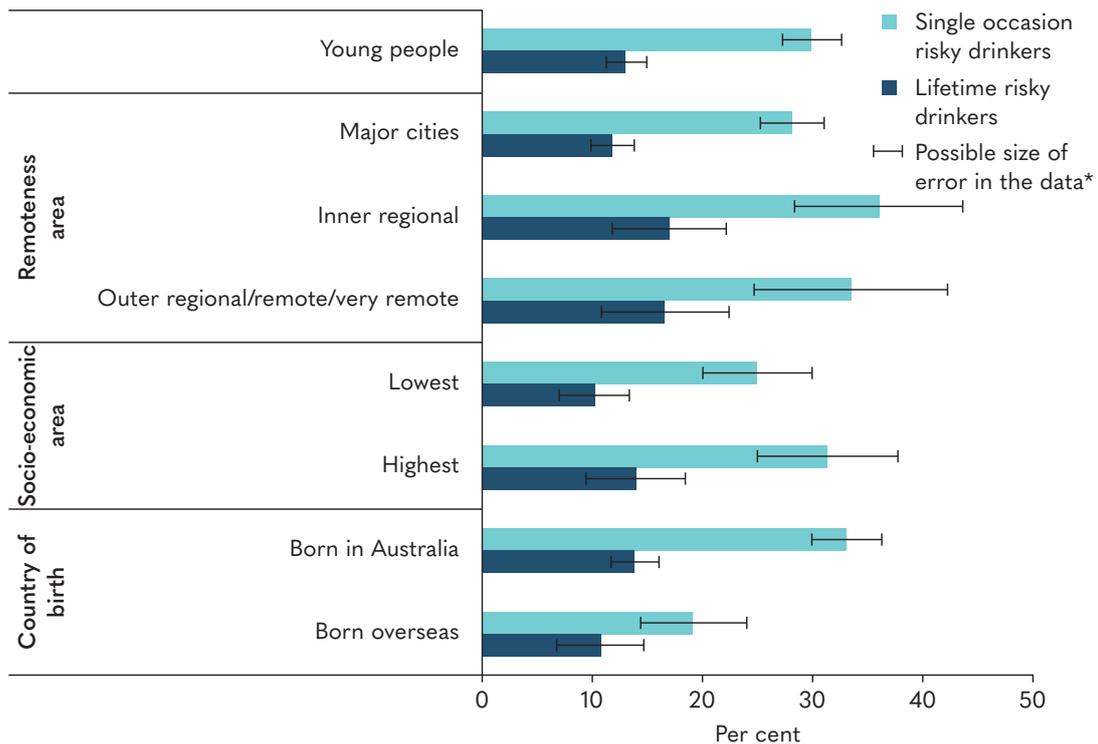
## Drinking levels

Young people were asked about their drinking habits over the past twelve months. Figure 3.5 shows the percentages of single occasion risky drinkers, lifetime risky drinkers and abstainers, by sex and age. Figure 3.6 shows the percentages of single occasion risky drinkers and lifetime risky drinkers by selected population groups. You will notice that both of these graphs have lines indicating the amount of possible error in the data: Figure 3.6 has greater margins of error than that Figure 3.5.



\* Where error bars overlap, difference in values could be due to chance. Where error bars do not overlap, difference in values is statistically significant.

**Figure 3.5** Alcohol use status for young people aged 14–24, by age and sex, 2019  
Source: AIHW, *Health of Young People*



\* Where error bars overlap, difference in values could be due to chance.  
Where error bars do not overlap, difference in values is statistically significant

**Figure 3.6** Alcohol use status for young people aged 14–24, by selected population groups, 2019  
Source: AIHW, *Health of Young People*

Thirty per cent (34% of males and 25% of females) were classed as ‘single occasion risky drinkers’, having drunk at a risky level at least once a month.

- 8.9% of those aged 14–17 were single occasion risky drinkers.
- 18.8% of those aged 18–24 were single occasion risky drinkers.

There was a considerably lower percentage of young people drinking at a level that could put them at risk of harm over their lifetime: 13.1% (18.7% of males and 6.6% of females).

- 2.2% of those aged 14–17 were lifetime risky drinkers.
- 18.8% of those aged 18–24 were lifetime risky drinkers.

In 2022–2023, 1.6% of those aged 14–17, and 28.1% of those aged 18–24, were drinking more than 10 standard drinks per week.

Thirty-eight per cent of young people (38% of males and 39% of females) were classed as abstainers, having not consumed alcohol in the previous 12 months.

- 73% of those aged 14–17 were abstainers.
- 21% of those aged 18–24 were abstainers.

In 2022–2023, 66.4% of those aged 14–17, and 16.3% of those aged 18–24, had ‘never had a full serve of alcohol’.

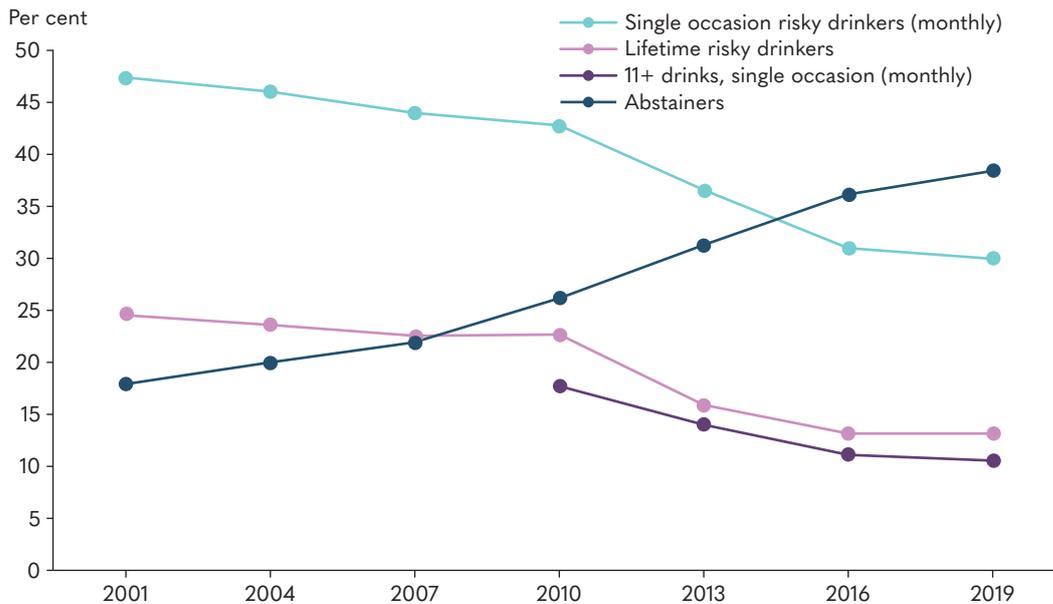
The survey also asked how frequently young people had drunk 11 or more drinks on a single occasion:

- 10.5% had done so at least once a month (15.3% of males and 5.3% of females).
- 22% had done so at least once a year, with a much higher percentage in the 18–24 age range (30%) than in the 14–17 age range (5.7%).

In 2022–2023, this had been done at least monthly by 1.5% of those aged 14–17, and 14.8% of those aged 18–24, and at least yearly by 3.8% of those aged 14–17, and 28.7% of those aged 18–24.

As shown in Figure 3.7, between 2001 and 2019, the proportion of lifetime risky drinkers and single occasion risk drinkers both dropped substantially, while the proportion of abstainers more than doubled. Data about those drinking more than 11 standard drinks on a single occasion, at least once a month, was not collected in 2001, but from 2010 to 2019 this also dropped substantially.

- Males dropped from 31% to 18.7%.
- Females dropped from 18.1% to 6.6%



**Figure 3.7** Alcohol use of young people aged 14–24 over time, 2001 to 2019

Source: AIHW, *Health of Young People*

A further breakdown of information, not shown in the graph, is:

- Single occasion risky drinkers, 2001 to 2019:
  - Males dropped from 53% to 34%
  - Females dropped from 42% to 25%
  - People aged 14–17 dropped from 30% to 8.9%
  - People aged 18–24 dropped from 57% to 41%.
- Lifetime risky drinkers, 2001 to 2019:
  - Males dropped from 31% to 18.7%
  - Females dropped from 18.1% to 6.6%
  - People aged 14–17 dropped from 13.3% to 2.2%
  - People aged 18–24 dropped from 31% to 18.8%.
- People drinking more than 11 standard drinks on a single occasion, 2010 to 2019:
  - The reduction has been largely driven by 18–24 year olds, dropping from 24% to 14.6%.
- Abstainers, 2001 to 2019:
  - People aged 14–17 increased from 32% to 73%
  - People aged 18–24 year increased from 9.7% to 21%.

### Drinking times

Of those young people who had drunk alcohol in the 12 weeks before the survey:

- 28% had drunk on a Friday.
- 26% had drunk on a Saturday.

### Types of alcohol

People who had drunk in the week before the survey were asked what type of alcohol they had drunk.

- Males:
  - 60% had drunk beer
  - 30% had drunk spirits (not pre-mixed)
  - 20% had drunk pre-mixed drinks.
- Females:
  - 35% had drunk wine
  - 30% had drunk pre-mixed drinks
  - 25% had drunk spirits (not pre-mixed).

### Harm caused by drinking alcohol

Of those young people who had drunk alcohol in the 12 months before the survey, 2.5 reported that while they were under the influence of alcohol, they had received an injury that required medical attention.

People were also asked about whether they had been involved in incidents related to alcohol in the previous 12 months:

- 12.1% of 14–17-year-olds had been victims of incidents (8.2% verbal abuse and 22% put in fear).
- 34% of 18–24-year-olds had been victims of incidents (25% verbal abuse, 22% put in fear and 7.5% physical abuse).

### Causes and protective factors: alcohol use

#### Causes

- genetics
- psychological factors (stress, anxiety, depression)
- environmental factors (peer pressure, availability, cultural norms)
- biochemical factors (altered brain function)
- lack of parental supervision
- social isolation and feelings of loneliness
- having a first drink at a very young age – for example, at 12 years of age
- poor role-modelling of the responsible use of alcohol by family and in the media
- mental health concerns
- low-SES background
- cultural stereotypes
- easy access
- unemployment
- low level of education
- poly-drug use

#### Protective factors

- strong family connections
- good academic achievement and school engagement
- positive relationship with parents and peers who discourage alcohol use
- clear and consistent family rules and consequences for alcohol use
- positive sense of **self-worth**
- access to personal support networks and people
- personal values and boundaries, which are either self-enforced or set in place by families
- laws regarding age limits
- education programs
- government health initiatives

**self-worth** a person's inner belief in their own value and place in the world, and their belief that they are worthy of esteem and respect from others

### Activity 3.3

#### Alcohol use

Do you think the use of alcohol among young people will continue to decrease? Why or why not?

**Skills:** critical thinking

### Smoking and e-cigarettes

#### Smoking tobacco cigarettes

As with the information on alcohol use, the data in this section predominantly comes from the 2019 *National Drug Strategy Household Survey*, with data for 14–24 year-olds extracted and in the 2021 AIHW report *Australia's youth: Alcohol, tobacco and other drugs*. Where available, data from the 2022–2023 *National Drug Strategy Household Survey* is also included.

The data report for the survey divides users of tobacco cigarettes (manufactured and/or roll-your-own) into the following categories:

- daily smokers
- occasional smokers (people who smoked once a week or less)

- ex-smokers (no longer smoked, but in the past had smoked 100 or more cigarettes)
- never smoked (have smoked fewer than 100 cigarettes in their lifetime).

Figure 3.8 shows the percentages of all four categories in 2019, by sex and age. Note that this graph indicates margins of error, which are quite large in some cases.

In 2019, 6.8% of young people (7.8% of males and 5.9% of females) described themselves as smoking daily.

- 1.9% of those aged 14–17 were daily smokers.
  - 9.2% of those aged 18–24 were daily smokers.
- By 2022–2023, these age groups had reduced to 0.9% and 5.9% respectively.

Only 4.2% of young people in 2019 reported being occasional smokers.

- 1.3% of those aged 14–17 were occasional smokers.
- 5.7% of those aged 18–24 were occasional smokers.

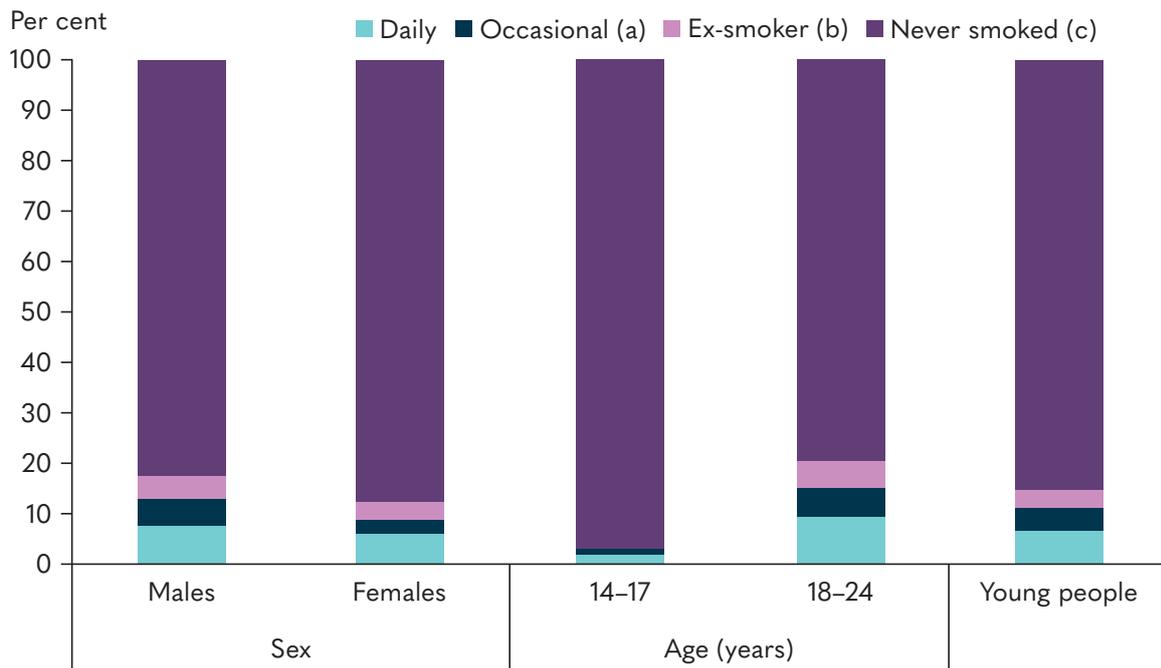
By 2022–2023, these age groups had reduced to 0.7% and 3.4% respectively.

In 2019, the majority of young people (85%) said they had never smoked.

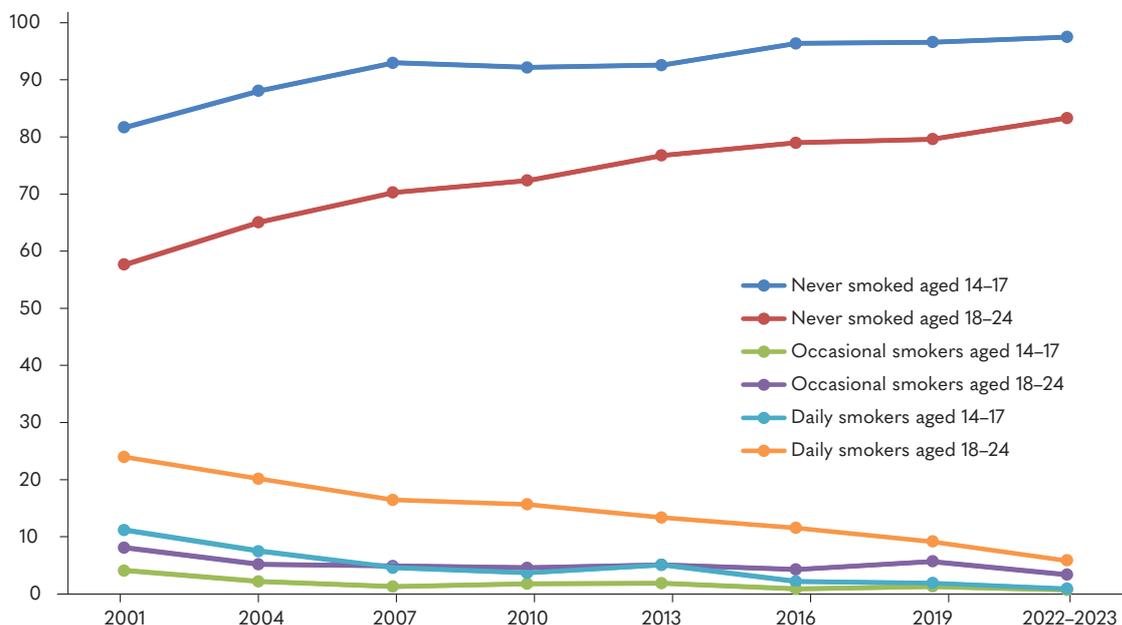
- 97% of those aged 14–17 had never smoked.
  - 80% of those aged 18–24 had never smoked.
- By 2022–2023, these age groups had increased to 97.5% and 83.3% respectively.

Of those who had smoked, the average age for smoking their first full cigarette was 16.6 years old.

As Figure 3.9 shows, changes between 2019 and 2022–2023 are reflective of a longer-term trend away from smoking by young people.



**Figure 3.8** Frequency of tobacco smoking for young people aged 14–24, by age and sex, 2019  
Source: AIHW, *Health of Young People*



**Figure 3.9** Smoker status among young people aged 14–24, by age, 2001 to 2022–2023.

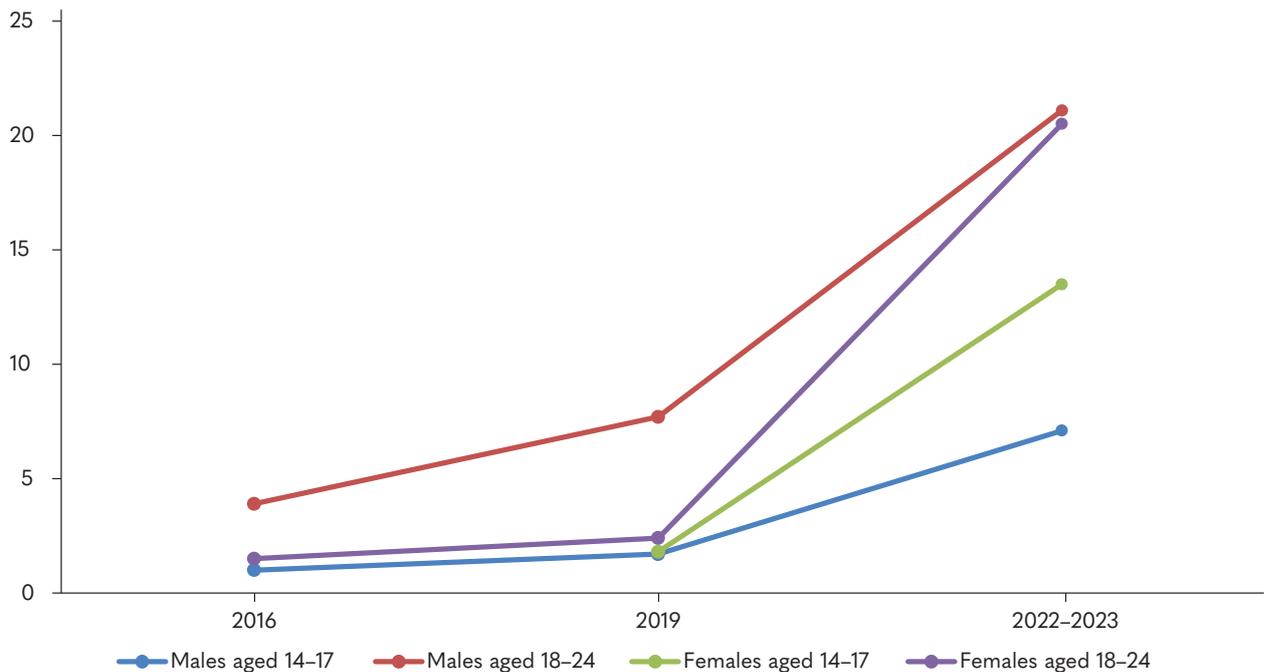
Source: *National Drug Strategy Household Survey 2022–2023*

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**Figure 3.10** Electronic cigarette usage among young people aged 14–24, by age, 2016 to 2022–2023. Source: *National Drug Strategy Household Survey 2022–2023*

### Smoking electronic cigarettes (vaping)

*National Drug Strategy Household Survey* first included questions about use of e-cigarettes (electronic cigarettes) in 2016. As Figure 3.10 shows, the increase in usage among young people has been increasing rapidly. As at 2022–2023:

- 9.7% of people aged 14–17 used e-cigarettes, with a much higher percentage of females (13.5%) than males (7.1%).
- 20.6% of people aged 18–24 used e-cigarettes (21% of males and 20.5% of females).

Compared to all other age groups, 18–24-year-olds had the highest proportion of e-cigarette usage.

Young people gave a variety of reasons for using e-cigarettes, of which the most common in 2022–2023 were:

- Curiosity: 73.7% of 14–17-year-olds and 68.2% of 18–24-year-olds
- Think they taste better than regular cigarettes:
  - 14.5% of 14–17-year-olds
  - 30.7% of 18–24-year-olds
- Think they are less harmful than regular cigarettes:
  - 16.2% of 14–17-year-olds
  - 15.3% of 18–24-year-olds
- They seem more acceptable than regular cigarettes:
  - 10.7% of 14–17-year-olds
  - 17.2% of 18–24-year-olds.

The survey also looked at the connection between the use of tobacco cigarettes and e-cigarettes. Information about young people is not separated out in the 2022–2023 datasheets, but the AIHW analysis of the 2019 survey identified the following proportions among people aged 14–24:

- 8% of current smokers used e-cigarettes, as compared to 2.3% of non-smokers.
- Slightly over 63% of current smokers had tried e-cigarettes at some point in their lives.
- In terms of smoking status when they first tried e-cigarettes:
  - In the 14–17 age group, 34% were current smokers and 65% had never smoked
  - In the 18–24 age group, 58% were current smokers and 39% had never smoked.

### Causes and protective factors: smoking and e-cigarettes

#### Causes (tobacco smoking)

- peer pressure
- stress and anxiety
- genetics
- easy access
- exposure to smoking at an early age
- parental smoking

#### Protective factors (tobacco smoking)

- education
- parental role modelling
- social support
- policies banning smoking in certain places
- higher tobacco prices

**Causes (e-cigarettes)**

- curiosity
- advertising and marketing
- belief that e-cigarettes are safer than traditional cigarettes
- availability and ease of use
- social influence (e.g. peer pressure)

**Protective factors (e-cigarettes)**

- knowledge of the risks
- strong parental and peer disapproval
- strong anti-smoking policies and regulations
- access to cessation resources

**Case Study 3.1**

**Video 3.1** Vaping:  
The facts

**Young people and e-cigarettes**

**Video 3.1** *Vaping: The facts* was created by Smokefree Sheffield to highlight concerns around vaping by children and young people. (Use the QR code to watch Video 3.1.)

**NEWS REPORT**

**We asked over 700 teens where they bought their vapes. Here's what they said**

**Christina Watts, Becky Freeman and Sam Egger**  
*The Conversation*, 27 September 2022

Teen vaping has been in the news, with reports of rapidly increasing use and illegal sales of e-cigarettes.

As a *Four Corners* documentary on ABC TV earlier this year showed, parents and schools are struggling to manage this swift rise in vaping, with fears children are addicted and harming their health.

In contrast, very limited research about Australian teen vaping has been published, until today.

We have published in the Australian and New Zealand Journal of Public Health the first results from the Generation Vape study. The study aims to track teenagers' knowledge,

Case study 3.1 *continued*

attitudes, beliefs and behaviours about using vapes (e-cigarettes).

Here's what we found about where teenagers were accessing vapes and what types of products they use.

### Vaping common, especially in non-smokers

We surveyed more than 700 teenagers 14–17 years old from New South Wales. The sample was closely representative of the population, with key characteristics such as age, gender, location and education monitored throughout data collection.

We found teenagers are readily accessing and using illegal, flavoured, disposable vaping products that contain nicotine.

Among the teens surveyed, 32% had ever vaped, at least a few puffs. Of these, more than half (54%) had never previously smoked.

### Where are teens getting vapes from?

We found most teens (70%) didn't directly buy the last vape they used. The vast majority (80%) of these got it from their friends.

However, for the 30% who did buy their own vape, close to half (49%) bought it from a friend or another individual, and 31% bought it from a retailer such as a petrol station, tobacconist or convenience store.

Teens also said they bought vapes through social media, at vape stores and via websites.

### What products are teens using, and why?

Of the teens who had ever vaped and reported the type of device they used, 86% had used a disposable vape. This confirms anecdotal reports.

These devices appeal to young people and are easy to use. They do not require refilling (unlike tank-style vaping products) and are activated by inhaling on the mouthpiece.

Disposable vapes can contain hundreds, or even thousands of puffs, and are inexpensive, with illicit vapes from retail stores costing between \$20–\$30, or as little as \$5 online.

There is an enormous range of vape flavours likely to appeal to children – from chewing gum to fruit and soft drink, even desserts. So it is unsurprising teens rated “flavourings and taste” as the most important characteristic of vapes they used.

Disposable vapes often contain very high concentrations of nicotine, even those claiming to be nicotine-free. The way these products are made (using nicotine salts rather than the free-base nicotine you'd find in cigarettes) allows manufacturers to increase the nicotine concentration without causing throat irritation.

In our study, over half (53%) of the teens who had ever vaped said they had used a vape containing nicotine. Many, however, were unsure whether they had used a vape containing nicotine (27%).

All vaping products, irrespective of nicotine content, are illegal to sell to under 18s in Australia.

Today, disposable vapes containing nicotine can only be legally sold in Australia by pharmacies to adult users with a valid prescription.

### We need to end illegal imports and sales

Our results emphasise that teen vaping is increasingly normalised,

Case study 3.1 *continued*

and the most popular devices are designed to be highly appealing to young people. This is despite product manufacturers and proponents claiming they are smoking cessation aids only for adult smokers who are struggling to quit.

Turning the tide on teen vaping requires strong and immediate policy action, including ending the illicit importation and sale of vaping products.

Education is often the default first action to address unhealthy behaviours in young people. However, unless this is coupled with strong, supportive policy action, this approach is unlikely to have any measurable impact. Education campaigns cannot protect young people from an industry that so freely disregards laws meant to protect health.

We have strong evidence that vaping leads to harms such as poisoning, injuries, burns, toxicity, addiction and lung injury. The odds of becoming a smoker is more than three times higher for never-smokers who vape than for never-smokers who don't vape.

**What's next?**

This study uses data from the first wave of the Generation Vape research project, a three-year study with Australian teenagers, young adults, parents and guardians of teenagers, and secondary school teachers.

It is funded by the Cancer Council NSW, federal Department of Health and Ageing, NSW Ministry of Health, Cancer Institute NSW and the Minderoo Foundation.

Future waves of this repeat cross-sectional study, coupled with in-depth interviews, will allow us to track and monitor changes to adolescent, young adult, teacher, and parent attitudes, perceptions, and knowledge of vaping over time.

Vaping is a rapidly evolving public health crisis in Australia. Our research provides evidence for concerted policy action to prevent young people from accessing harmful and addictive products.

Failure to act will see a whole new generation of Australians addicted to dangerous products.

- 1 From Video 3.1, identify three short-term effects of vaping.
- 2 Describe the environmental impact of vapes, as outlined in Video 3.1.
- 3 Identify what manufacturers claim is the purpose of vapes.
- 4 Describe how vapes are marketed to appeal to young people.
- 5 Explain how the method of including nicotine in vapes is different from cigarettes, and an effect of this.
- 6 Do you think vapes will continue to be legal in Australia? Why or why not?

**Skills:** analysis, critical thinking

## Illicit drug use

The *National Drug Strategy Household Survey* defines illicit drugs as: ‘any drug which is illegal to possess or use, as well as any legal drug used in an illegal manner, for example pharmaceutical drug used for non-medical purposes; or glue or petrol that is sold legally, but is used in a manner that is not intended’.

As with the information on alcohol use and smoking, the data in this section predominantly comes from the 2019 *National Drug Strategy Household Survey*, with data for 14–24 year-olds extracted and in the 2021 AIHW report *Australia’s youth: Alcohol, tobacco and other drugs*. Where available, data from the 2022–2023 *National Drug Strategy Household Survey* is also included.

In 2019, 24% of young people (27% of males and 21% of females) reported having used illicit drugs in the 12 months before the survey.

- 9.7% of those aged 14–17 had used illicit drugs.
- 31% of those aged 18–24 had used illicit drugs.

## Types of drugs used

In 2022–2023 (as in 2019) the non-medical use of pharmaceuticals was considerably lower than that of other illicit drugs.

Non-medical use of pharmaceuticals in the 12 months before the 2022–2023 survey was reported by:

- 3.1% of those aged 14–17
- 9.0% of those aged 18–24.

Pain-killers/pain-relievers and opioids were the most commonly used (1.6% of 14–17-year-olds and 3.2% of 18–24-year-olds), followed by tranquilisers/sleeping pills (0.5% and 3%).

Other illicit drugs were used in the 12 months before the 2022–2023 survey by:

- 13.3% of those aged 14–17
- 34.6% of those aged 18–24

Cannabis was by far the most commonly used drug (9.7% of 14–17-year-olds and 25.5% of 18–24-year-olds), followed by cocaine (0.2% and 11.3%) and then ecstasy (0.7% and 6.7%).

## Association with mental illness and psychological distress

The 2019 report found correlations of mental illness and psychological distress with use of illicit drugs, but cautioned that this did not mean there was a causal relationship:

In 2019, young people aged 14–24 with self-reported mental health illness were more likely to have engaged in illicit use of drugs (including pharmaceuticals) in the last 12 months than people without (36% compared with 22%).



**Figure 3.11** In 2019, 24% of young people aged 14–24 had engaged in illicit use of drugs in the past 12 months.

Young people aged 18–24 with low levels of psychological distress were less likely to have engaged in illicit use of drugs (including pharmaceuticals) than those with higher levels of psychological distress (43% for high/very high distress, 34% for moderate distress and 24% for low distress). It is important to note that these findings are associations and do not establish a causal relationship between mental illness and drug use (AIHW 2020). Mental illness may have preceded or followed drug use. The relationship between drug taking and mental illness is complex. Drugs are sometimes used for short-term relief and can also make symptoms of mental illness worse (SANE Australia 2016).

### Factors influencing decisions

In 2022–2023, the most common factors listed by young people as influencing their first use of an illicit drug (excluding pharmaceuticals) were:

- to see what it was like/curiosity (68% of 14–17-year-olds and 75% of 18–24-year-olds)
- friends or family members were using it/it was offered by a friend or family member (64.1% and 65.2%, respectively)
- to do something exciting (26.6% and 32.1%, respectively).

The survey also asked about the factors influencing young people who have *never* used an illicit drug. The data currently released from 2022–2023 does not provide an age breakdown for these factors. However, the 2019 analysis provided this information, which is shown in Figure 3.12.

### Change since 2001

Between 2001 and 2019, the use of illicit drugs (including pharmaceuticals) by the 15–24 age group decreased:

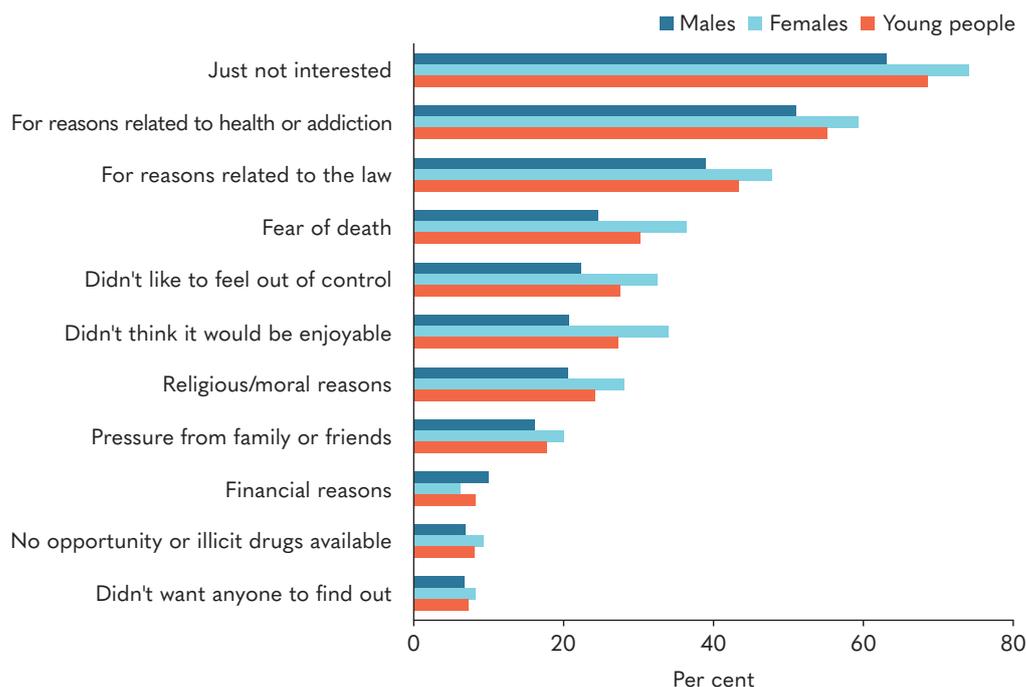
- The proportion who had used illicit drugs in the previous 12 months dropped from 32% to 24%.
- The proportion who had ever used illicit drugs dropped from 50% to 38%.

The period from 2001 to 2007 showed the largest reduction (32% to 22%), after which the proportions remained similar, but with a slight upward trend.

Between 2001 and 2007, the reduction in young people's use of illicit drugs over the previous 12 months carries across age groups and sexes:

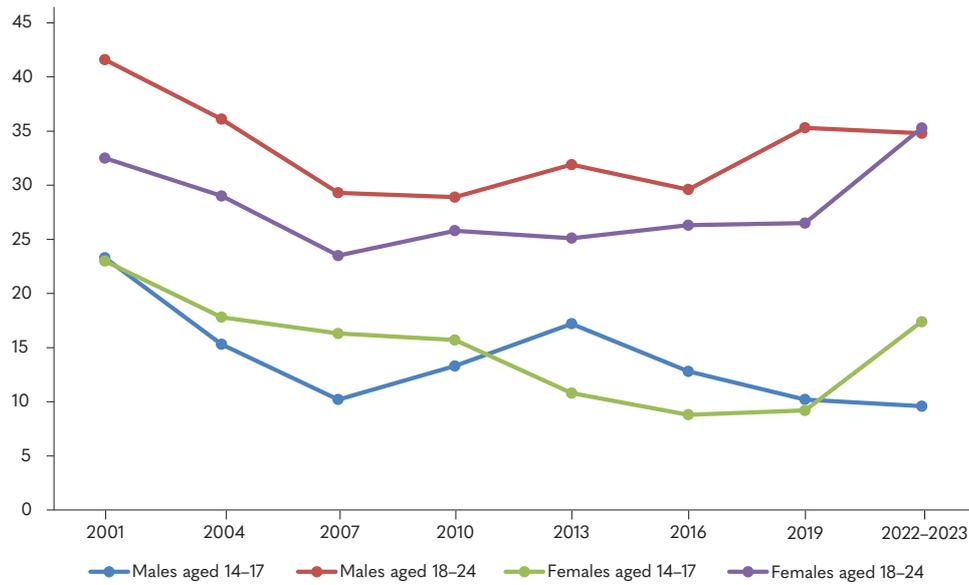
- 14–17-year-olds dropped from 23% to 13.2%.
- 18–24-year-olds dropped from 37% to 26%.
- Males dropped from 35% to 23%.
- Females dropped from 29% to 21%.

The period 2010 to 2019 saw a decrease in recent use by 14–17-year-olds, but an increase by



**Figure 3.12** Factors influencing the decision of young people aged 14–24 to never illicitly use drugs (including pharmaceuticals), by sex, 2019

Source: AIHW, *Health of Young People*



Cigarette use from 2001 to 2022

**Figure 3.13** Recent illicit use of drugs (excluding pharmaceuticals) for young people aged 14–24, 2001 to 2022–2023

Source: *National Drug Strategy Household Survey 2022–2023*

18–24-year-olds, with use by males and females remaining largely unchanged:

- 14–17-year-olds dropped from 14.5% to 9.7%.
- 18–24-year-olds increased from 27% to 31%.
- Males increased slightly from 24% to 27%.
- Females dropped slightly from 22% to 21%.

Figure 3.13 shows recent use of non-pharmaceutical illicit drugs from 2001 to the most recent survey of 2022–2023. This follows a similar trend to 2019, but with an increase in use for females between 2019 and 2022–2023.

However, more detailed data shows that from 2001 to 2022–2023, use in the previous 12 months of illicit drugs (excluding pharmaceuticals) did vary by type of drug:

- Cannabis use decreased:
  - 14–17-year-olds: 20.7% to 9.7%
  - 18–24-year-olds: 32% to 25.5%.
- Cocaine use remained relatively unchanged for the 14–17 age group, but increased for those aged 18–24:
  - 14–17-year-olds: 0.7% to 0.2% (with a note that there is a high error margin)
  - 18–24-year-olds: 4.4% to 11.3%.
- Ecstasy use decreased:
  - 14–17-year-olds: 3.2% to 0.7% (with a high error margin for 2022–2023)
  - 18–24-year-olds: 11.7% to 6.7%.

### Causes and protective factors: illicit drug use

#### Causes

- peer pressure
- accessibility
- stress and mental health issues
- family and social environment
- socio-economic factors

#### Protective factors

- positive social networks
- education and awareness
- healthy lifestyle choices
- access to mental health services
- community engagement



**Figure 3.14** Young people are less likely than any other age group to seek professional help.

## Mental health

More than 75% of mental health conditions experienced by Australians will have occurred before the age of 25, and half of these will have been started by the age of 14. In any given year, around 14% (one in seven) people aged 4 to 17 will experience a mental health condition.

When compared to older Australians, young Australians are experiencing higher levels of psychological distress. Beyond Blue reported in 2024 that in the previous 12 months, 19.9% of young people aged 11–17 had levels of psychological distress that were high or very high. Within this group, there was a higher percentage of young females aged 16–17 (36.2%) and particularly those with a major depressive disorder (80.7%).

Major depressive disorders were more prevalent in the 12–17 age group (5%) than the 4–11 age group (1.1%). In addition, Beyond Blue advises that in the past 12 months, 6.9% of 4 to 17-year-olds will have suffered from an anxiety disorder.

The Beyond Blue website states that of young people aged 12–17:

- one in 10 will self-harm
- one in 13 will seriously consider suicide
- one in 40 will make an attempt at suicide.

**connectedness**  
the number and quality of social connections or relationships with family, friends and acquaintances

Suicide is a leading cause of death for young Australians, accounting for 2.4 deaths per 100 000 young people aged 5–17 years. Of these deaths, 80% are of people between 15 and 17 years of age. In 2019, suicide represented 40% of deaths among the 15–17 age group and 36% of deaths among the 18–24

age group, which is an increase of 25% over the previous decade. Rates among Indigenous young people are higher when compared to non-Indigenous young people.

While coronary heart disease and other conditions result in more premature deaths than suicide, a person who dies by suicide loses more years of potential life. In 2019, a person who died by suicide lost 36.7 years of potential life.

Young Australians make use of mental health services at a higher rate than the rest of the

population, although many do not, cannot or choose not to access support. Beyond Blue reports that young women are much more likely than young men to seek professional help for a mental health problem, but the numbers are still low: 13% of males and 31% of females.

The COVID-19 pandemic led to an increase in people experiencing severe psychological di

A rise in mental health service use and an increase in severe psychological distress were observed during the COVID-19 pandemic in 2020 and 2021. However, there is no evidence to date that COVID-19 has been associated with an increase in suspected deaths by suicide in the general population.

### Causes and protective factors: mental health

#### Causes

- poor body image and sense of self-worth
- lack of parental supervision or positive role models
- low engagement with school and limited future career options
- significant trauma and grief
- social isolation
- unemployment
- low level of education
- sexuality issues
- access to firearms
- incarceration
- substance abuse
- victim of child abuse
- family history of mental illness

#### Protective factors

- strong social support networks and **connectedness**
- feelings of safety and connection at school
- personal resiliency; coping and management skills
- personal interests and hobbies
- at least one involved parent
- regular positive experiences and success
- positive outlook and perspective on life
- laws regarding age limits (e.g. sexual consent)
- access to health services
- education around youth issues
- economic security

### Activity 3.4

#### Mental health

- 1 Consider your own situation. What causes may impact on your mental health? What protective factors for mental health are present in your life?
- 2 What strategies could help to address suicide rates in young people?

**Skills:** analysis, problem-solving

### Injury and deaths

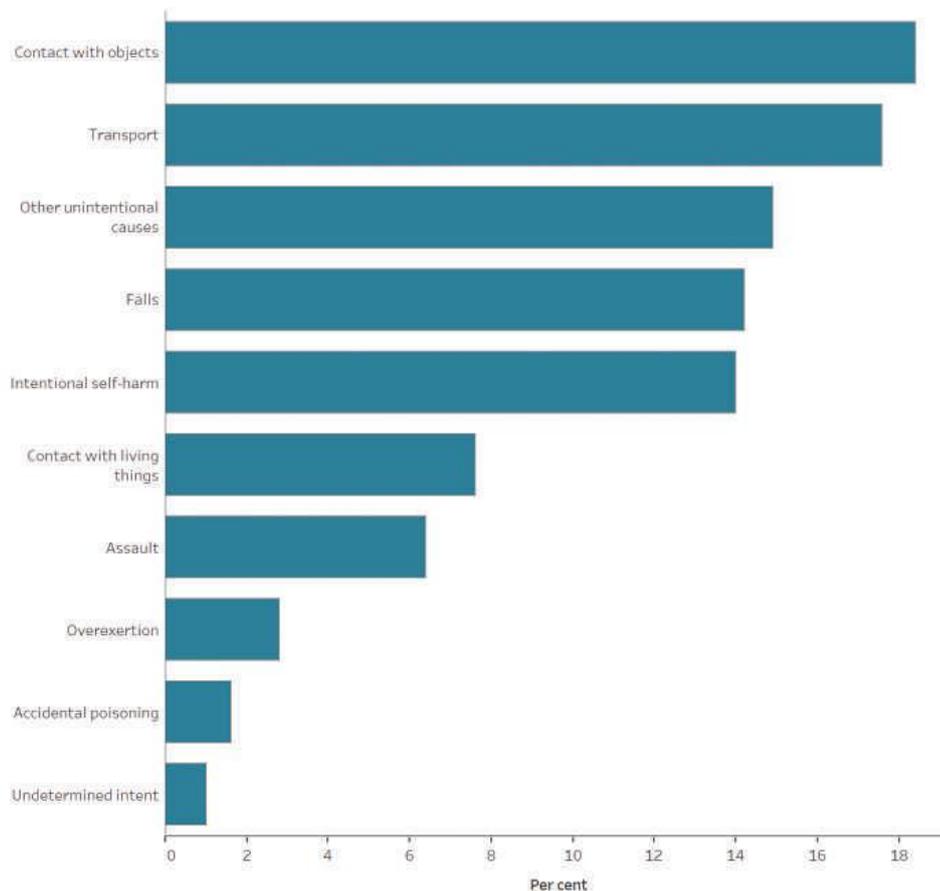
The AIHW reported that in 2021–22 the two leading causes of injuries that resulted in people aged 15–24 being hospitalised were ‘contact with objects’ (which is being cut or struck by an inanimate object, but not a human or animal) and transport accidents, at 18.4% and 17.6% respectively (Figure 3.15).

Death rates among young people have been falling over the past decade. In 2009 there were 41 deaths per 100 000, but by 2021 this had dropped to 38 deaths per 100 000. Death rates among young males were higher than among young females (53 and 21 per 100 000 respectively).

In 2021 there were 1200 deaths among people aged 15–24, of which 809 (69%) were the result of injuries.

Of these injury deaths, 50% were caused by suicide and 28% by land transport accidents. The next cause was accidental poisoning, at 8%

Although the overall number death rate among young people has been falling, deaths as a result of suicide have been increasing: in 2009 there were 9.1 per 100 000, and in 2021 the figure was 13 per 100 000, with males being more likely to die by suicide than females. Of intentional self-harm deaths across all age ranges, 13% were of young people.



**Figure 3.15** Hospitalised injury cases of people aged 15–24, by causes of injury, 2021–22

Source: AIHW, *Health of Young People*

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### Causes and protective factors: injury and deaths

#### Causes

- unsupervised activities
- lack of safety education
- recklessness and impulsivity
- environmental hazards (e.g. workplace)
- violence

#### Protective factors

- safe environments
- education and awareness
- supervision and monitoring
- good mental health
- strong social connections

### Road safety

Road traffic crashes account for 45% of all young Australian injury deaths, with drivers being twice as likely to be hospitalised as passengers. The injury death rate for Indigenous youth is five times greater than for non-Indigenous youth, indicating a massive inequity in this area. Only 10–15% of the licensed driving population in Australia is aged 17–25 years, but these young drivers make up a quarter of all Australian road deaths. This indicates that young people are overrepresented in the death toll on Australian roads. A 17-year-old driver with a P1 licence is four times more likely to be involved in a fatal crash than a driver over 26 years. The most common factor in road fatalities of young

drivers is speeding. Males aged 17–25 represent over 30% of speeding drivers and riders in fatal crashes, while females aged 17–25 represent only 6%. This highlights another inequity on the roads for young people, with males more likely to be involved, injured or killed as a road user. Males are overrepresented due to the higher likelihood that they will engage in riskier behaviours when driving or as a passenger of a vehicle.

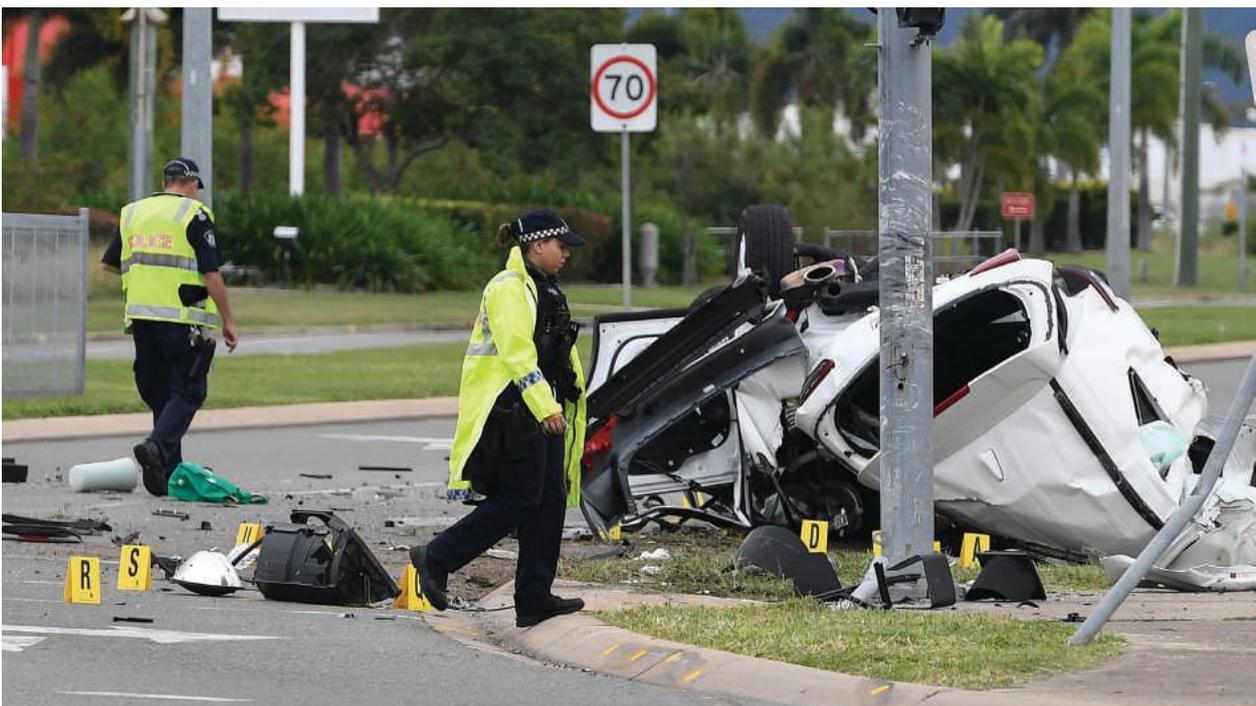
### Causes and protective factors: road safety

#### Causes

- lack of driver experience
- drug and alcohol use
- high levels of driver fatigue
- sex (males involved in more road fatalities)
- poor road design
- geographic location
- risk-taking behaviours
- high-powered vehicles

#### Protective factors

- driver education programs in schools and the media
- graduated licensing scheme
- strict road laws (e.g. drink driving and reduced demerit points)
- Driver Reviver
- road and vehicle improvements
- government initiatives



**Figure 3.16** On 7 June 2020, four teenagers were killed in a single-vehicle crash in Townsville, Queensland.

### Activity 3.5

#### Injuries

Are the current licensing rules enough or too much? Explain.

**Skills:** critical thinking

### Revise and summarise 3.1

- 1 List the key issues facing young people in Australia, and for each key issue, identify
  - a the trend of that key issue
  - b the causes of the key issue
  - c the protective factors of the key issue



Quiz

### Think critically and apply 3.1

- 1 Consider your own situation. For two or more of the key issues in this section, identify:
  - a the causes you are faced with
  - b the protective factors that are present in your life.

**Skills:** analysis, critical thinking



**Figure 3.17** Young people, are among the healthiest groups of people in Australia, but awareness of health issues is important.

## 3.2 The determinants of health and health-related behaviours

### Learning objective 3.2

EXAMINE how health-related behaviours are affected by the determinants of health

As you saw in Chapter 1, the determinants of health are the factors that interact to determine the level of health that people experience. They include:

- broad features of society
- environmental factors
- socio-economic characteristics
- health behaviours
- biomedical factors.

The determinants act in varying degrees and can have either a positive or a negative influence on a person's health. Often determinants are closely linked and changes in one area may impact on others.

### Environmental factors

#### Rural or remote areas

Young people who live in rural and remote regions experience poorer health than those who live

in cities. In some areas there is limited access to healthy food options, while young people may be exposed to dangerous work and living environments. This may contribute to higher rates of chronic disease.

There are also strong cultural stereotypes that discourage young men from employing preventative health measures, such as regular health check-ups. This is further compounded by a lack of access to both basic and specialised medical services in these areas. Needing to travel further to access basic medical services means that young people in rural and remote regions have less opportunity to attend to basic health needs, although the increased availability of online and telehealth services is leading to some improvement in this area.

However, remote living can also offer unique opportunities for physical activity, such as outdoor recreation and manual labour, which can promote a healthy lifestyle. Overall, the effect of remoteness on health is complex and multi-faceted.



**Figure 3.18** The Royal Flying Doctor Service provides emergency and healthcare services to rural and remote Australia. In spite of this, many young people are unable to access basic medical services with ease.

### Urban environments

Although urban environments offer greater access to healthcare than is available to young people in rural and remote areas, there are also challenges. Living in a city means having access to a wide variety of health food options, but there are also a large number of fast food outlets, which may be more convenient and attractive to some young people.

Limited or expensive rental accommodation, can lead to young people living in poor quality or overcrowded housing, and working long hours to meet the cost of living. Where transport is primarily by car, the amount of incidental exercise is reduced, while cost and the lack of green spaces make recreational exercise more challenging.

### Socio-economic characteristics

Many young people share the same level of economic advantage or disadvantage as their parents. Many young people are dependent on their families for financial support. For those who are able to earn an income, it is typically part-time work while still at school. Low income may limit access to healthy food and opportunities for physical activity.

Young people from low socio-economic backgrounds are more likely to smoke, drink alcohol in risky amounts and have a poorer diet. Therefore, low socio-economic status represents a significant risk factor for health, particularly for lifestyle-related chronic diseases. People from low socio-economic backgrounds also display lower rates of utilisation of health services, and have poorer housing conditions.

### Employment

Over recent decades, there has been a strong trend towards less full-time employment and more part-time, casual and contract work. In addition to changes in the type of employment, new jobs are not being created at the same rate, which is making it very competitive for young people to find employment in today's society.

Australia is facing increasing rates of youth unemployment, which is placing huge financial



**Figure 3.19** Many young people who work do so in unskilled, part-time roles, such as in takeaway food outlets.

pressure on government welfare payments, and also means increased financial pressures on the families of young Australians looking for work. There are typically even fewer employment opportunities for young people in rural and remote areas.

Employment has a number of benefits for young people, including financial independence, improved self-confidence and feelings of self-worth due to being valued by their employer, colleagues and the wider community. However, the opposite effects can also occur in young people who struggle to find consistent employment and become reliant on government payments.

Many young people work in unskilled, part-time roles such as in takeaway food outlets, other hospitality industry jobs and basic machinery operating jobs. For these jobs, many young people are required to work outside of school hours (weekends and nights), which impacts on study and social commitments, and may introduce new risks associated with fatigue. Many young people who leave school enter into structured apprenticeships and traineeships, where the initial level of pay is quite low, increasing annually with experience. Less disposable income decreases the likelihood that young people will be able to undertake preventative health measures.

## Education

Education is integral to a young person's health and wellbeing, as well as their future productivity and contribution to society. A lack of awareness and knowledge of the signs and symptoms of ill-health, as well as the skills to access appropriate health services, can leave young people exposed to poor health.

There has been a positive trend in education over the last 50 years, with significantly more young people staying longer at school and in higher education.

Retention rates (students staying to the completion of Year 12) have increased from 23% in the late 1960s to 76% in 2009. Retention rates have been fairly stable since the early 2000s.

Over half of all 15–24-year-olds are studying for a qualification; however, rates are substantially lower among Indigenous students and those living in remote areas. Studies have highlighted that nearly one-third of school leavers aged 15–24 years did not complete Year 12, and those who left school without completing Year 10 were twice as likely to be unemployed than those who completed Year 12 (25% compared with 12%). To address this issue, the Council of Australian Governments (COAG) introduced a youth participation requirement

from 1 January 2010, requiring young people to be in school until they complete Year 10 and then to participate in full-time education, training or employment until they turn 17.

**food security**  
being able to  
obtain sufficient,  
safe and  
nutritious food

School education now has an even bigger role to play in shaping values and health behaviours among young Australians, as they are staying at school for longer. It is important that schools provide health education in areas such as drug use, sun protection, healthy eating and physical activity, and also that they create supportive environments for these areas by having good policies. Examples include healthy canteens, daily physical activity circuits, mental health supports and diversity and inclusion policies.

## Housing

Housing conditions can have a significant impact on health-related behaviours. Poor housing

conditions, such as overcrowding, inadequate ventilation and exposure to environmental hazards can contribute to the development of various physical and mental health problems. On the other hand, adequate and safe housing can promote positive health behaviours, such as physical activity and healthy eating, by providing a supportive environment for these behaviours. Housing also affects access to healthcare and community resources, which can influence health behaviours and outcomes. Therefore, ensuring access to safe and healthy housing is an important aspect of promoting overall health and wellbeing.

## Access to services

Access to health services can have an impact on health-related behaviours. When people have access to quality healthcare, they are more likely to engage in healthy behaviours and seek treatment for health issues in a timely manner. Additionally, access to preventive care services can help people adopt healthier behaviours, while access to health education can help increase awareness and knowledge of health practices. On the other hand, lack of access to healthcare can lead to delayed treatment and can negatively impact health behaviours.

## Food security

**Food security** can significantly impact health-related behaviours. When individuals have ready access to nutritious food, they are more likely to adopt healthy eating habits and maintain a balanced diet. On the other hand, food insecurity can lead to malnutrition, increase the risk of chronic diseases, and reduce the ability to lead a healthy lifestyle. Food insecurity can also result in stress and anxiety, which can further impact physical and mental health. It is essential to ensure food security for all individuals to support healthy behaviours and improve overall health outcomes.

## Migration and refugee status

Migration and refugee status can have significant impacts on health-related behaviours. The stress and trauma of migration and displacement can lead to physical and mental health problems, such as increased rates of anxiety, depression and post-traumatic stress disorder (PTSD). This can,

in turn, affect health-related behaviours such as sleep patterns, eating habits and lifestyle choices.

In addition, migration and displacement often lead to changes in living conditions, such as limited access to healthcare, safe housing and nutritious food, which can negatively impact health. Furthermore, refugees and migrants may experience discrimination and social isolation, which can further contribute to poor health

outcomes. Another potential issue is language barriers: if English is a second language in the home, young people may face difficulties in clearly communicating their health needs.

However, it is worth noting that migration and refugee status can also provide opportunities for improvement in health-related behaviours, such as access to better healthcare and safer living conditions in the country of resettlement.

### Case study 3.2

#### Safe Havens

Safe Haven is an initiative by NSW Health to provide people experiencing distress or suicidal thoughts with a non-clinical alternative to a hospital emergency ward. It is open to all ages, but is a particularly valuable option for young people.

A key feature of Safe Havens is that they are run by people with lived experience of suicidal ideation, who also helped design the model of care. These peer-support workers offer a calm, non-judgemental, culturally sensitive environment. Because Safe Havens are on or near hospital grounds, mental health professionals are also on hand to provide information and clinical support if needed. But the first point of contact is people who can use their lived experience to support other people.

A Safe Haven is a place you can go if you're feeling distressed or having suicidal thoughts.

It is a safe place where you can talk openly about how you are feeling and what you're going through.

A place where you can feel supported and not judged.

You can talk to peer-support workers or be connected to a mental health professional.

If you don't feel like chatting, you can spend time in a quiet space and listen to music.

It's free and you don't need an appointment.



Video 3.2 Safe Haven Westmead



Figure 3.20 Safe Havens are open to all.

NSW Health, 'Safe Haven'

Case study 3.2 *continued*

**Figure 3.21** Safe Havens are staffed by peer-support workers.

- 1 What are Safe Havens?
- 2 What are the key features of Safe Havens?
- 3 Do you feel that these Safe Havens will be something that young people access? Why or why not?
- 4 Suggest other possible strategies to assist young people dealing with mental health issues.

**Skills:** analysis, critical thinking, problem-solving

## Health behaviours

Health behaviours are part of a person's individual lifestyle. Many Australians could reduce their health problems by modifying risk factors such as smoking or vaping, high alcohol use, physical inactivity and poor diet. On the other hand, positive health behaviours such as good eating patterns, quality sleep, regular exercise and good social supports can have a beneficial effect on health.

Legal or illegal drug use can have both short- and long-term impacts on young people. Individuals who engage in drug use during adolescence are more likely to continue drug use later in life. Many adult tobacco or marijuana users started smoking during adolescence. During this period, many young people experiment with substances that may cause immediate or long-term health problems. Short-term problems include injury/hospitalisation from intoxication or misuse, dependence, withdrawal symptoms, psychotic disorders, poor concentration, engagement

in risky behaviours and impacts on academic performance. In the long term, harmful drug use can cause a range of health problems, including blood-borne diseases, damage to the liver, heart and brain, and increased risk of cancer and other serious health conditions, as well as severe impacts on socialising and maintaining healthy relationships. Limiting access to harmful substances like tobacco and drugs can have a positive effect on a young person's health.

Physical activity is a key part of a young person's life. It is a time when many young people develop their patterns of lifelong physical activity. Encouraging physical activity through sport, recreation and outdoor activities plays a key role in the health of young people.

Dietary behaviour often becomes an individual's responsibility as they gain independence and potentially greater access to finances. Promoting healthy eating habits and nutrition education is essential for young people to lead a healthy life.



**Figure 3.22** Promoting healthy eating habits and nutrition education is essential if young people are to lead a healthy life.

Sexual practices and behaviours may commence at some point through the adolescent and young adult years. Implementing comprehensive sex education and promoting safe sexual practices provides young people with key skills that will benefit them throughout their life.

### Biomedical factors

Biomedical factors, such as heredity, age, blood pressure, blood lipids, blood glucose levels and obesity, can have both short- and long-term risks for health. As you saw in Chapter 1, these will often interact with other determinants of health, such as health behaviours.

### Heredity

Each individual has a unique combination of genetic material passed on from their parents. Genetics may either protect individuals from disease or increase their risk. For example, familial hypercholesterolemia (a genetic condition in which the body produces too much cholesterol) increases the risk of cardiovascular disease. Many

individuals may be genetically predisposed to a particular disease or health condition; however, it is often a combination of genetics, the individual's lifestyle choices and the environment that ultimately causes disease.

### Gender

Society places different pressures on young males and females. Young females are presented with culturally-idealised and often digitally-altered images of women through advertising and other media. Young males are also presented with idealised images of what masculinity looks like, often with a focus on muscle mass. Gender-diverse and culturally-diverse individuals can experience different social conditioning around body image. These social influences can lead to young people developing disordered eating practices, inappropriate use of supplements and feeling anxious or depressed about their appearance. Statistically, females are more likely than males to seek advice and medical care when issues do present themselves.

### Research skills 3.1

Research a health-related issue for young people. Your research should cover the following:

- the nature of the issue
- what the data is telling us about it
- why it is an issue
- any protective factors against it
- strategies currently in place
- effective new strategies
- possible further research questions.

You may wish to refer to the research skills material in the Interactive Textbook when completing this activity.

**Skills:** research



Quiz

### Revise and summarise 3.2

- 1 What are the determinants of health?
- 2 How do the determinants of health affect health-related behaviours?

### Think critically and apply 3.2

Consider three of the new strategies identified in this section. How effective do you think each might be? Justify your response.

**Skills:** critical thinking



**Figure 3.23** Engaging in regular exercise is a positive health behaviour for young people

## 3.3 Skills for strengthening the individual

### Learning objective 3.3

ANALYSE how the skills for strengthening individuals can protect and enhance health and wellbeing in relation to the health issue you researched

As young people grow in maturity and independence, they must take on increasing responsibility for their own health. While some lifestyle decisions can have a direct impact upon a young person's immediate health status (e.g. dangerous risk-taking, leading to a broken leg), other consequences are more subtle or won't arise until later in life. Mental health disorders tend to develop gradually without obvious signs and symptoms, and a young person may not realise that their lifestyle, drug use and relationships are contributing towards deteriorating mental health. Similarly, a poor diet, smoking and low activity levels may not immediately lead to obesity and heart disease, but the long-term risk is very high. Because young people tend to live with a more immediate and short-term outlook, they can also tend to ignore the potential for ill-health.

When a young person has a positive attitude towards their own health and wellbeing, they can

use a number of skills to support themselves in achieving and maintaining this.

The responsibility for attaining good health does not just rest with the individual. Through the actions of caregivers, peers, schools, community groups and the government, young people can develop a range of skills that will empower them to attain better health.

The syllabus requires you to look at these skills in relation to the health issue you previously researched (Research skills 3.1). You should analyse how health and wellbeing in relation to this issue can be protected and enhanced through skills for strengthening the individual, such as:

- **self-efficacy**
- health literacy
- help-seeking behaviours
- problem-solving
- resilience and coping strategies
- sense of purpose
- ethical behaviour
- connectedness.

**self-efficacy**  
the belief you have in your ability to achieve your goals and produce desired outcomes, and your motivations to do so



**Figure 3.24** There are a number of skills that can support young people in maintaining a positive attitude towards their own health and wellbeing.

## Self-efficacy

Self-efficacy is the belief in one's own abilities to succeed in specific tasks or situations.

This belief can protect and enhance health and wellbeing by promoting several positive outcomes, such as:

- better stress management – when people have high self-efficacy, they are more likely to believe they can handle stress and negative situations effectively, which can reduce the negative impact of stress on their health
- increased motivation and engagement – people with high self-efficacy are more motivated to engage in healthy behaviours and pursue goals related to their health and wellbeing, as they believe they have the ability to succeed
- resilience and coping skills – high self-efficacy can help individuals develop resilience and coping skills as they believe they have the ability to overcome difficulties
- improved mental health – self-efficacy can positively impact mental health by reducing anxiety and depression and increasing feelings of self-worth and confidence.

Overall, self-efficacy can play a significant role in promoting and maintaining good health and wellbeing, as it empowers individuals to take control of their lives and engage in behaviours that support their physical and mental health.

## Health literacy

Young people live in an age of information, where the internet has made virtually all information available instantly. While skills in finding information have always been essential, today's young people must be able to discriminate between accurate and useful information, and that which is useless and possibly even harmful, when making an informed health-based decision.

Knowledge of health-based issues is taught predominantly at home and school. The K–10 Health and Movement Science Syllabus in NSW covers a range of relevant health issues, such as smoking, drugs, driver education and mental health. Information about who and where to go for more help or information is also provided.

The skills required to access, analyse, assess and review health information are essential.



**Figure 3.25** Web-based health information can be misleading, unless you are using a reputable site, so personal advice from a GP is far more reliable.

When seeking advice for a particular health issue, web-based information can be very misleading and opinionated. Personal advice from a GP is far more reliable, and therefore young people need to be wise when seeking such information.

However, underlying attitudes towards health are perhaps the most powerful tool in being health literate. Simply knowing that smoking is bad for your health is often not enough to deter some people. While a positive attitude towards personal health is not necessarily an obvious component of health literacy, it will compel people to continue to seek more knowledge and skills in ways that will enable them to attain the best possible health.

## Help-seeking behaviours

Help-seeking behaviours refer to the process of reaching out for support or resources when facing a challenge or problem. This behaviour has been shown to have several positive effects on health and wellbeing, and includes the following approaches:

- early intervention – help-seeking behaviour can lead to early intervention and treatment for mental health issues or medical problems, which can result in better outcomes and faster recovery
- reduced stress – talking to others and getting support can help reduce stress and anxiety, improving mental health and overall wellbeing

- improved coping skills – help-seeking behaviour can also lead to the development of new coping skills and problem-solving strategies, which can be beneficial in managing future challenges.
- enhanced social support – reaching out for help can also strengthen social connections and increase feelings of support and belonging, which have been linked to improved mental health and overall wellbeing.

In conclusion, help-seeking behaviour is an important aspect of self-care and can have a significant impact on health and wellbeing by enabling individuals to access resources, develop coping skills and receive support from others.

### Activity 3.6

#### Social supports

Consider your own situation. Outline the social supports that are available to you.

**Skills:** critical thinking

## Problem-solving

Problem-solving helps to protect and enhance health and wellbeing by allowing individuals to address and overcome challenges and difficulties in their lives. This process can help reduce stress and anxiety, improve mental wellbeing and lead to healthier coping mechanisms. By actively finding solutions to problems, individuals can take control of their health and wellbeing, rather than feel helpless or overwhelmed. This can lead to increased confidence and **self-esteem**, and can also improve physical health by reducing the negative effects of stress on the body. Additionally, successful problem-solving can help individuals build resilience, allowing them to better handle future challenges.

## Resilience and coping strategies

No individual is immune from life situations that are stressful and challenging. These could be physical, emotional, social, relational or financial in nature. For young people, being able to handle and recover from challenging circumstances can be difficult, as the skills of resilience and coping are often learned by experience. Young people may find it hard to maintain a clear and accurate perspective on events (as do some adults), which

can compound an issue. Often, their emotional reaction to a stressful situation is exacerbated by an inaccurate perception of the reality of the issue. To compound this, the teenage years can be emotionally challenging, and the daily pressure from peers to be and look a certain way exerts a powerful force that can be difficult for young people to cope with.

To support young people during such events, parents and other significant adults can help by listening and offering reassurance and guidance, helping students to keep an issue in perspective and maintain a positive frame of mind.

If a young person is at risk of significant mental harm, professional guidance from psychologists should be sought to help them work through the issue successfully.

It is also important that young people experience challenging circumstances, particularly where they have some responsibility for them. These invaluable learning experiences will help them greatly in the future to either avoid such situations or to show greater resilience.

**self-esteem** how you view yourself and how much you like yourself

To create such situations, programs such as the Duke of Edinburgh Award provide challenges that develop inner strength and confidence. The MindMatters program also has a strong emphasis on developing resilience as a key protective factor against mental health disorders.

### Sense of purpose

When young people feel like they have a sense of direction in their life, it provides purpose and motivation. Compare the levels of motivation in two HSC students. One student knows exactly what they need to do to get into a particular university course, while the other has no ideas about what they would like to do once they finish Year 12. The student with the set goal has a reason for working hard and aiming to achieve at their maximum potential. Having a mindset that is forward thinking is a very motivating tool. The same can be applied to starting an exercise and diet-modification program. Having a desired level of health and fitness in mind will provide greater motivation.

**self-identity** recognition, awareness and acceptance of the qualities and characteristics that make an individual feel unique

**self-concept** the belief a person has in their own strengths, abilities, personality and status; a sense of the kind of person you are

A strong sense of self-belief in one's own ability and self-worth can also help young people to be driven by who they want to be in future years. While at school, this can contribute to greater engagement, as well as act as a protective factor against a range of poor health behaviours, such as drug and alcohol abuse and risky sexual behaviours. When you value your future self, you make decisions today that protect and preserve who you desire to be in

the future. A supportive family upbringing plays an important role in reinforcing this, whereas young people who suffer neglect may feel a hopelessness about their future self, leading to a range of social and mental health concerns.

A significant feature of a young person's future is their potential career – their source of income and employment as an adult. Encouraging young people to value the importance of a good education in helping secure a positive future is a key role of schools, as they seek to build the confidence and structures to support young people. The government also invests significant energy and money into providing pathways and support for young people to identify and work towards securing meaningful and stable employment. The My Future website (<https://cambridge.edu.au/redirect/10289>) is an example of this.

Young people who feel anxious, apathetic or pessimistic, or lack confidence about their future success and wellbeing, often make poor health and lifestyle choices, as they lack a sense of direction and purpose in their lives. Feeling confident and optimistic, with a view of the future in which success and a high quality of life are seen as possible, is essential for young people to be able to attain good health.

As already mentioned, a positive sense of self-confidence, self-esteem, self-worth, **self-identity** and body image is vitally important for attaining good overall health. While each of these concepts is slightly different, they all contribute towards a person's overall **self-concept**. A healthy self-concept is developed through positive life experiences, a supportive upbringing and a well-rounded education. This sets an invaluable foundation for the rest of a person's life. Some examples where this is important include:

- having confidence in one's ability to achieve steady and satisfying employment
- developing a strong sense of purpose and meaning in life
- contributing to meaningful interpersonal relationships
- developing good conflict-resolution skills
- gaining inner strength and resilience to overcome difficult circumstances
- accepting who you are and being proud of your unique individual characteristics.



**Figure 3.26** Having a set goal provides purpose and motivation.

## Ethical behaviour

Ethical behaviour protects and enhances health and wellbeing by promoting trust, respect and fairness in interactions between individuals and organisations. Ethical behaviour can help to prevent harm to individuals, improve quality of care and increase access to resources, leading to better health outcomes. By establishing and maintaining ethical standards, individuals and organisations can foster a positive environment that prioritises the health and wellbeing of all. Additionally, ethical behaviour helps to build trust and accountability in the healthcare system, which can result in improved access to care and better health outcomes for individuals and communities.

## Connectedness

People are generally associated with a number of different social circles. For example, contact and relationships with colleagues, supervisors and clients at work can be a social circle completely removed from the social circle you associate with on the weekend, while playing sport or when at school. Within each of these social circles, people have a deep-seated need to feel connected, to belong and to be genuinely accepted within that circle. Feeling like you are an outsider, on the fringes of a social circle, can be very disconcerting and can lead to feelings of self-doubt and loneliness. Forging stronger and more intimate relationships, where people know more about each other and are more vulnerable with one another, is a sign of strong connectedness within a group.

Good social and communication skills can allow a young person to be able to increase their connectedness, particularly when joining new social circles, such as during new employment. Strong connectedness – particularly in close relationships, such as with friends and family – can provide a strong support network for young people. If a teenager feels disconnected at school, they will be very hesitant to seek support and guidance from either peers or teachers during tough times.

Programs are often run by schools to increase their sense of belonging. Community action and group projects, such as community fundraisers or awareness-raising groups, can increase the sense of community in a diverse population, such as a school.



**Figure 3.27** People belong to many different social circles.

The Australian government initiative MindMatters provides resources and professional development initiatives for teachers to support schools in promoting and protecting mental, social and emotional wellbeing.

However, if a young person is feeling isolated, or unable to safely share their concerns with someone they trust, they should seek a support network that can provide reliable advice and guidance. A good place to start is Kids Helpline (<https://cambridge.edu.au/redirect/10290>) or Reach Out (<https://cambridge.edu.au/redirect/10291>), which can provide support and advice, and refer young people to appropriate professional services

as needed. Statistically, young people who are socially isolated are at greater risk of alcohol and drug abuse, mental health disorders and risky sexual behaviours.

From a broader perspective, feeling connected to society at large, as a valued and contributing member, is important for the community in which a young person lives. This encourages good citizenship and inspires young people to be proactive and to have a say in the social and political decision-making that affects them.



Quiz

### Revise and summarise 3.3

- 1 Define self-efficacy.
- 2 Discuss the importance of health literacy for the health and wellbeing of young people.
- 3 Give three examples of the benefits of help-seeking behaviours.
- 4 Explain how problem-solving can protect and enhance health and wellbeing.
- 5 Explain why it is important to develop resilience and coping strategies.
- 6 Describe how a sense of purpose can act as a protective factor against poor health behaviour.
- 7 Explain the importance of ethical behaviour to the healthcare system.
- 8 Outline what is meant by 'connectedness'.

### Think critically and apply 3.3

In relation to the health issue you researched in section 3.2 (see Research skills 3.1), analyse how the skills for strengthening the individual can protect and enhance an individual's health and wellbeing, as well as that of others.

**Skills:** analysis



**Figure 3.28** Strong connectedness – particularly in close relationships, such as with friends and family – can provide a strong support network for young people.

## 3.4 Improving health and wellbeing

### Learning objective 3.4

REFLECT on your health and health behaviours and indicate a plan for improvement

In this chapter, you have looked at key issues in the health of young people, and at health-related behaviours. After checking your recall and understanding of these, you will now undertake a personal reflection and create an action plan for improving your own health and wellbeing.

A reflection statement requires you to explain and justify your views. In your reflection statement, you should take the opportunity to explore what is good about your health and what could be improved about your health. This reflection should lead to a course of action to improve your health and wellbeing.

Action plans usually involve what, who and when. The ‘what’ are the things you will need to do to achieve your goals. The person or persons responsible for achieving this is the ‘who’. The ‘when’ provides a timeframe for achieving the goals.

### Revise and summarise 3.4

- 1 Identify two key health issues that affect young people.
- 2 Explain what is meant by the term ‘health behaviours’, giving examples of both positive and negative behaviours.



Quiz

### Think critically and apply 3.4

- 1 Reflect on your health and health behaviours.
- 2 Create an action plan for two goals that you have identified about your health and health behaviours following your reflection.

**Skills:** critical thinking



**Figure 3.29** Healthy eating and social connectedness are two issues that have been considered in this chapter.

## Chapter summary

- Young people are among the healthiest groups of people in Australia, but they are not without health issues or concerns.
- The Australian Institute of Health and Welfare (AIHW) provides data on the health of young people, in areas such as physical activity, intimate relationships, alcohol use, smoking and e-cigarettes, illicit use of drugs, mental health and injury and deaths.
- Young people who live in rural and remote regions experience poorer health than those who live in cities. However, there are also challenges for those in urban environments. The effect of environment on health is complex and multifaceted.
- Many young people share the same level of economic advantage or disadvantage as their parents, and aspects such as employment, education, housing, access to services, food security and migration and refugee status can all have an effect on health.
- A young person's health is influenced by health behaviours that are part of their individual lifestyle.
- Personal biomedical factors carry both short- and long-term risks for health. These are often influenced by health behaviours.
- As young people grow in maturity and independence, they must take on increasing responsibility for their own health.
- Health and wellbeing can be protected and enhanced through skills for strengthening the individual, such as self-efficacy, health literacy, help-seeking behaviours, problem-solving, resilience and coping strategies, sense of purpose, ethical behaviour and connectedness.

## Multiple-choice questions

- 1 A key health issue for young people is:
  - A dementia
  - B COPD
  - C mental health
  - D arthritis
- 2 Suicide rates for young males are:
  - A increasing
  - B decreasing
  - C stable
  - D not an issue
- 3 In 2019, the trend in young peoples' usage of cigarettes and e-cigarettes was:
  - A use of cigarettes was increasing, and e-cigarettes was decreasing
  - B use of e-cigarettes was increasing, and cigarettes was decreasing
  - C use of cigarettes and use of e-cigarettes were both increasing
  - D use of cigarettes and use of e-cigarettes were both decreasing
- 4 A protective factor for road safety is:
  - A wearing a seatbelt
  - B speeding
  - C poor road design
  - D using a mobile phone while driving
- 5 A causal factor for mental health issues is:
  - A having a supportive family
  - B seeking help when stressed
  - C practising mindfulness
  - D substance abuse
- 6 A determinant of health that may affect a young person's behaviours is:
  - A income status
  - B friends and peers
  - C social media
  - D all of the above

- 7 A useful skill for a young person to develop to protect and enhance their health and wellbeing is:  
A resilience  
B unethical behaviour  
C low sense of self  
D poor health literacy
- 8 Self-efficacy is:  
A related to your peer interactions  
B related to self-confidence  
C your capacity to fail at things you attempt  
D important to protect you from diabetes
- 9 An example of a help-seeking behaviour is:  
A keeping issues to yourself  
B asking a friend for a lift home  
C seeing a counsellor when feeling anxious  
D eating chocolate when stressed
- 10 An example of a skill for strengthening the individual could be:  
A coping strategies  
B feeling unconnected  
C wearing sunscreen  
D driver education course

## Exam-style questions

- 1 Compare the health of young Indigenous Australians to that of other young Australians. (8 marks)
- 2 What are the current patterns of mortality for young people? (3 marks)
- 3 How do the determinants of health influence ONE key health issue affecting young people? (8 marks)
- 4 Propose strategies to overcome the factors that adversely affect the health of young people. (5 marks)
- 5 Explain the determinants of health that influence the health of young people in Australia. (4 marks)
- 6 How do help-seeking behaviours, resilience and coping strategies protect and enhance the health and wellbeing of young people? (8 marks)
- 7 What are the causes and protective factors for ONE key health issue facing young people? (5 marks)
- 8 Analyse how young people can protect and enhance their health and wellbeing by building skills for strengthening the individual. (8 marks)
- 9 How can people be supported to protect and enhance their health and wellbeing by developing their health literacy, ethical behaviour and connectedness? (8 marks)
- 10 Assess the skills required for strengthening the individual in terms of protecting and enhancing a young person's health and wellbeing. (8 marks)

# Chapter 4

## Improving and promoting young people's health

### After completing this chapter, you will be able to demonstrate knowledge of:

- how young people advocate for their health and the health of others
- the role of government and non-government agencies and communities in promoting young people's health, and the impact this has
- the nature of health promotion in Australia
- how health promotion in Australia is influenced and impacted by various approaches to health and global health policies
- the United Nations Sustainable Development Goals in relation to health, both in Australia and globally.

### Key terminology

#### Syllabus terms

Aboriginal and Torres Strait Islander approaches to health	health lens
advocate	health promotion
biomedical model of health	salutogenic model of health
community	sociocultural model of health
determinants of health	strategies
ecological model of health	Sustainable Development Goals (SDGs)
equality	World Health Organization (WHO)
equity	

#### Other important terms

activist	Ottawa Charter
HIV/AIDS	social media
intersectoral	United Nations
Millennium Development Goals (MDGs)	



### Driving questions

- 1 What avenues can young people use to raise concerns and advocate for issues of importance?
- 2 In what ways are governments, non-government organisations (NGOs), communities and individuals involved in promoting the health of young people?
- 3 How is health promotion in Australia approached?
- 4 What are some global health policies that have had an impact on Australia?

# Introduction

Engaging and empowering young people to take control of their health and to advocate for their needs and the needs of others is a key step in the creation of a better and more sustainable world. It is a responsibility that is shared by stakeholders at all levels. Working collaboratively with youth to create lasting change and positive health outcomes means providing opportunities for young people to not only have a voice but also to

play an active role in all levels of community and government.

As the world changes with unprecedented speed, young people are proving to be invaluable partners who can advance meaningful solutions.

United Nations Secretary-General  
Ban Ki-moon, 2015

## 4.1 Young people and health advocacy

### Learning objective 4.1

EXAMINE how young people advocate for their own health and the health of others

Connected to each other like never before, young people contribute to and want to contribute to the resilience of their communities, proposing innovative solutions, driving social progress and inspiring political change, in urban as well as rural contexts. Young people constitute a tremendous and essential asset worth investing in, opening the door to an unparalleled multiplier effect.

UN Envoy on Youth

Young people represent one-fifth of the Australian population, with 3.2 million Australians aged between 14 and 25. Young people are often

referred to as ‘our future’ and while this is certainly true, they can only bring about positive change and progress if they are given the opportunity to advocate for their health and the health of others.

Adolescents and young people are uniquely positioned to be effective advocates to hold their governments accountable for the delivery of promises, policies and programs that affect their lives.

WHO advocacy toolkit

There are many avenues open to young people to advocate for their health. Through the use of **social media**, government and non-government organisations (NGOs), community and **activist** groups, young people can play an important role in focusing attention and improving awareness of issues relating to health.

### Activity 4.1

#### Youth connection

Read the quote by the UN Youth Envoy and discuss the following questions:

- 1 How are youth connected to each other like ‘never before’?
- 2 What are resilience, innovation and social progress?
- 3 In what ways are young people an essential asset?
- 4 How can youth be ‘invested in’?

**Skills:** analysis

### Youth advocacy

Young people are seldom recognised as a group with the right to be involved in policy and decision-making. Regularly, decisions are made for young people that have a direct impact on their lives and health but in which they have little say. Youth **advocacy** is about empowering young people in their everyday lives, considering their needs and interests in decision-making at all levels and giving them a voice.

### Past advocacy

The involvement of youth in planning interventions for previous major health issues has been key to their success.

### Example: the HIV/AIDS epidemic

In the 1980s the **HIV/AIDS** epidemic was responsible for the deaths of millions of young people worldwide. Despite the increase in rates of infection and death there was little urgency to find a treatment or medication that might target the opportunistic infections that led to deaths in HIV patients.

While numerous support groups were developed to assist people who were diagnosed with HIV, the main focus of those groups was to provide comfort

to those with the disease, assisting with matters like hospital visits and preparing wills. There was little push to find a cure.

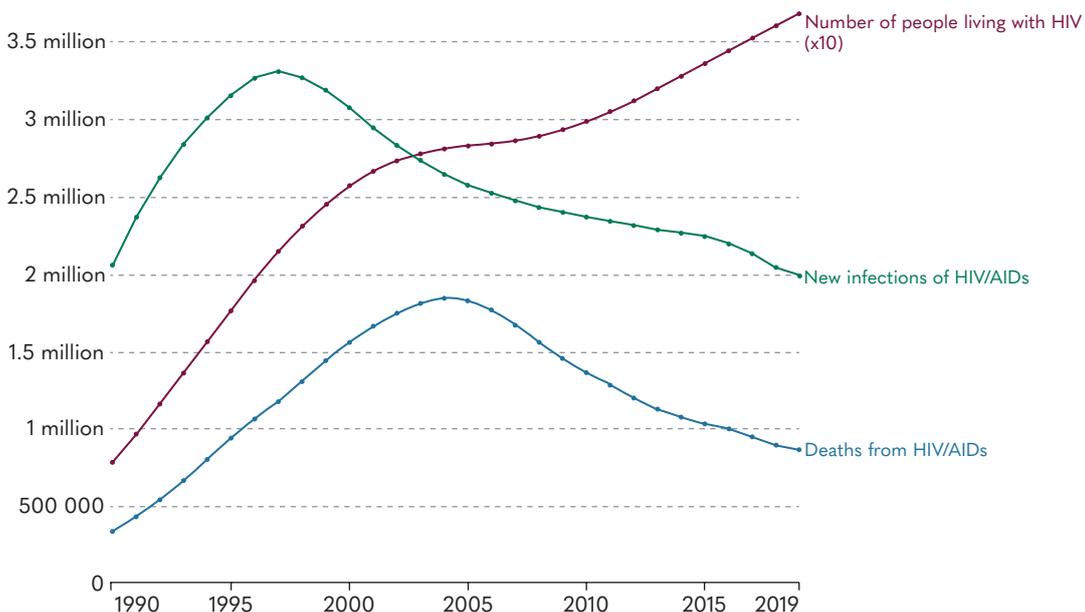
Those most affected by the disease began to stand up and make their voices heard. Activist groups such as ACT UP were formed and passionately and loudly lobbied governments to increase funding into research for a cure and access to medications that would increase the life expectancy of those diagnosed with HIV.

The main driving force behind many of these groups was young people. Young gay people were seeing and experiencing firsthand the devastating effects of the disease and the need for action. The impact of their action can be seen in the reduction of HIV-related incidence and deaths, and the increase in life expectancy of those diagnosed.

**social media** websites and applications that focus on community, the sharing of ideas and interests and the creation of networks  
**activist** a person who campaigns to bring about political or social change  
**advocacy** an action aimed at gaining support for a particular cause  
**HIV/AIDS** human immunodeficiency virus/acquired immunodeficiency syndrome. HIV attacks the body's immune system and if not treated can then lead to AIDS. There is no effective cure for AIDS

**Prevalence, new cases and deaths from HIV/AIDS, World, 1990 to 2019**

To fit all three measures on the same visualization, the total number of people living with HIV has been divided by ten (i.e. in 2019 there were 36.8 million people living with HIV).



Source: IHME, Global Burden of Disease (2019)

**Figure 4.1** Prevalence, new cases and deaths from HIV/AIDS worldwide 1990–present

Graph by: Our World in Data.

ISBN 978-1-108-95129-6

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Cambridge University Press & Assessment

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**Figure 4.2** Activist group ACT UP lobbies to raise awareness and increase funding for HIV treatment and research.

Historically, self-directed advocacy was centred on raising awareness and rallying support through newspaper advertising, phone calls, letterbox drops, soapbox street speeches and rallies. Developments in information and communications technology (ICT), improvements in access to data-based information, changes in accessibility and rights to information and freedoms of speech, however, have led to significant shifts in the way that youth advocate.

### Example: National Youth Advisory Group

In a more formal setting, the establishment of the National Youth Advisory Group in 1979 was the first formal youth advisory group to the federal government. The group consisted of young Australians with a diverse range of talents, interests and backgrounds who reported directly to the federal government on priority areas of concern for the nation's youth. This milestone group paved the way for an increased determination within federal and state governments to hear the voices of youth.

### NEWS RELEASE

## MINISTER FOR EMPLOYMENT AND YOUTH AFFAIRS

The Hon. Ian Viner, MP

NATIONAL YOUTH ADVISORY GROUP

52/79

Australia's first group of young people to have direct, formal advisory links with the Federal Government, met in Canberra today for the first time.

The Minister for Employment and Youth Affairs, Mr Viner, said today the meeting of the 12 member National Youth Advisory Group marked a milestone in the way Government related to youth.

"It is the first time that a body representative of young people - with members of particular talents, interests and backgrounds, who can make a valuable contribution to Government policy-making - has been built into the machinery of Government," Mr. Viner said.

The Group's Chairman is 24-year-old Melbourne Solicitor, Mr. Graham Allan, who has been involved with a number of organisations concerned with young people including the National Youth Council of Australia, the Youth Council of Victoria, the United Nations Association and the Good Neighbour Council.

Other members of the group are: James BILIOS (NSW), Annamalia CHIMENTON (VIC) Michael Gilliver (QLD), Brendon GODDARD (VIC), Lesley HAMMOND (SA), Ilsa KONRADS (NSW), Sue KNOWLES (WA), Jan MARSH (VIC), Roger WOOLLEY (TAS), Michael CUSACK (VIC), Gatjil DJERRKURA (NT).

In a brief address to the meeting, Mr. Viner told the Group that it was meeting not only to improve consultation, but that in partnership with the Government, its charter was also to help make better decisions about youth and community.

"From today young Australians have a special Group which will be able to critically examine and report directly to Government on the broadest range of matters affecting them", he said.

Mr. Viner asked the members of the Group to look for areas where the Government can positively promote an idea or an activity or stimulate an interest to give leadership to the youth of Australia.

He said that the Office of Youth Affairs was already looking at areas of keen interest to young people such as transition from school to work, crisis accommodation centres, and welcomed the views of the Group where expanded research was required.

The Group spent today discussing its priority areas of concern and how it could best involve young people in making a contribution to decision-making and on the planning and follow-up for the National Youth Conference to be held in October.

CANBERRA  
22 May 1979

**Figure 4.3** The National Youth Advisory Group established in 1979 was the first formal youth advisory group to be established in Australia.

### Current advocacy

Current youth advocacy takes many forms, from youth-established movements to government-led youth advocacy groups and social media. There are many opportunities for youth to have a voice and advocate on the issues that concern them.

### Social and digital media

One of the key factors that has allowed for an increase in voices of youth is social and digital media. There are many different platforms for engagement, including Twitter, Facebook, TikTok and Instagram, that allow global audiences to be reached through the click of a button. This allows

messages to be mobilised into large-scale movements in multiple locations at a much faster rate.

Rayne Fisher-Quann, the founder of March for our Education, demonstrates the effectiveness of the use of social media as a platform for youth health advocacy. Seventeen-year-old Rayne used Twitter to organise a school walkout of 100 000 students across 100 different schools in Ontario, Canada. This was to protest the cut-backs that would see sex education reduced in schools, including the removal of vital content such as lessons about consent. With limited ways to engage in democracy, this avenue of protest was identified by Rayne as one of the few ways students could ensure their voices were heard.



**Figure 4.4** Rayne Fisher-Quann advocating for sex education

## Activity 4.2

### Social media and advocacy

- 1 Social media gives everyone the ability to broadcast their thoughts and opinions, with no need to provide evidence for their statements. What is the responsibility of the consumer of social media?
- 2 What evidence is there on social and digital media that the broadcasting of ideas and issues relating to health is sometimes based not on facts but on hype and misinformation?
- 3 Imagine you were a health expert who came across multiple posts on social media spreading misinformation about a health issue. What do you think would be an effective way of combating this misinformation?

**Skills:** analysis, problem-solving



Depth  
Study



Collaborative  
investigation

While the use of social media to promote change provides many positive outcomes, it also opens up activists to the negative aspects of social media. Young people must navigate their way through direct criticism and attacks in a way they may not have previously experienced.

It is important for young people not only to advocate for health issues that predominantly affect them, but also to advocate on health issues that affect the wider population. Often it is young people who are best suited to create messages that are effectively aimed at the target audience and delivered in a way that ensures that the message is received.

One such example is COVID-19. At the beginning of the pandemic, government messages about the spread of the highly contagious virus were being lost on young people. Young people were being accused of complacency and of ignoring important health messages. In their interviews with young people, Youth Affairs Council Victoria (YACVic) identified several issues with the way the messages were being delivered. The messages were not being delivered in forums in which young people engaged, but rather through news platforms, in methods more targeted towards older populations. Once identified, additional messages were delivered through channels in which young people were active participants, including various forms of social media.

Many young people turn to social media and peer networks for their information rather than more traditional sources of news and media. It is therefore crucial to have young people involved in the spread of these important messages to ensure they are not getting lost or too complex.

### Official voice in national and global settings

In addition to non-official advocacy through social media, youth have increasingly been given an official voice in national and global settings. One such setting is the United Nations (UN). The UN openly advocates for youth involvement, providing opportunities for young people to have meaningful roles in directing future change. One example is the UN Envoy on Youth, an ambassador appointed by the UN Secretary-General to specifically focus on increasing youth participation in inter-governmental matters, maximising engagement and mobilisation of young people and utilising

the potential of young people within the UN. The current envoy, Jayantha Wickramanayake, was appointed in 2017 at the age of 26, having already been involved in global youth development on an international level since she was 21.

‘Young people are the experts of their own realities, and young people all over the world are making a difference every day by tackling issues that matter most to them. The idea that young people are change-makers is not just a marketing campaign, it is a fact. We must dispel the myths surrounding young people, that they are irresponsible, disengaged troublemakers, or do not have the experience to create real impact. Even in the most adverse of circumstances we have seen young people rising to the challenge and leading the way – from humanitarian crises to COVID-19 response. There is no doubt that we need young people’s innovation, drive, creativity and – more than anything – unwavering optimism that a better world is possible for everyone.’

Jayathma Wickramanayake,  
UN Envoy on Youth

In addition to the UN Envoy on Youth, the UN has developed and implemented the Young Leaders for the SDGs program, where ‘SDGs’ stands for ‘Sustainable Development Goals’. This is a platform that, every two years, recognises 17 extraordinary, diverse young people from around the world who demonstrate leadership, innovation and resourcefulness in advocating for and tackling some of the world’s big issues including HIV/AIDs, gender rights, peace, climate change, education innovation, and inclusion, and disability rights.

UNICEF’s Voices of Youth is another platform developed by youth, for youth to make their voices heard. It provides a space for young people to share stories about their real-life experiences and concerns on a range of issues including mental health, physical health, advocacy and the environment. Throughout the forum are numerous examples of the ways that youth are advocating within their communities, including schools, universities and workplaces.

## NEWS REPORT

### Let's Talk About Data

Voices of Youth, UNICEF, 2019

<https://www.voicesofyouth.org/campaign/how-use-data-advocacy>

*When the right data are in the right hands at the right time, decisions can be better informed, more equitable, more likely to protect children's and adolescents' rights.*

Young people around the world are rallying towards a new era of advocacy: one that is backed by data and fuelled by their real-life experiences.

Data play an important role in supporting youth voices and helping them spread messages about the issues that are most important to them.

This includes advocating for policies and services that are accessible and culturally relevant. When we are at the front and centre of this fight to improve our health and wellbeing, we can achieve our best lives. Below are three examples of how young people are using data to advocate for health policies, plans and programs in their own lives.

**'Hi, I'm Malvikha!** When I first tried to start a psychology club in my high school, I did not have many facts and statistics to support my requests. I knew that young people in my school needed more support for their mental wellbeing.

Conversations about mental conditions were largely taboo topics. My advocacy was not rooted in evidence; I was on a journey to identify data on adolescents' health and wellbeing, but these facts were simply not available.

Fortunately, things look different these days. We now know more about the state of adolescent health across the world, in part due to resources like the **UNICEF country dashboard** on adolescent health including non-communicable diseases (NCDs), disability and mortality. Such

resources are powerful tools for youth, policymakers and advocates that are interested in developing evidence-based responses to health needs.'

**'Hi everyone, Winnie here!** I'm passionate about gender equity and the role this plays in addressing young people's sexual and reproductive health and wellbeing especially among rural communities and those who may not have access to digital platforms.

I work at the intersection of education, gender equality, and sexual reproductive health. Having reliable data to highlight the need for better investments in improving the health and educational opportunities of adolescents is vital in these contexts, especially when there are competing priorities.'

**'What's up? My name is David** and I'm tuning in from Saint Lucia. I use sports as a tool to tackle important issues faced by youth and children in Saint Lucia.

- Did you know that in Saint Lucia, 22% of the population in 2016–18 suffered from moderate to severe food insecurity?
- Trends in nutritional risk factors have been climbing since the 1990s, with the prevalence of overweight at 24% in girls and 21% in boys aged 10–19.
- This is matched by a high prevalence of behavioural risk factors like insufficient physical activity – 86% in girls and 83% in boys – that negatively shape adolescent health and wellbeing in the community.

Sports can be a powerful and creative tool to introduce important topics to youth in an accessible manner that connects with and empowers them.

*continued*

With the growing burden of non-communicable diseases (NCDs) around the world, data holds more potential

now than ever before to shape health policies, plans, and programs for adolescent health.'

### Activity 4.3

#### Data

Data fuels youth advocacy and with a greater accessibility to data and a greater opportunity to share it, youth advocacy is more effective.

Read the article 'Let's Talk about Data' and answer the questions below.

- 1 What is the importance of having access to reliable data?
- 2 How does the use of data increase the effectiveness of youth advocacy?
- 3 Discuss the examples provided and explain how the use of data assisted each of the advocates in their plights.
- 4 For an issue relevant to you and the students at your school (such as mental health, nutrition or physical activity) and research the trends and data associated with the issue among school-aged children.
- 5 Develop a plan of action to address the issue within your school or local community. Use data to support your proposal. Ensure your proposal details:
  - a the issue
  - b the data surrounding the issue
  - c the potential consequences if the issue is not addressed
  - d suggestions for how to effectively address the issue through the youth at your school.

**Skills:** collaboration, communication, creative thinking, problem-solving



Depth  
Study

### Case study 4.1

#### Dujuan Hoosan

As well as providing official recognition and support for youth advocacy, increased opportunities for youth to speak up about issues of concern is being provided.

At the age of 10, Arrernte and Garrwa boy, Dujuan Hoosan, was the focus of the documentary film *In My Blood It Runs*, which reveals First Nations experiences of the education and juvenile justice systems.

When the film was released in 2019, Dujuan, now 12 years old, became the youngest person ever to address the **United Nations** Human Rights Council. Raising concerns about Indigenous education and juvenile incarceration, Dujuan issued a call for help. You can watch Dujuan's speech at

**United Nations (UN)** an international organisation consisting of 193 member states that seeks to promote peace, justice, respect, human rights, tolerance and solidarity by working together to find shared solutions to common problems

<https://cambridge.edu.au/redirect/10347>. Dujuan also wrote to the Prime Minister to encourage him to watch the film and reach out to him for a chat.

Since the documentary, Dujuan has worked with his grandmothers through the group Children's Ground to promote an Indigenous-education model. They also wrote a picture book, *In My Blood It Runs*, which was illustrated by Dhungatti man and Archibald-winning artist Blak Douglas.

The news report on the following page talks about the history of First Nations-led schools and Dujuan's story.

Case study 4.1 *continued***NEWS REPORT****Community-controlled schools create better education outcomes for First Nations students**

In Australia, more than a dozen independent, community-controlled First Nations schools were set up in the 1970s and '80s. These schools, some still in operation, offered culturally and linguistically relevant education to First Nations students reflecting Indigenous ways of knowing, being and doing.

Our research projects have explored self-determination in Indigenous community-controlled schools in Australia. We found First Nations-led schools can support self-determination and improve education outcomes for Indigenous young people.

This is also the lesson of a new children's book *In My Blood It Runs* by Arrernte and Garrwa man Djuwan Hoosan. The new book shares Djuwan's experience of navigating an educational system not designed for him, and the benefits of First Nations-controlled education.

**First Nations controlled schools**

Our research found many First Nations-led schools were set up in the 1970s and 1980s, as communities began to fight for appropriate education. This emerged after a long history of insufficient government-mandated education, forced exclusion from school, or forced attendance at missionary and reserve schools.

These included the community-controlled Yipirinya School in Mparntwe. The school was set up by families in the town camps and their European allies. The school developed curriculum in Arrernte, Pitjantjatjara, Western Arrarnte

(also known as Western Aranda), Lurijta and Warlpiri, as well as in English and Aboriginal English. Classes were initially taught in the town camps.

Others included the Black Community School in Townsville. The school was set up by Torres Strait Islander land rights campaigners Eddie "Kioki" Mabo, Bonita Mabo and Woiworrung and Yorta Yorta author and activist Burnum Burnum. Another example is the Northland College for Koori kids in Richmond.

The Hughes Report, published in 1988, became the basis of Aboriginal and Torres Strait Islander policy for the next decade. It recognised First Nations-controlled schools as an important step in overcoming a long history of educational exclusion. The report called for self-determination in education, the training of First Nations teachers, and developing suitable curricula that embedded Indigenous languages and knowledges.

Bilingual and multilingual schooling began from community-led initiatives in First Nations communities. They demonstrated how schools controlled by local communities provide safe and sustaining places for First Nations young people. It was around this time the numbers of First Nations people participating in education increased most dramatically. Aboriginal and Torres Strait Islander enrolments in universities increased by 50% in the 1980s, and primary school enrolments increased by 40% in the 1990s.

Case study 4.1 *continued**continued*

However, policy began to shift away from this focus in the late 1990s and onwards. Education debates began to emphasise attendance as the key issue, and measuring English-only literacy and numeracy data as a way to gauge the success of education.

**Recent developments**

Released last year, Dujuan's story *In My Blood it Runs*, coauthored with his grandmothers Margaret Anderson and Carol Turner, illustrates how Indigenous children balance their existence in two distinct worlds.

After many years of struggling at school, Dujuan left Mparntwe (Alice Springs) to attend an Indigenous-led Garrwa homeland school on his father's country in Borrooloola, about 1,200km north of Mparntwe. Here, he was able to learn on Country, from Aboriginal teachers, in a nourishing and rewarding environment. He became excited to attend school and his learning journey took off.

First Nations-led non-profit organisation Children's Ground recently released a report responding to ongoing policy failures in First Nations education. This includes the dismantling of bilingual education.

The report calls for a First Nations-controlled education system and the establishment of an independent governing body to oversee it. The recommendations in the report align with the United Nations Declaration on the Rights of Indigenous Peoples. This includes a key focus on self-determination in education.

In particular, Article 14 of the Declaration recognises the right of Indigenous peoples to establish and

control their own educational systems. This would ensure education is culturally and linguistically relevant to Indigenous peoples.

And the recent release of a report from the Joint Standing Committee on Aboriginal and Torres Strait Islander Affairs into whether Australia should implement the UN declaration has renewed attention on self-determination.

Similar discussions have been had in Canada for many years. Recent treaties have included provisions to transfer control of education of First Nations students to First Nations groups. Graduation rates have been positively impacted for groups who have obtained authority over education. When First Nations group Mi'kmaq from northeastern Canada initially took control of their education system in 1998 only 30% of their students were graduating from secondary school. According to the most recent annual report, 83% are now graduating.

**Where to from here?**

We can look to successful examples in Australia, such as Yipirinya School in Mparntwe, the Black Community School, and recent education reforms in Canada, as important lessons on how to support First Nations-controlled education in line with the UN Declaration on the Rights of Indigenous Peoples.

We can also look to Dujuan's story. His book is a call to action to reform education, juvenile justice, child welfare and racist practices.

Dujuan's story invites us to imagine how we can make school work for First Nations children.

**Case study 4.1** *continued*

- 1 What is the significance of Dujuan's speech at the UN?
- 2 In what ways and for whom is Dujuan advocating?
- 3 How does the documentary also provide a voice for Dujuan to advocate for the issues he is passionate about?
- 4 What other avenues are available for 12-year-olds to advocate through?
- 5 Write and record a speech addressing the UN on a different issue that you think is important to you as an Australian youth.

**Skills:** analysis, communication, creative thinking, research

**Case study 4.2****The role of young people in fighting disease**

The following article was written in March 2020 at the very start of the COVID-19 pandemic.

**NEWS REPORT****Just as in coronavirus, young people are key to stopping tuberculosis**

Leslie A. Enane

*The Conversation*, 24 March 2020

The world is experiencing a historic pandemic of a novel coronavirus that has completely altered our daily lives and the entire world economy. Younger people experience more mild or moderate infections, although they are not spared from severe disease.

There is increasing concern that the massive disruption of this crisis may bring about a resurgence of tuberculosis, or TB – an ancient disease, in contrast to COVID-19 – due to the overwhelming impact of the coronavirus on health systems and on public health capacity. Given severe disruption to daily life and to health services, people suffering from TB may be unable to access care – for example, if they are unable to get transportation, if clinic or hospital activities are diverted to COVID-19 and unable to treat TB patients, or if labs stop processing TB

testing. With delayed diagnosis and care, TB cases may increase.

Experts estimate that TB kills 4,000 people every day and 1.5 million people every year, making it the leading infectious cause of death globally. Progress made in ending TB has not been fast enough. Ending the TB pandemic requires a comprehensive approach that ensures optimal treatment for the most vulnerable groups.

As a paediatric infectious disease physician and researcher, I study how to improve care engagement and outcomes for adolescents and young adults living with TB or HIV. In a study in Botswana, our team interviewed healthcare workers about what changes are needed in youth TB management to improve outcomes. I believe that tackling TB infections and transmission must include addressing youth needs in

*continued*

Case study 4.2 *continued*

TB care and putting young people at the forefront of this fight.

### Current approaches don't serve youngsters well

Youth between 10 and 24 years of age experience 17% of all TB disease, or 1.8 million cases annually, and disease in youth may contribute to TB transmission within communities and households. Despite this, dedicated public health approaches or treatment guidelines have not been developed for youth with TB. Young people face challenges accessing TB diagnosis and completing treatment.

The transitions of adolescence can make it challenging for youth to engage with health services, particularly for complex and stigmatized diseases such as TB and HIV. They often rely on family to keep them engaged in care, but if they don't have consistent support and resources, they may leave treatment.

Adolescents may be particularly affected by TB/HIV stigma, challenges in adhering to medications and structural barriers to care. They are also less likely to engage in testing

and treatment for HIV, which often coincides with TB disease.

While healthcare workers attempt to adapt their management to adolescent needs, they have limited time and resources to do this, and lack dedicated guidelines, training or evidence-based models to guide their efforts. One nurse we interviewed told us, 'if you don't address the challenges, they end up lost.'

Despite longstanding knowledge that youth are at risk for TB, current care models may not meet young people's needs.

What might more responsive care look like? The healthcare workers we interviewed strongly advocated for youth-friendly interventions similar to those being implemented in HIV treatment. That can include peer support groups or networks to help provide socialisation and education about treatment. These groups go a long way to break through the isolation and stigma that young people experience.

Other models include having youth-friendly spaces, resources for more



**Figure 4.5** World TB Day awareness rally on 24 March 2018 in Mumbai, India

Case study 4.2 *continued*

intensive counselling and dedicated training for healthcare workers to provide youth-friendly care. Other strategies such as increasing community-based care models or home visits bring treatment closer to young people.

Most importantly, we found that young people should be involved at each stage of planning, implementing and assessing the impact of such interventions. Youth can speak to their own needs and can best advocate for improvements to care and public health agendas.

Young TB activists Phumeza Tisile and Nandita Venkatesan, who were both left deaf by the toxicities of medications for drug-resistant TB, have given powerful voice to TB survivors. Further, youth who have gone through TB treatment can serve as a key resource for their peers. As one nurse noted, 'after they complete treatment, they are different people than when they came, and they can be the best teachers for others.'

### Young people are central to the fight

On March 16, as the White House introduced stronger guidelines for social distancing in an effort to avoid a catastrophic surge in COVID-19 cases, Ambassador Deborah Birx, who coordinates the coronavirus response, had a distinct message for young people. 'I think the millennials can help us tremendously. ... Public health people like myself don't always come out with

compelling and exciting messages that a 25- to 35-year-old may find interesting and something that they would take to heart. The millennials can speak to one another about how important it is in this moment to protect all (vulnerable) people ... There's more millennials now than in any other cohort, and they can help us in this moment.'

Birx is directly applying lessons from her decades of fighting HIV to the novel coronavirus pandemic. Young people have always been leading the fight against HIV. In the 1980s, it was young ACT UP activists who pioneered patient advocacy and revolutionised the process by which novel drugs were quickly tested in clinical trials, speeding advancements to effective antiretroviral therapy.

Ryan White, a world-changing teenager, courageously fought against HIV stigma and discrimination, and his legacy includes the comprehensive national HIV care program that bears his name. Among the lessons of the HIV pandemic are that young people have the ability to drive social and systemic change.

We don't yet know what lies ahead for the global TB, HIV or coronavirus pandemics. But we would do well to look to adolescents and youth to advocate for the solutions that will bring an end to this crisis, and to all global infectious disease emergencies.

- 1 What are some of the barriers that young people face when it comes to accessing information and treatments relating to infectious disease such as COVID-19, TB and HIV?
- 2 Explain the benefits of having young people directly involved and advocating for health issues such as COVID-19 and TB.
- 3 How can care for youth dealing with these health issues be made to be more responsive?
- 4 What are the benefits and limitations of social media as a platform for health advocacy and health promotion?

**Case study 4.2** *continued*

- 5 Analyse the importance of having health messages that can effectively reach all groups within a population.
- 6 Explore and research another example of youth advocacy and impact in a relevant issue. You may like to consider climate change and mental health.

**Skills:** analysis, research

**Future Advocacy**

The opportunities for youth to advocate for their needs continue to be strengthened. The continual increase and push for youth engagement and mobilisation on a global and national scale will ensure that there are numerous avenues for youth advocacy. This commitment is reflected in the federal and state governments' allocation of funds.

Within Australia in 2021, eight youth organisations received a share of a significant grant aimed to give a greater voice to Australian youth. This came at the same time as the strengthening of the Australian Youth Affairs Coalition (AYAC) in its role as national advocate for youth to the Commonwealth within Australia. This commitment was further bolstered by an increase in funding to encourage more extensive participation. Further commitments were made to fund additional projects headed by youth from a wide range of geographic areas including cities, regional and rural and remote areas, thereby developing a more cohesive network of youth.

The development of youth advisory committees within organisations is becoming commonplace, providing many more opportunities for youth to

advocate in areas of their individual interests in the future.

Youth advisory committees exist or are being developed in organisations such as:

- The Australian Red Cross
- eSafety
- Motorcycling NSW
- National Association for Prevention of Child Abuse and Neglect (NAPCAN)
- NSW Aboriginal Land Council
- Tennis NSW.

These committees generally seek a diverse group young people between the ages of 12–25 who are passionate about their area of interest.



**Figure 4.6** Tennis Australia is one of the organisations with a youth advisory committee

**Activity 4.4****Youth advisory committees**

For one of your areas of interest or concern and for one of the above organisations or another of your choice, determine whether or not they have a youth advisory committee.

If they do:

- Read through the information available on the type of people they are looking for to represent youth on their committee.
- Draft a letter of application outlining why you would be a perfect candidate for the role.

If they do not have a youth advisory committee:

- Draft a letter to the organisation outlining the value and importance of having the voice of youth providing input into their organisation and expressing why you would be a great member of the committee.

**Skills:** communication, creative thinking

## The role of individuals within their communities

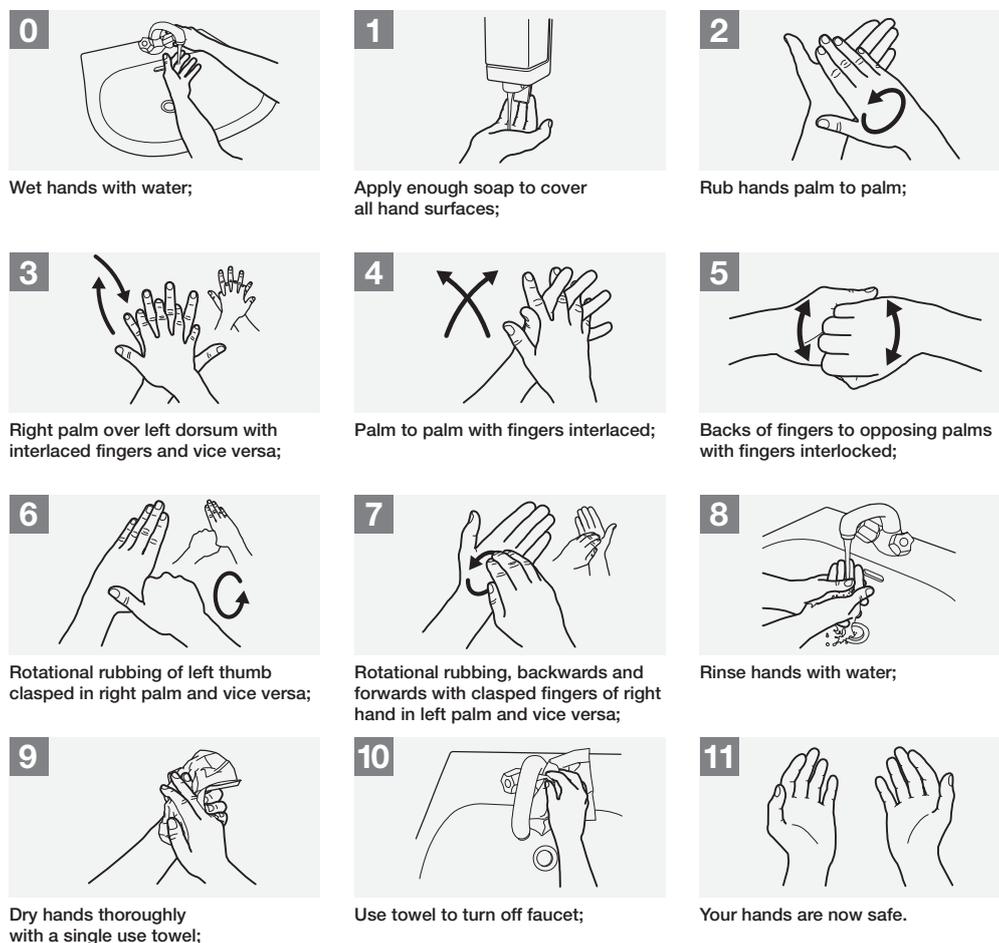
In addition to being actively involved in advocating for health, individuals can play a significant role in the development and promotion of their own health and the health of the members of their community.

As discussed in Chapter 3, personal choices about health-related behaviours are a major contributing factor to an individual's health status. Decisions about diet, physical activity, drug use and sexual health practices can all lead to either positive or negative health outcomes. These health outcomes can in turn have a direct or indirect impact on the community around them. For example, there are many choices an individual makes about their sexual health practices that can affect the greater community. A person who engages in risky sexual practices, such as having multiple partners, not using protection and not getting tested for an STI, may be at risk of passing on an infection to another person.

Similarly, a person who does not engage in appropriate hygiene practices might be at risk of passing on a virus to other members of the community. For example, during the COVID-19 pandemic, individuals were called upon to take responsibility for their hygiene practices in order to reduce the spread of the virus. Hand-washing and personal hygiene practices such as managing coughs and sneezes, wearing face masks and limiting personal contact were an integral part of managing the spread of the disease.

Individuals can also play a valuable role in promoting positive health choices among their peers and community. Supporting community-based groups and initiatives (e.g. local exercise groups, youth health and sport centres) and engaging with the wider community in roles such as volunteering can also be methods of active **health promotion** that benefits not only young people but also the wider community.

**health promotion**  
the process of enabling people to increase control over, and to improve, their health



**Figure 4.7** A World Health Organization poster about washing hands. Hand-washing practices were an integral part of reducing the spread of the COVID-19 virus.

## NEWS REPORT

### Top three issues that young people care most about in 2022

Mission Australia

29 November 2022

We asked 18,800 young people about the issues they care most about in Mission Australia's 21st annual *Youth Survey 2022*. Along with the challenges and concerns young people face, the report also reveals the top three issues in Australia today for young people aged 15 to 19 years.

#### 1. Half of all young people surveyed said the environment was one of the most important issues in Australia

From severe flooding in parts of the region to raging bushfires, young people were more concerned about the effects of climate change on the environment than ever before. Over half (51%) of the young people who responded to the *Youth Survey 2022* said the environment was one of the biggest issues in Australia today, an increase from 38% in 2021 and 30% in 2020.

Not only was the environment one of the most important issues in Australia, around one quarter (26%) of respondents said they were 'extremely' or 'very concerned' about climate change and its effects.

#### 2. Equity and discrimination still matter to young people

Equity and discrimination were major areas of concern for young people, both at a national and personal level. More than one-third of young people said equity and discrimination (36%) was an

important national issue, and just over one-quarter (27%) of those surveyed were unfairly treated in the past year, mostly due to their gender, race/cultural background or mental health.

#### 3. Mental health is a national and personal concern for many young people

Mental health encompasses more than just an absence of mental health disorders. According to the World Health Organization, 'mental health' can be defined as a state of mental wellbeing that allows people to:

- cope with the stressors of life
- realise their potential
- contribute to their community
- make healthy decisions
- build relationships.

In our annual *Youth Survey 2022*, half (50%) of the young people we surveyed indicated they were positive about their future, but the proportion of young people with this positive outlook has sadly decreased since 2020.

Almost three in 10 (29%) young people indicated high levels of psychological distress and almost one-quarter (24%) said they felt lonely all or most of the time.

More than half (53%) of all respondents also said they needed support with their mental health at some point in their life.

Mental health can affect young people in a myriad of ways.

### Activity 4.5

#### Concerns of young people

Read through the article 'Top three issues that young people care most about in 2022'.

- 1 Outline the major concerns of young people in Australia today based on the results of the survey.
- 2 Choose one of the issues and, in groups, brainstorm ways that a young person could advocate for the issue.
- 3 Visit the Mission Australia website, and look for the results from another year's *Youth Survey* – either since the 2022 survey, or a survey from 10 or 20 years ago. How do the results compare to the 2022 survey?

**Skills:** collaboration, analysis

### Practical application 4.1

#### Local issues of concern

- 1 As a class, brainstorm the major issues relating to young people in your local community. They could include some of the issues identified in the article, or others for which you have concern.
- 2 Select one issue, and collectively write an email to your local government representative, outlining your concerns and offering suggestions for ways that the issue could be addressed. Ensure your language and tone are respectful.

**Skills:** collaboration, communication, problem-solving



Quiz

### Revise and summarise 4.1

- 1 How do young people advocate for their own and others' health?
- 2 Outline an example of past advocacy.
- 3 Outline an example of current advocacy.
- 4 Outline an area of potential future advocacy.
- 5 What is the role of individuals within their communities in health advocacy?

### Think critically and apply 4.1

- 1 Analyse the reasons why it is important for youth to advocate for their health and the health of others.
- 2 Research an Australia-based forum for youth advocacy and evaluate how effective you think they are in advocating for their identified issue.
- 3 Propose other avenues for advocacy the group may be able to utilise.

**Skills:** analysis, communication, creative thinking, research



Collaborative investigation

## 4.2 Organisations and communities involved in youth health advocacy

### Learning objective 4.2

DISCUSS the role of government and non-government agencies and communities in promoting young people's health, and the impact of this role

Young people can be considered a comparatively powerless group within Australian society. While some opportunities exist for young people to advocate for their health, they frequently must rely on others to speak on their behalf and protect their rights and needs.

Decisions are made at all levels of government that directly impact on the lives and wellbeing of young people, but young people rarely play an active role in government bodies. Similarly, schools and community groups play a significant role in the formation of health-related habits and attitudes, and therefore have a responsibility to support and advocate for the health of those younger and more vulnerable members of their communities.

### Government

Responsibility for supporting and promoting the health of young people lies with all levels of government. As mentioned earlier, as a group with limited political power, young people rely on those in positions of influence and authority to protect their rights and to support their needs.

Within the different tiers of Australian government, a range of different measures, policies and legislation have been developed to support the health of young people and children. Governments also work in conjunction with other agencies to address the health needs of the younger members of society.

### Commonwealth Government

The Commonwealth government's involvement in the promotion of the health of young people

is a directive and coordinating role. It responds to information analysed and collected by various agencies and bodies, and addresses health issues through national strategies.

The Commonwealth Government's responsibilities include:

- guiding the principles behind state-based child protection policies
- national policy development such as the National Framework for Protecting Australia's Children 2021–2031
- participation in international health-promotion activities and conventions. For example, Australia is a signatory to the UN Convention on the Rights of the Child, which is an agreement by countries to protect the rights of children. The principles outlined in the convention then help to shape Australian policies and legislation
- identifying priority issues concerning the health of Australians and implementing strategies to ensure that these issues are addressed
- developing and implementing national health-promotion campaigns
- coordinating and supporting state-based health-promotion strategies
- allocating funding to state governments and NGOs for research and health-promotion activities
- providing funding for primary healthcare services and services delivered by the private sector
- working with state governments to direct policies relating to health.

### National Action Plan for the Health of Children and Young People 2020–2030

The National Action Plan for the Health of Children and Young People: 2020–2030 (The Action Plan) sets out the direction for a national approach to improve the health and wellbeing of children and young people. It provides a particular focus on advocating

for the health of those at greatest risk to ensure that all Australian children and young people have the opportunity to fulfil their potential and achieve an optimum level of health and wellbeing. The Action Plan is both a call to action and a tool for action, guiding collaborative and unified approaches to achieve goals in several priority areas.

The Action Plan aims to:

- improve health equity across populations
- empower parents and caregivers to maximise healthy development
- tackle mental health and risky behaviours
- address chronic conditions and preventive health
- strengthen the workforce.

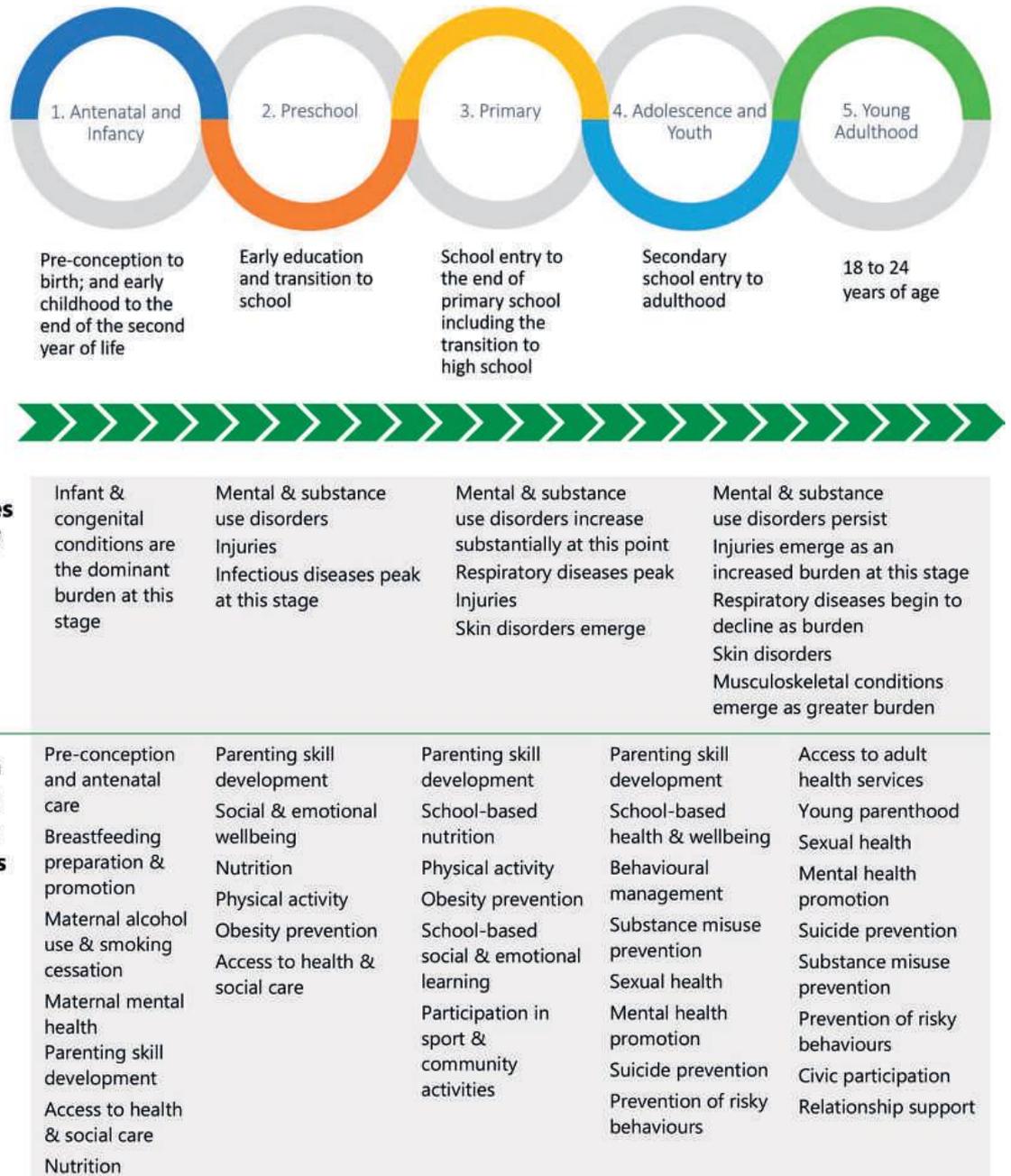


Figure 4.8 National Action Plan for the Health of Children and Young People 2020–2030

## Activity 4.6

### National Action Plan for the Health of Children and Young People 2020–2030

From the table in Figure 4.8, identify one action from each of the priority areas. Devise a strategy that could be employed to address that issue.

**Skills:** creative thinking

### State and territory governments

State and territory governments play a significant role in the support and promotion of the health of young people. States and territories have the responsibility to create legislation in line with national policy frameworks as they have a greater understanding of the needs of their members.

Within NSW, one of the key pieces of legislation that advocates for the health of young people is the *Advocate for Children and Young People Act 2014* (the Act). The Act led to the establishment of the Office of the NSW Advocate for Children and Young People (ACYP) and sets out the responsibilities and functions of the office (described in more detail below).

While the ACYP is an independent body, the NSW State Government works closely with, and monitors its work through the Parliamentary Joint Committee on Children and Young People. In addition to monitoring the ACYP, the committee is also involved in assessing trends and changes in issues and services relating to children and young

people, and can advise on any changes they may see as necessary.

The Act also led to the establishment of the Youth Advisory Council of NSW (YAC). The YAC consists of 12 young people aged 12–24 from diverse backgrounds within NSW. They work closely with government ministers and agencies to provide advice and youth perspectives on issues and policies that affect children and young people.

Another way in which states and territories work to support the health and interests of young people is through the development of state- and territory-based advocates, commissions and guardians. The commissioners communicate regularly and meet twice a year to work together and share information on how to improve the wellbeing of young people across Australia. When issues of national significance arise, the Australian Children’s Commissioners and Guardians (ACCG) may decide to prepare a collective submission.

## Activity 4.7

### Youth Advisory Council of NSW

The YAC is open to all people living in NSW aged between 12 and 24. Imagine that you are applying for the YAC, and prepare an application that addresses the following questions:

- 1 What do you think are the important issues affecting children and young people in NSW? Explain why you think these issues are important. Your answers should be no more than 250 words.
- 2 What life experiences have you had which would assist you in contributing to the YAC work?
- 3 Provide any details of any current or past voluntary or community activities you have been involved in.
- 4 Provide any additional information that you think would be relevant to the application.

**Skills:** communication

## Non-government and community organisations

### Office of the NSW Advocate for Children and Young People (ACYP)

Although it was established under the *Advocate for Children and Young People Act 2014*, which directs its functions and responsibilities, the ACYP is an independent body. The key focus of ACYP is to make NSW a better place for children and young people. It does this by engaging with young people and children through surveys and forums to gain their feedback and input into relevant issues as well as by performing research into key areas that impact young people. The office then uses this information to make recommendations to parliament, government and non-government agencies on a variety of issues, helping to shape policies, practices and services that directly impact children and young people.

### Multicultural Youth Advocacy Network (MYAN) Australia

MYAN is a non-government, non-profit organisation that works to support and advise those who work with young people. As a national advocate for young people, it works closely with young people, governments and communities with a specific focus on the protection and promotion of the rights of young people from refugee and migrant backgrounds.

MYAN works to enable young people to be active participants in Australian society, assisting them in overcoming challenges to fulfil their potential. They achieve this by:

- guiding national dialogue about policy issues relating to young people
- providing and supporting leadership opportunities for young people
- assisting young people to develop advocacy skills to influence national and international policy
- establishing research partnerships
- holding multicultural youth events
- creating and delivering training and professional development
- maintaining a system of MYAN networks across Australia.

MYAN Australia is supported by the Centre for Multicultural Youth (CMY) and is overseen by a National Governance Committee.

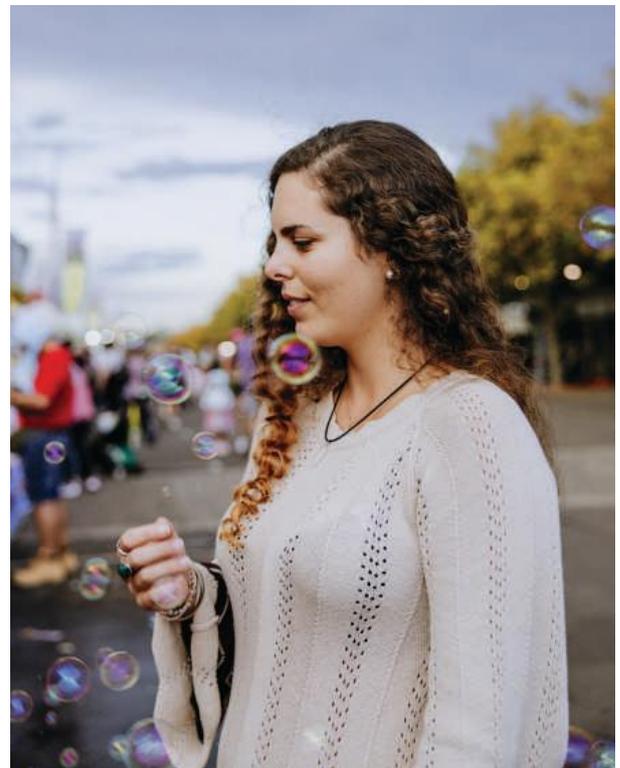


Collaborative investigation

### National Aboriginal Community Controlled Health Organisation (NACCHO)

NACCHO is a key non-government organisation that supports the promotion of the health of Aboriginal and Torres Strait Islander peoples. Funded by the federal government, NACCHO represents over 140 Aboriginal Community Controlled Health Services (ACCHSs) that focus on the health and wellbeing of the Aboriginal and Torres Strait Islander peoples.

ACCHSs are operated and run by the Aboriginal and Torres Strait Islander communities in which they are established. They provide culturally appropriate primary healthcare services that focus on holistic health. Community control is an essential element for the effective delivery of



**Figure 4.9** The key focus of the ACYP is to make NSW a better place for children and young people.

healthcare because it ensures that Aboriginal and Torres Strait Islander communities lead centre processes and procedures. The community control model provides the types of services and delivery models that are valued by, and supportive of, holistic health and wellbeing for Aboriginal and Torres Strait Islander people. NACCHO represents these health services at a national level, ensuring that their needs are advocated for and met.

### Aboriginal Health and Medical Research Council

NACCHO is supported by the Aboriginal Health and Medical Research Council (AH&MRC), which works to ensure that all ACCHs have access to a capable and well-resourced workforce to provide high-quality healthcare services for Aboriginal and Torres Strait Islander communities. They collaborate with Aboriginal, Torres Strait Islander and non-Indigenous health partners to promote the health of Indigenous Australians and address the determinants that lead to negative health outcomes. The AH&MRC works to improve Aboriginal and Torres Strait Islander health outcomes through policy, planning, consultation and support services.



Figure 4.10 headspace

### headspace

headspace is a non-profit organisation that is devoted to providing services and support to assist young people in a range of issues. It is a multifaceted organisation and delivers a variety of services that address issues relevant to young people, including depression, mental illness, relationships, sexual health, drug use, stress, family, bullying and general wellbeing. Young people play an active role in the design, development and evaluation of services to ensure that they are effectively tailored to young people aged from 12 to 25.

Services are provided in a variety of different mediums to ensure that all young people have access. The main avenues include:

- headspace centres
- a national telehealth service
- eheadspace
- headspace vocational services
- headspace schools
- headspace early psychosis program.

## Activity 4.8

### headspace

Go to the headspace website and have a good look around.

- 1 What services does headspace provide? Are these services free or do you have to pay?
- 2 How does headspace address the needs of young people? Identify the range of issues addressed by headspace.
- 3 How does headspace specifically address the needs of Aboriginal and Torres Strait Islander youth?
- 4 Identify the headspace centres in your local area. Evaluate how easy they would be to access for a high school student.
- 5 If you were unable to attend a centre, what active support services are available online to provide you with the care you need?
- 6 As a young person and the target audience of the website, write an email to headspace evaluating its website and services. Include things that you thought were done well. For example, you could mention the range of topics, the layout, the navigation, suggestions for improvement and the likelihood of you using the service in the future if you had the need.

**Skills:** communication, research

### Children and Young People with Disability Australia (CYDA)

CYDA is a not-for-profit organisation that seeks to support and empower children and young people with a disability. It works with government, communities and families to safeguard the rights and aspirations of these children and young people. As the national peak body representing children and young people with a disability, a core element of its work is advocacy. CYDA establishes a vital connection between the experiences of children and young people and their families and the federal government, along with other significant stakeholders. This connection plays an essential role in the development of effective policy and the establishment of support services that directly address the needs of this group.

Activities in which CYDA is involved include:

- promoting inclusion within the community
- developing pathways for those with disabilities to achieve educational goals
- transforming community attitudes towards young people with disability
- exposing and addressing discrimination, abuse and neglect
- empowering young people with a disability by providing opportunities for advocacy, connection and development.

CYDA is supported by funding from the Australian Government, including the Department of Social Services and the National Disability Insurance Scheme, as well as donations from organisations, communities and individuals.

### National Disability Insurance Agency (NDIA)

The NDIA is an independent statutory agency that was established to implement the National Disability Insurance Scheme (NDIS).



**Figure 4.11** NDIS rally on the front lawns of Parliament House, 27 November 2012

The NDIS was established in 2013 in response to a public enquiry into a long-term disability care and support scheme. The enquiry was commissioned by the federal government and highlighted the fact that existing support measures for people with a disability were ineffective and insufficient.

The *National Disability Insurance Scheme Act 2013* was established and trials began in July 2013, with a full scheme rollout in 2016. The NDIS provides support to people with a permanent and significant disability that affects their ability to take part in everyday activities. It works with people with disabilities and their families to establish goals relating to independence, community involvement, education, employment and health and wellbeing, and then works to achieve them. The support provided aims to reduce the impact of disability on life and provide flexibility, choice and control over how the support is received and utilised.

## Impact of organisations and communities

Community-based groups are often some of the most effective forms of health promotion due to the close connection these groups have with the local area. Community groups often have a much clearer idea of the needs of their community, what sorts of strategies and initiatives will be best received and the most effective forms of implementation. This is equally true for young

people. Being able to identify the particular needs of young people within a community means that effective programs and strategies can be employed to best support community members.

Although there is room for improvement, organisations and communities within Australia continue to have a positive impact on the health of young Australians.

### Activity 4.9

#### Community-based groups

- 1 Identify two community-based groups within your local area that are designed to support and address the needs of young people. These could include support groups, religious groups, sporting groups or specialist interest groups.
- 2 Outline how they provide support for the needs of young people and the benefits that a young person may gain from participating in their activities.

**Skills:** research

### Revise and summarise 4.2

- 1 Outline the role that government and non-government organisations and communities have in promoting the health of young people, including Aboriginal and/or Torres Strait Islander young people.
- 2 Describe the impact of organisations and communities on the health of young people.



Quiz

### Think critically and apply 4.2

Select an organisation that has a key role in promoting the health of young people. Imagine that you are a member of the board of directors, and prepare an email to the Commonwealth Government on behalf of the organisation, requesting an increase in funding for your programs and services.

In your email:

- Justify the importance of your organisation in the promotion of the health of young people, including Aboriginal and/or Torres Strait Islander young people.
- Outline some of the valuable work you are currently doing and the impact that it is having on the young people of Australia
- Design and describe a future service or initiative that would be implemented were the increase in funding to be approved.

**Skills:** communication, problem-solving

## 4.3 Health promotion in Australia

### Learning objective 4.3

ANALYSE how health promotion in Australia is influenced and impacted by models of health and global health policies

There are many underlying factors that influence the level of health that an individual experiences. Health behaviours, personal biomedical factors, and sociocultural, environmental and socio-economic factors all contribute in varying degrees to determine an individual's health. Health promotion aims to ensure that these factors contribute to health in a positive way, achieving better health for all.

The **World Health Organization (WHO)** is the leading international organisation for health in the United Nations. It has played a key role in the development of a global health movement and the development of international policies relating to health promotion.

WHO defines health promotion as 'the process of enabling people to increase control over their health and its determinants, and thereby improve their health'. This definition recognises the influence of many outside factors on health and the importance of empowerment of the individual in order to improve health.

Health promotion encompasses a broad range of activities and has evolved over the years.

### Approaches to health

The evolution of health promotion has been largely reflective of the different views and approaches to health, including:

- Aboriginal and Torres Strait Islander approaches to health
- the biomedical model
- the sociocultural model
- the salutogenic model
- the ecological model.

### Aboriginal and Torres Strait Islander approaches to health

Aboriginal and Torres Strait Islander approaches to health are communal and holistic. The importance of cultural wellbeing is valued along with physical, spiritual, social and emotional wellbeing, and is closely connected to the health of First Nations lands.

The health of First Nations people traditionally encompassed a rich history of traditional medicines and health practices. Most of these practices are no longer feasible because of stolen lands.

The impact of colonisation has led to ongoing social and cultural effects on Aboriginal and Torres Strait Islander peoples. The destruction of cultures, communities and Country, which underpin the holistic nature of Indigenous health, have had a cumulative effect on the health of Aboriginal and Torres Strait Islander peoples since colonisation. This is the reason First Nations people experience inequity in the domain of health, as well as other areas such as education and justice.

Health promotion that is reflective of the Indigenous models of healthcare is paramount to addressing differences in health outcomes.

**World Health Organization (WHO)** an agency of the United Nations that seeks to achieve high levels of health for all



**Figure 4.12** The Indigenous model of health is communal and holistic.

Ensuring the delivery of culturally appropriate and responsive services that reflect the needs and values of the communities in which they are being delivered is vital. The recent Close the Gap focus on genuine partnerships with First Nations people has led to a shift in health promotion and care that is based on First Nations health models.

### The biomedical model of health

The biomedical model of health is largely concerned with the diagnosis, cure and treatment of disease. It is a model of health that is predominantly

**intersectoral** actions that involve multiple sectors of society, including government and non-government agencies

reflected in the medical profession practised by doctors and health professionals. The main focus of the biomedical model is on the physical and biological elements of disease and illness, with attention devoted to curative processes.

Because of this focus, the emphasis is on an individual's choices relating to risk behaviours like smoking and drinking. It does not account for the influences of the social and economic environments in which an individual lives, thereby placing a greater burden on the healthcare system to 'fix' ill health rather than for individuals to take responsibility for their health. This view of health shaped health promotion prior to the 1970s but has since been identified as possessing many limitations.

### The sociocultural model of health

In the 1970s there came greater understanding of the influence of broader society on an individual's health, and with it the sociocultural model of health.

The sociocultural model of health recognises that health was the product of a complex interaction between multiple determinants such as social, cultural, socio-economic and environmental factors rather than just illness and injury. It reflects the understanding that for improvements in health to occur, these determinants must be acknowledged and addressed.

This model has five guiding principles, or areas. The sociocultural model of health:

- addresses the broader determinants of health
- acts to reduce social inequities
- empowers individuals and communities
- acts to enable access to healthcare

- involves intersectoral collaboration.

This is the view that is largely adopted today and can be seen in the way that health promotion at all levels is approached. Health promotion campaigns seek to modify behaviours while acknowledging that there are many influencing factors behind an individual's decisions. Health promotion in Australia involves all levels of society, using an **intersectoral** approach, as modelled in the social model of health. The sociocultural model of health is also a core element of the Ottawa Charter and the Sustainable Development Goals.

### The salutogenic model of health

The salutogenic model of health provides a view of health that focuses on how and why people stay well. This view was developed by sociologist Aaron Antonovsky and focuses on stressors, coping and health. It concentrates on how people develop adaptive coping mechanisms to move towards better health. It also recognises the impact of other supporting factors such as wealth, self-belief, social stability and cultural stability in the ability of an individual to develop a sense of coherence.

This model is similar to others in the sense that it acknowledges that individuals should not be held accountable for their health alone, but rather recognises health as a balance whereby someone needs social stability, a sense of purpose and low levels of distress and stress to achieve peak health.

Health promotion based on this model therefore targets the broader aspects of health rather than just individual behaviour.

### The ecological model of health

The ecological model of health recognises the various factors influencing health behaviours. It places emphasis on environmental influences while also considering social and psychological influences.

Health promotion strategies that reflect this approach generally have a multifaceted approach to targeting health behaviours. The result is generally comprehensive approaches that address a whole population.

This framework acknowledges the interaction of the determinants of health and therefore systematically targets change at each level.

## Global health policies and their impact on health promotion in Australia

Australia is an active member of the global movement towards better health for all. Over the past 40 years, Australia has been involved in numerous international conferences and global declarations that have shaped the way that we approach health promotion within Australia.

### Global organisations

Two significant bodies that have had key influence on health promotion in Australia are the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Health Organization (WHO).

#### UNESCO

World War II was the catalyst for the establishment for UNESCO, an organisation that would break cultural barriers and fervently pursue genuine and lasting peace. A global body since its establishment in 1945, UNESCO has expanded to consist of 195 members and eight associate members with 50 field offices around the world.

UNESCO uses the sciences, education, culture, communication and information to foster a global culture of peace and address key issues such as poverty and sustainable development. Australia is a member body of UNESCO and has been since its establishment. Australian health promotion reflects the core goals of UNESCO, which include:

- supporting all Australians in accessing quality education
- utilising scientific knowledge and policy to shape sustainable development
- acknowledging and addressing social and ethical issues
- supporting and encouraging diversity and inclusion
- promoting the use of and access to information and communication.

UNESCO works in partnership with numerous bodies that are active within Australia, including WHO.

#### WHO

WHO is at the forefront of global health promotion and is committed to empowering all people everywhere to achieve high levels of health. Founded in 1948, it is a United Nations agency consisting of 194 member states, working in over 150 different locations. Collaboration is at the core of every facet of WHO, which partners with a diverse range of bodies including governments, NGOs, foundations, advocates, researchers and health workers to achieve positive health outcomes for all.

WHO uses this intersectoral approach to promote:

- education – about a broad range of health topics such as disease prevention, risk and protective factors
- prevention – through programs such as vaccination and immunisation
- emergency response – to epidemics such as COVID-19 and Zika virus, as well as other long-standing communicable diseases such as HIV, malaria and polio.

Australia is a founding member of WHO and has been an active partner for almost 70 years. Collaborating with WHO on a variety of priority health issues, Australia has worked hard to advance both regional and global health agendas. Australia has provided leadership in numerous areas of public health and has partnered with and shared expertise with numerous bodies to support the work of WHO. Currently within Australia there are 46 centres that work directly with WHO on a range of priorities.

As the result of health promotion approaches that reflect the core values of WHO, Australia has established a world class healthcare system, managed threats to health, steadily increased life expectancy and is a leader in many areas of public health. Australia has worked closely with WHO over many years to implement numerous health promotion campaigns and contribute to effective policy development.

### Other health promotions

Australia has been involved in other global health promotions and policies, separate from UNESCO and WHO (see Case studies 4.3 and 4.4 on the following pages).

Depth  
Study

### Case study 4.3

#### Global Standards for Health Promoting Schools

A collaborative project between WHO and UNESCO, the development of Global Standards for Health Promoting Schools seeks to establish a framework grounded in health and education and shared principles, strengths and understandings. This framework can be implemented by countries around the world, establishing a global network of Health Promoting Schools.

## NEWS REPORT

### UNESCO and WHO urge countries to make every school a health-promoting school

22 June 2021

UNESCO and the World Health Organization today launched the Global Standards for Health-promoting Schools, a resource package for schools to improve the health and wellbeing of 1.9 billion school-aged children and adolescents. The closure of many schools around the world during the COVID-19 pandemic has caused severe disruptions to education. An estimated 365 million primary school students have gone without school meals and significantly increased rates of stress, anxiety and other mental health issues have been observed.

“Schools play a vital role in the wellbeing of students, families and their communities, and the link between education and health has never been more evident,” said Dr Tedros Adhanom Ghebreyesus, WHO Director-General. “These newly launched global standards are designed to create schools that nurture education and health, and that equip students with the knowledge and skills for their future health and wellbeing, employability and life prospects.”

Based on a set of eight global standards, the resource package aims to ensure all schools promote life skills, cognitive and socioemotional skills and healthy lifestyles for all learners. These global standards will be piloted in Botswana, Egypt, Ethiopia, Kenya and Paraguay. The initiative contributes to WHO’s 13th General Program of Work target of ‘1 billion lives made healthier’ by 2023 and the global Education 2030 Agenda coordinated by UNESCO.

“Education and health are interdependent basic human rights for all, at the core of any human right, and essential to social and economic development,” said UNESCO Director General, Audrey Azoulay. “A school that is not health-promoting is no longer justifiable and acceptable. I call for all of us to affirm our commitment and role, to make every school a health-promoting school.”

The global standards provide a resource for education systems to help foster health and wellbeing through stronger governance.

Case study 4.3 *continued*

UNESCO and WHO will work with governments to enable countries to adapt the package to their specific contexts. The evidence is clear. Comprehensive school health and nutrition programmes in schools have significant impacts among school-aged children. For example:

- School health and nutrition interventions for girls and boys in low-income areas where worms and anaemia are prevalent can lead to 2.5 years of additional schooling.
  - Malaria prevention interventions can result in a 62% reduction in absenteeism.
  - Nutritious school meals increase enrolment rates by 9% on average, and attendance by 8%; they can also reduce anaemia in adolescent girls by up to 20%.
  - Hand-washing promotion reduces absenteeism due to gastrointestinal and respiratory illnesses by 21–61% in low-income countries.
  - Free screening and eyeglasses have led to a 5% higher probability of students passing standardized tests in reading and math.
- Comprehensive sexuality education encourages the adoption of healthier behaviours, promotes sexual and reproductive health and rights, and improves sexual and reproductive health outcomes such as the reduction of HIV infection and adolescent pregnancy rates.
  - Improving water and sanitation (WASH) services and supplies in school, as well as knowledge on menstrual hygiene, equips girls to maintain their body hygiene and health with dignity, and may limit the number of school days missed during menstruation.

The Health Promoting Schools approach was first articulated by WHO, UNESCO and UNICEF in 1995 and adopted in over 90 countries and territories. However, few countries have implemented it at scale, and even fewer have effectively adapted their education systems to include health promotion. The new global standards will help countries to integrate health promotion into all schools and boost the health and wellbeing of their children.

- 1 What is the purpose of the Global Standards for Health Promoting Schools?
- 2 How do the global standards reflect the importance of acknowledging and addressing the determinants of health?
- 3 Analyse the effectiveness of the Global Standards for Health Promoting Schools as framework that can be applied to various countries and contexts.

**Skills:** analysis

Depth  
Study

## Case study 4.4

### Global Polio Eradication Initiative

One example of a successful global health campaign is the Global Polio Eradication Initiative (GPEI). Polio is an infectious viral disease that is transmitted by person-to-person contact and can cause paralysis predominantly in children. Before the development of vaccines, polio was responsible for the paralysis of hundreds of thousands of children. After the introduction of the vaccines to developed countries in the 1950s and 1960s, polio was virtually eradicated from these countries. However, in developing countries the process was much slower.

Since the GPEI's establishment in 1988, the global incidence of polio cases has seen a dramatic decrease, with type 2 and type 3 of the poliovirus being declared eradicated, and a 99.9% reduction in overall rates of incidence.

The success of the campaign came from an approach that was coordinated and collaborative. The GPEI is a public-private partnership led by national governments, including Australia, and has six core partners – WHO, Rotary International, the US Centers for Disease Control and Prevention (CDC), the United Nations Children's Fund (UNICEF), the Bill & Melinda Gates Foundation and Gavi, the Vaccine Alliance. This intersectoral approach towards health promotion is one that is modelled in Australia.

Another factor that made it so successful was the way the campaign engaged with at-risk communities. GPEI works with the communities to establish trust towards health workers, engaging the communities to advocate for the vaccine and develop positive attitudes towards health workers. This community-focused approach is reflected in the way that many Indigenous health promotion activities are now delivered.

- 1 Discuss some of the challenges that may have existed when distributing vaccines in developing countries.
- 2 Outline why a collaborative approach is so necessary for the eradication of polio.
- 3 Brainstorm examples of coordinated and collaborative health promotion activities within Australia.



Video 4.1 Polio and COVID-19

### The complications of COVID-19

The importance of a coordinated and collaborative approach was again highlighted during the COVID-19 pandemic, when the delivery of polio vaccinations to children was interrupted. This interruption saw a spike in cases of polio in the two remaining countries where wild polio still exists, Pakistan and Afghanistan. The nature of the polio virus means that if left unattended it could become rife again.

Use the QR code to watch Video 4.1, then answer the following questions.

- 1 What is an immunity gap and how was it caused in this case?
- 2 How is PolioPLUS an example of a holistic approach to health promotion?
- 3 Describe how the unique infrastructure of the PolioPLUS program has assisted in the fight against COVID-19.
- 4 The global eradication of polio is almost 100% complete. What specific efforts have been made over the past couple of years in Afghanistan and Pakistan to reinstate vaccinations and close the immunity gap?
- 5 Analyse what remaining steps need to be taken to enable the complete worldwide eradication of the polio virus.

**Skills:** analysis

## Case study 4.5

### Family planning and sexual health

Family planning and sexual and reproductive health within Australia has been shaped by global policy. The establishment of the International Planned Parenthood Federation (IPPF) in 1952 was the first significant step in advocating for sexual and reproductive rights on a global scale. The Declaration on Population in 1966 furthered this step and, in 1967, Australia became a signatory to the Declaration. In 1969, the National Health and Medical Research Council of Australia recommended to the Australian states the establishment of family planning facilities.

The advice was realised with the development of the Family Planning Alliance Australia (FPA), an Associate Member of IPPF and a federation that consists of member organisations from all states and territories. The FPA works in partnership with organisations to shape policy and advocate for sexual and reproductive rights. It continues to work with sister IPPF members on a global scale.

The FPA works to deliver services focused on education in contraception, cervical cancer screening, STIs, breast screening, pregnancy tests, counselling, pregnancy termination, menopause management, management of gynaecological problems, domestic and sexual violence, and comprehensive sexuality education. Clinical services in these areas are also delivered and are targeted to high needs groups, including people with disabilities, culturally and linguistically diverse people, young people, gender diverse people, and Aboriginal and Torres Strait Islander people.

## Case study 4.6

### Millennium Development Goals and the Millennium Declaration

In the year 2000, Australia and 188 other nations adopted the Millennium Declaration and committed to the **Millennium Development Goals (MDGs)**.

The MDGs were eight global goals, applicable to all countries, derived from the United Nations' Millennium Declaration. They committed global leaders to take action to achieve the goals by 2015. The goals were:

- MDG 1: Eradicate extreme poverty and hunger.
- MDG 2: Achieve universal primary education.
- MDG 3: Promote gender equality and empower women.
- MDG 4: Reduce child mortality.
- MDG 5: Improve maternal health.
- MDG 6: Combat HIV/AIDS, malaria and other diseases.
- MDG 7: Ensure environmental sustainability.
- MDG 8: Develop a global partnership for development.

Australia's commitment and work towards these goals helped to shape health promotion not only in Australia but also on a global scale. Like the WHO's Ottawa Charter, the MDGs reflected the interrelation of the determinants of health and the way in which improvement in one area of the goals can lead to improvements in others. It also reflected the importance of partnerships between governments, non-government organisations, communities and individuals in achieving positive health outcomes. Australia's commitment to the goals saw significant increases in official aid to support and work with other countries to achieve the goals.

These goals have since been superseded by the Sustainable Development Goals (SDGs) – see section 4.4 of this chapter.

- 1 How effective do you think the efforts have been to achieve the MDGs?
- 2 In 2015, the MDGs were superseded by the SDGs. What are some of the ways that the SDGs have built on the MDGs?
- 3 Analyse the importance of targeted global action against issues such as poverty, education, mortality and morbidity.



**Video 4.2**  
The Millennium  
Development Goals

### Millennium Development Goals (MDGs)

goals developed the United Nations to combat poverty, hunger, disease, illiteracy, environmental degradation and discrimination. Committed to by leaders around the world in the year 2000, they have since been superseded by the Sustainable Development Goals.

### Skills: analysis

## The Ottawa Charter

**Ottawa Charter** a WHO framework for health promotion that can be applied to all health-promoting agencies

The most significant global policy to be developed was the WHO's **Ottawa Charter** for Health Promotion.

The Ottawa Charter was the product of the first International Conference on Health Promotion, which was held in Ottawa, Canada

in 1986. The conference was held in response to the growing recognition of the need for a global health movement.

The charter clearly identified that for good health to be achieved, some prerequisites existed, including peace, a stable ecosystem, social justice and equity, and resources such as education and income. It identified the necessity for an intersectoral collaboration for health promotion and called for support from international organisations in setting up strategies and programs for health promotion.

The charter was the first of its kind and identified five key principles of health promotion that could be applied by countries in a manner that best addressed their needs and population. These five action areas played

a significant role in shaping health promotion and achieving positive health outcomes not just in Australia but also globally.

### Action areas of the Ottawa Charter

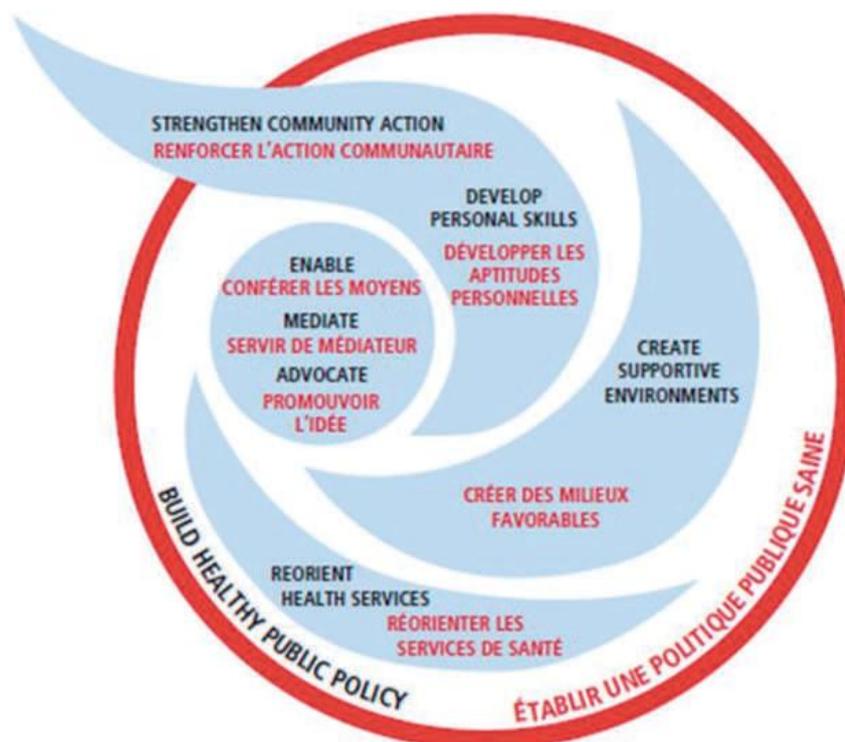
One of the key elements of the Ottawa Charter and the way that it shaped health promotion in Australia was the importance of intersectoral collaboration. Intersectoral collaboration is when different sectors of society coordinate in order to address a particular issue or reach a certain outcome. This makes the work more effective and usually leads to a more sustainable outcome than would be achieved by different areas of the health sector working in isolation.

The action areas of the Ottawa Charter address the different facets of society and provide a sound framework for health promotion.

### 1 Developing personal skills

Developing personal skills is related to the maintenance of positive health behaviours and the altering of negative health behaviours – for example, education about healthy and unhealthy nutrition so you can make informed choices that are conducive to good health.

Health promotion provides information and education for health, and life skills. This gives



**Figure 4.13** The Ottawa Charter Emblem

people more options, meaning they have greater control over their own health and over their environments, and to make choices conducive to health.

This action is at the core of numerous health promotion campaigns that aim to increase awareness of risk factors associated with certain behaviours, including speeding and smoking. Legislation and policy also reflects the importance of developing personal skills through the inclusion of Personal Development, Health and Physical Education (PDHPE) as a compulsory subject from Kindergarten to Year 10.

## 2 Creating supportive environments

Creating **supportive environments** involves everyone taking care of each other, their communities and their natural environment, so that people recognise and support healthy lifestyles – for example, by altering work conditions so that they are safer for all. Creating supportive environments has been a key element of numerous health promotion initiatives, including ‘Healthy Canteens’, community development plans that incorporate cycle paths, parks and equipment to encourage physical activity and workplace health and safety policies and laws.

## 3 Strengthening community action

Strengthening community action involves seeing how communities can improve the health status of their members. If communities agree on action priorities, make decisions and implement them for the better, then these communities are empowered to own and control their own health problems. Some examples of this in action include community-run festivals and family sports days for promoting physical activity and connection, the Biggest Morning Tea for cancer awareness and research, and the Push Up Challenge for mental health awareness.

## 4 Reorienting health services

**Reorienting health services** involves going beyond the traditional focus of healthcare providing curative services, and expanding the role of healthcare to include promotion of good health and prevention of illness and disease. For example, organisations may provide information about positive health methods and behaviours (Cancer Council) and offer disposal sites for needles.

## 5 Building healthy public policy

Building healthy public policy requires health to be important to governments at all levels. It means taking account of the importance of health for individuals and communities when laws are made and changed. Building healthy public policy is not just limited to laws but also includes the allocation of funding. Building healthy public policy has shaped our road laws, funding for preventative health and smoking restrictions. It also supports NGOs in tackling priority health issues such as cancer and diabetes.

### The Ottawa Charter in Australia

The multi-faceted approach to health promotion that is inherent in the Ottawa Charter is necessary to bring about real and lasting change. This approach to health promotion provides a targeted approach that addresses all areas in which poor health decisions may be made. It provides support at all levels, highlights poor health choices and supports positive ones. Health-promotion strategies target the same issue in a variety of different ways, ensuring that no one escapes the message. Health promotion based on the Ottawa Charter has been used to target many health priority issues and negative health behaviours within Australia to produce positive outcomes.

For example, the issue of road safety in Australia is one that has seen some vast improvements over the last couple of decades. Health promotion based on each action area of the Ottawa Charter has driven numerous campaigns aimed at different aspects of road safety. These use a coordinated approach that is often government driven but is supported by many other agencies and organisations. This has also been the case for anti-smoking campaigns. Positive trends relating to smoking continue to occur thanks predominantly to a coordinated approach.

**supportive environments** the places people live, work and play that protect them from threats to health and that increase their ability to make health-promoting choices

**reorienting health services** directing the focus of the health sector towards health promotion, prevention and supporting the wellbeing of the whole person to complement traditional roles of diagnosis, treatment and rehabilitation; reorientation can also involve coordinating other sectors to work for health

### Activity 4.10

#### The Ottawa Charter

- 1 For each of the action areas of the Ottawa Charter, identify how it has been applied to the issue of road safety or smoking within Australia.
- 2 Evaluate the success of this approach.

**Skills:** analysis

### Health promotion and community partnership

Partnerships with communities continue to be crucial to the success of health promotion activities and the improvement of health across all cultural groups, including Aboriginal and Torres Strait Islander Peoples. Community partnership is a principle that is reflected both in the principles of social justice (participation) and in the majority of more recent health promotion approaches, including the Ottawa Charter.

The value of engaging with communities comes from:

- a greater understanding of their needs and how to address them
- cultural sensitivity by understanding a group's cultural heritage, traditions and values

- establishing effective communication by acknowledging and addressing language barriers
- empowering individuals and communities through contributing to the planning, development and implementation of health promotion activities
- establishing trust.

Community participation has been a key factor in the establishment of the Aboriginal Community Controlled Health Services (ACCHSs).

ACHHSs are operated and run by people from the Aboriginal communities in which they are established. This ensures that the needs of the community are reflected in the services being provided and that all services are delivered in a culturally appropriate manner.



Quiz

### Revise and summarise 4.3

- 1 Describe the progression of health promotion in Australia.
- 2 Outline the influence of various models of health on the promotion of health.
- 3 Discuss the impact of global health policies on health promotion in Australia.

### Think critically and apply 4.3

- 1 Research a current health promotion campaign targeting a major health issue within Australia. For example, the issue could be tobacco use, vaping, obesity, diabetes, skin cancer or another health issue.
- 2 For the campaign, identify how the Ottawa Charter action areas are reflected in the implementation of the campaign.
- 3 Analyse what model of health is evident in the nature of the health promotion campaign.

**Skills:** analysis, research

## 4.4 United Nations Sustainable Development Goals

### Learning Objective 4.4

EXAMINE the United Nations Sustainable Development Goals in relation to health, both globally and in Australia

Health promotion in Australia continues to evolve. It continues to be shaped by global health issues and policies. Some of the most recent global policies that are providing direction for Australian health promotion are the United Nations Sustainable Development Goals (SDGs).

The SDGs are a 'plan of action' for the world to address its largest issues. The SDGs provide a framework that addresses people, the planet and prosperity in a manner that promotes collaboration and worldwide goals. It looks to build on previous global action plans such as the Millennium Development Goals (MDGs), and to continue the

work that has already been started in addressing global issues and achieve what they did not.

Developed in 2015, the SDGs were agreed upon and adopted by all United Nations member states. Implementation of the goals began on 1 January 2016, with the aim to achieve all targets within 15 years – by the year 2030. The goals, although global in nature, are relevant and applicable to all countries, regardless of their economic, social or political situation. It is the responsibility of national leaders to apply the goals to their country, taking into account their national circumstances. The goals have been developed to encourage collaborative implementation that involves all levels of society.

There are 17 SDGs, with 169 specific targets between them. The goals are integrated and indivisible, and address the major elements of sustainable development: economic, social and environmental. A set of indicators has also been developed to assist countries in measuring their progress.



Collaborative investigation

**Figure 4.14** The 17 Sustainable Development Goals (<https://www.un.org/sustainabledevelopment>)

The content of this publication has not been approved by the United Nations and does not reflect the views of the United Nations or its officials or Member States.

The goals are ambitious but will be transformational, providing a better world for all if achieved.

### Sustainable Development Goals

Goal 1. End poverty in all its forms everywhere.

Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Goal 3. Ensure healthy lives and promote wellbeing for all at all ages.

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Goal 5. Achieve gender equality and empower all women and girls.

Goal 6. Ensure availability and sustainable management of water and sanitation for all.

Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all.

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Goal 10. Reduce inequality within and among countries.

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.

Goal 12. Ensure sustainable consumption and production patterns.

Goal 13. Take urgent action to combat climate change and its impacts.\*

Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

Goal 17. Strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development.

\* Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change.

United Nations, *Transforming Our World: The 2030 Agenda for Sustainable Development*

The sustainable development goals provide countries with an action plan to address major issues affecting the planet and people. This plan can then be customised to suit the specific needs and situations of each country. What implementation of the goals will look like varies from country to country. This variation can be due to a number of different factors including:

- resources available
- varying cultural needs
- the stage that a country has reached in achieving the goals
- varying needs of the population
- differing structures of governance.

While implemented in varying ways in various countries, the goals encourage collaboration from all levels within a country and internationally.

## Activity 4.11

### Sustainable Development Goals

Read through the 17 SDGs. For a more in-depth look at the goals, look up the United Nations website: <https://cambridge.edu.au/redirect/10294>

One of the key elements of the SDGs that is reflected throughout is to 'leave no one behind'. Explore this statement and identify what you think it means.

**Skills:** analysis

## The World Health Organization applying a health lens in the SDGs

Of the 17 SDGs, there is only one that is explicitly devoted to health. SDG3, 'Ensure healthy lives and promote wellbeing for all at all ages', identifies key targets to measure the improvements in the health status of the global population.

### Sustainable Development Goal 3

The key targets for SDG3 are listed below.

3.1 By 2030, reduce the global maternal mortality ratio to less than 70 per 100 000 live births.

3.2 By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births.

3.3 By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.

3.4 By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and wellbeing.

3.5 Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol.

3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents.

3.7 By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes.

3.8 Achieve universal health coverage, including financial risk protection, access to quality essential healthcare services and access to safe, effective, quality and affordable essential medicines and vaccines for all.

3.9 By 2030, substantially reduce the number of deaths and illnesses from

hazardous chemicals and air, water and soil pollution and contamination.

#### Means of implementation for the targets

3.a Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate.

3.b Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all.

3.c Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States.

3.d Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

United Nations, *Transforming Our World: The 2030 Agenda for Sustainable Development*

The 17 targets in SDG3 address specific health issues in a variety of different areas. These include:

- Decrease preventable deaths – infants, children, road accidents and substance abuse; support WHO tobacco control.
- Implement communicable disease control – end AIDS; focus on neglected tropical diseases, malaria, tuberculosis, hepatitis and water-borne diseases.
- Implement non-communicable disease control – prevention and treatment.
- Improve access to reproductive health services.

- Achieve access to quality healthcare for all.
- Increase support of health workforce in developing countries.
- Strengthen capacity to manage global health risks.

### Health in the other SDGs

The interrelated nature of the SDGs means that these health issues are not addressed in isolation but are supported in a range of ways across the other SDGs. As previously discussed, the determinants of health significantly impact an individual's health status. The SDGs look to directly improve many of the determinants that influence health:

- nutrition (SDG 2)
- education (SDG 4)
- gender equality (SDG 5)
- water and sanitation (SDG 6)
- employment (SDG 8)
- infrastructure to support wellbeing (SDG 9)
- reduce inequality (SDG 10)
- housing (SDG 11) and road safety
- healthy environments (SDGs 13–15)
- reduce violence, abuse and related deaths (SDG 16).

In addition to addressing the determinants directly, many of the targets within the SDGs have an indirect and positive influence on health.

One of the fundamental principles underpinning the SDGs is the pledge that 'no one will be left behind'. This statement is a declaration that these targets and goals will be addressed for all people of all nations and all levels of society. It declares that those groups who experience disadvantage and inequality will be assisted in the ways that are needed for them to achieve the goals as well. This principle is also reflected in the way that the financing of the SDGs have been approached on a global scale.

The Addis Ababa Action Agenda sets out a comprehensive framework for financing sustainable development. It recognises the importance of international cooperation and support through all sectors, including government, public and private, in order to finance and support the SDGs. It also recognises that some developing countries will require assistance in order to achieve these goals.



**Figure 4.15** The opening session of the second SDG Summit in New York City on September 18, 2023

## Case study 4.7

### SDG3 in action – addressing HIV globally

#### Focus on Angola

In Angola, rates of HIV infection and mortality rates from AIDS are on the decline. Over the 10 year period from 2012 to 2022, annual new infections decreased by 46.4%, from 28 000 to 15 000, while annual AIDS-related deaths dropped by 24.5%, from 17 000 to 13 000. However, there remain a significant number of people who live unaware of their infection. There is great inequality in rates of infection between young men and women, with women and girls twice as likely to contract HIV. The disparity in HIV and AIDS rates in Angola can be attributed to a lack of education, a lack of testing services and the stigma associated with the virus.

In order to address this growing issue, women-led community groups, called Bancadas Femininas, have been established and work with women to increase awareness of HIV and other health issues. Group members known as Activistas encourage HIV testing and work to improve communication and reduce the stigma associated with HIV, particularly among adolescents who would normally avoid such services.

In order to educate young women about HIV, and to dispel long-held misconceptions, Bancadas Femininas uses stories, music and drama to deliver their messages. Meetings are organised through schools and churches, as well as in community areas and marketplaces, in order to be accessible to both school students and girls no longer at school.

The groups also focus on providing support and education to pregnant women who are HIV positive.

Reducing generational transmission of the virus is a key part of the fight against AIDS. Networks of pregnant women and mothers – many of whom are themselves living with the virus – provide support and education to pregnant women who are HIV-positive, encouraging the use of antiretrovirals to protect their unborn babies.



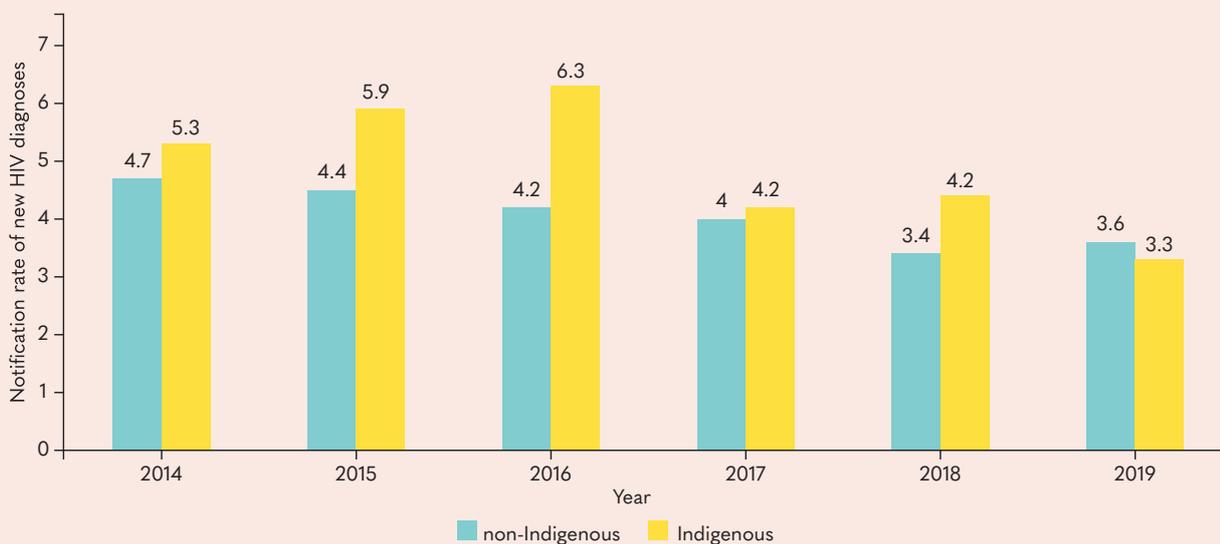
**Figure 4.16** Educating girls and women on HIV/AIDS

*continued*

Case study 4.7 *continued*

## Focus on Australia

Within Australia, rates of HIV infection have been in a decline since the late 1980s. The focus of HIV/AIDS prevention takes a slightly different approach from that in Angola as the needs and resources of the country are different.



**Figure 4.17** Notification rate of new HIV diagnoses in Australia per 100 000 population, 2014 to 2019

Rates of infection in Australia have remained relatively low and steady over the past 10 years and the focus is on complete eradication of transmission. In 2018, the drug Pre-Exposure Prophylaxis (PrEP), a preventive drug for people at medium to high risk of HIV, was included on the Pharmaceutical Benefits Schedule (PBS). This increased accessibility to those most at risk of contracting HIV, including gay and bisexual men, Aboriginal and Torres Strait Islander people, migrant groups and other groups at higher risk. This is one element of a comprehensive approach to reduce transmission rates and eradicate HIV/AIDS within Australia. In addition to the change to the PBS, the Australian Government has also allocated substantial funding towards education and awareness activities in those communities.

- 1 Consider the Bancadas Feminanas program in Angola:
  - a Identify the SDGs that are being addressed by the program.
  - b Outline how they are being addressed.
  - c Describe the core features of the program that make it successful.
- 2 In 2021, the Angolan Government, through the Ministry of Health and the United Nations Development Program (UNDP), launched the Global Fund Grant for 2021–24. This was a significant investment in the national health system to help fight against HIV, malaria, tuberculosis and COVID-19. Analyse the importance of a collaborative and comprehensive approach to tackling issues such as HIV/AIDS.
- 3 Consider the Australian strategy of including PrEP on the PBS.
  - a Evaluate the effectiveness of this strategy in addressing HIV/AIDS within Australia.
  - b Outline how the SDG are being addressed in this strategy.
- 4 Research the other major strategies that are in place to address HIV/AIDS in Australia.
- 5 Compare the different approaches to management of the virus in Australia and Angola. What are the key differences in their approach? Explain reasons for these differences.
- 6 Look at Figure 4.17 comparing rates of HIV/AIDS infection between Indigenous and non-Indigenous people in Australia. What improvements can be seen in recent years? To what can this be attributed?

**Skills:** analysis, research

**Case study 4.8**

**The impact of COVID-19 on HIV responses**

Look through the infographic (Figure 4.18) outlining the effects of the COVID-19 pandemic on HIV responses.

- 1 What were some of the biggest barriers to successful delivery of HIV treatment and prevention programs during the COVID-19 pandemic?
- 2 Outline some of the ways that these barriers were overcome.
- 3 Analyse how the impact may have varied between Australia and Angola.

**Skills:** analysis



**Figure 4.18** Impact of the COVID-19 pandemic on HIV responses

**Skills:** analysis

**Activity 4.12**

**Health-related SDGs**

- 1 SDG3 is the only goal that directly addresses health issues. Even though the remaining goals might not specifically address health issues there are many that directly impact on health. Outline how each of the goals influences health.
- 2 Discuss the determinants of health that are reflected in the goals.
- 3 Critically analyse the importance of the interrelated nature of the health-related SDGs. Support your answer with examples of other targets within the SDGs that directly support the achievement of these goals.

**Skills:** analysis



In 2018, it was recognised that in order for the SDGs to be achieved, a more direct and collaborative approach would need to be taken. Working with several key leaders, and 13 global organisations engaged in health, WHO developed the Global Action Plan for Healthy Lives and Well-being for All (SDG3 GAP).

The SDG3 GAP aims to enhance collaboration and accelerate progress towards the health-related SDGs. Figure 4.19 provides a summary of the key features of the GAP. The key themes of the plan are to engage, accelerate, align and account, and will be applied across seven accelerator themes. The key focus of the GAP is the achievement of the 13 targets of SDG3 – good health and wellbeing.

### Activity 4.13

#### SDG3 GAP

Review the main components of the SDG3 GAP.

- 1 Summarise the main themes of the plan.
- 2 The WHO website contains many case studies of countries addressing SDG3. Research one country case study and summarise how it is addressing SDG3 and reflecting the principles of the SDG.

**Skills:** analysis

## The SDGs in Australia

### Adopt

On 25 September 2015, Australia joined 193 other countries in supporting the 2030 Agenda for Sustainable Development – the Sustainable Development Goals. Prior to this, Australia was actively involved in the development of the goals. The SDGs are aligned with Australia's priorities and have provided significant influence in shaping policies and the direction of government decisions and funding.

### Implement

The implementation of the SDGs extends well beyond government and engages all levels of society including the private sector, non-government organisations, communities, individuals, international organisations, educational institutions and the private sector. A collaborative approach among all levels is essential to success in achieving the goals.

Since the SDGs were adopted in 2015, the Australian Government has developed a core group of senior officials to oversee and monitor the SDGs. The group, co-chaired by the Department of the Prime Minister and Cabinet and the Department of Foreign Affairs and Trade (DFAT), coordinates how to best implement the 2030 Goals within Australia, both on a domestic and an international level. The officials, as well as engaging with all levels of government – state, territory and local – have also collaborated with numerous other stakeholders

to promote and monitor Australia's progress in reaching these goals.

### Monitor

As part of their commitment to achieving the SDGs, each country that signed up committed to completing at least two Voluntary National Reviews (VNRs) sometime over the course of the 15 years. The VNRs provide an illustration of the countries' actions towards achieving the goals and their current progress.



Depth  
Study

Australia conducted its first VNR in 2018. This review, which was reported to the UN, reports on the activities and initiatives that have been implemented and are being implemented by all levels of Australian society. It also reports on the actions of the business and education sector, civil society, academia, communities and individuals, and all levels of government. It highlights the involvement of Australians at all levels in achieving the goals.

In order to effectively report progress on the goals, the Australian Government has established a Reporting Platform on the Sustainable Development Goals Indicators (SDGs; <https://cambridge.edu.au/redirect/10295>). The platform provides access to data on how Australia is advancing in its efforts towards achieving the goals. The platform is one part of a comprehensive review process that monitors and evaluates achievements.

Monitoring the SDGs in the light of young people's needs and perspectives is something that has been taken on by the Sustainable Development Solutions Network Youth (SDSN Youth). Through a research and review process, SDSN Youth curated a list of some of the main concerns of young people within Australia. They then conducted research and analysis of data relating to these concerns to determine whether or not they are being addressed. SDSN Youth is also looking at the progress that youth are making in achieving the SDGs, and will be developing and releasing a progress report, aiming to advocate for youth involvement and youth needs in relation to the SDGs.

### Act

There are thousands of different projects currently underway across Australia that address the SDGs. The projects range from nationwide initiatives to community-based projects. Some of these projects have been established in response to the SDGs, while others were already in place as Australia worked towards similar priorities.

With the support of the Australian Government, the Australian SDG was developed to provide organisations with a platform to showcase their projects and the action they are taking to address the SDGs. The website provides a forum where the details of the projects can be posted with an overview of the project goal and how they are working towards achieving the goals. It provides opportunities for others to get involved and support the actions being currently taken.

## Using the SDGs to promote the health of young people in a local community

There are numerous projects currently in place that support and promote the SDGs. As the targets are so closely in line with Australia's priorities, there was already much drive to improve the health of Australians, young and old.

The SDGs provide a further framework and guidance to address health issues relevant to young Australians. The networks established to promote the implantation of the SDG agenda also provide a platform for communities, individuals and government and non-government agencies to collaborate and address these challenges together.

One way in which the SDGs promote the health of young people is by engaging young people in the process themselves. An example of youth engagement is the Aboriginal Volunteer Program, which supported groups of young Aboriginal and Torres Strait Islander volunteers to work on community development projects with the remote South Australian community of Oodnadatta, an area traditionally owned by the Arabana people. The program was delivered through collaborative partnerships between the Australian Volunteers Program, the Aboriginal Volunteer Program, Volunteering SA & NT, the South Australian Aboriginal Reference Group, Australian Volunteers International (AVI) and the community of Oodnadatta. Further agencies became involved as the project developed, including government, non-government and private agencies, which strengthened the success of the program and assisted in achieving the goals.

### Activity 4.14

#### SDG3

- 1 Research projects that address SDG3 – Good Health and Wellbeing. A good place to look is the 'Projects' page on the Sustainable Development Goals website (<https://cambridge.edu.au/redirect/10296>).
- 2 Identify three different projects that are working to achieve the goal of good health and wellbeing. Include an example of:
  - a community-based project
  - an international project
  - one other project of your choice.

**Skills:** research

The program was built around addressing the collective needs of the community, with goals established in consultation with community members. Included in the goals was a focus on young people, with a range of after-school activities organised and run in partnership with local community members and the local youth themselves. Youth-specific activities included sports events, music and movie nights and agricultural studies. Positive role modelling was seen as one of the greatest achievements of the project and was extremely important in promoting a sense of hope among the young Aboriginal people in Oodnadatta: this includes people with Aranda, Antakarainnja, Loritja and Pitjantjatjara family ties.

As well as benefiting the Oodnadatta community in which the program took place, there was significant benefit to the volunteers themselves. Volunteers experienced growth in self-confidence, resilience and a sense of connectedness to culture and community.

The AVP's work towards addressing SDGs 3, 4, 8, 10 and 17 provides an excellent example of the importance of collaborative partnerships. It supports the SDG principle of 'leave no one behind' by assisting those experiencing the greatest inequities in our community: Indigenous Australians who live in remote areas. It demonstrates the power of youth-driven projects and the positive change that can be brought about through the work of volunteers.

Another example of a project working towards SDGs, and having a positive impact on the health



**Figure 4.20** The focus of the program in Oodnadatta was youth involvement and positive role modelling.

of the youth in a local community, is the work of Green Connect. Green Connect is a not-for-profit social enterprise that works to plan, establish and initiate market farms in local communities. It seeks to employ young people and former refugees to grow fruit and vegetables without the use of pesticides. The produce is available directly to customers, supporting fair wages, providing valuable skills and promoting sustainable farming and waste reduction.

There are many more initiatives in action throughout the nation that aim to promote the health of young people. The nature of the SDGs means that they are able to be applied and tailored to suit all communities and nations.

### Revise and summarise 4.4

- 1 What are SDGs?
- 2 How are the SDGs being used to improve health?
- 3 Discuss how WHO is applying the SDGs to health.
- 4 Outline how the SDGs are being used in Australia.
- 5 Describe how the SDGs could be used to promote the health of young people in a local community.



Quiz

### Think critically and apply 4.4

Complete one of the following activities:

- 1 Critically evaluate the effectiveness of SDG3 in addressing health and wellbeing in Australia. Support your answer with examples.
- 2 Evaluate the role of youth in the achievement of SDGs. In your answer, refer to the global implementation of the SDGs as well as achievements in Australia.

**Skills:** analysis

## Chapter summary

- Young people represent one-fifth of the Australian population, with 3.2 million Australians aged between 14 and 25.
- Through the use of social media, government and non-government organisations (NGOs), and community and activist groups, young people can play an important role in focusing attention on and improving awareness of issues relating to health.
- Youth advocacy is about empowering young people in their everyday lives, considering their needs and interests in decision-making at all levels and giving them a voice.
- In addition to being actively involved in advocating for health, individuals play a significant role in the development and promotion of their own health and the health of the members of their community.
- Responsibility for supporting and promoting the health of young people lies with all levels of government.
- There are many non-government and community organisations that focus on the health and wellbeing of young people.
- Community-based groups are often some of the most effective forms of health promotion due to the close connection these groups have with the local area.
- The World Health Organization (WHO) defines health promotion as ‘the process of enabling people to increase control over their health and its determinants, and thereby improve their health’.
- The evolution of health promotion has been largely reflective of the different views and approaches to health.
- Aboriginal and Torres Strait Islander approaches to health are communal and holistic.
- The biomedical model of health is largely concerned with the diagnosis, cure and treatment of disease.
- The sociocultural model of health recognises that health is the product of a complex interaction between multiple determinants such as social, cultural, socio-economic and environmental factors, rather than just illness and injury.
- The salutogenic model of health provides a view of health that focuses on how and why people stay well.
- The ecological model of health recognises the various factors influencing health behaviours.
- Over the past 40 years, Australia has been involved in numerous international conferences and global declarations that have shaped the way that we approach health promotion within Australia.
- Two significant bodies that have had key influence on health promotion in Australia are the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Health Organization (WHO).
- The WHO Ottawa Charter was the product of the first International Conference on Health Promotion, which was held in Ottawa, Canada in 1986.
- The charter was the first of its kind and identified five key principles of health promotion.
- One of the key elements of the Ottawa Charter was the importance of intersectoral collaboration.
- The multi-faceted approach to health promotion that is inherent in the Ottawa Charter provides a targeted approach that addresses all areas in which poor health decisions may be made.
- Partnerships with communities continue to be crucial to the success of health promotion activities and the improvement of health across all cultural groups.
- The United Nations Sustainable Development Goals (SDGs) are a ‘plan of action’ for the world to address its largest issues.

- The SDGs were agreed upon and adopted by all United Nations member states. Implementation began on 1 January 2016, with the aim to achieve all targets within 15 years – by the year 2030.
- SDG3 is 'Ensure healthy lives and promote wellbeing for all at all ages'.
- Other SDGs look to directly improve many of the determinants that influence health.
- In addition to addressing the determinants directly, many of the targets within the SDGs have an indirect and positive influence on health.
- The SDG health-related targets are closely related to, and reflect the main priorities of, WHO's policies and programs.
- The SDGs are aligned with Australia's priorities and have provided significant influence in shaping policies and the direction of government decisions and funding.
- There are thousands of different projects currently underway across Australia that address the SDGs.
- The SDGs provide a further framework and guidance to address health issues relevant to young Australians.

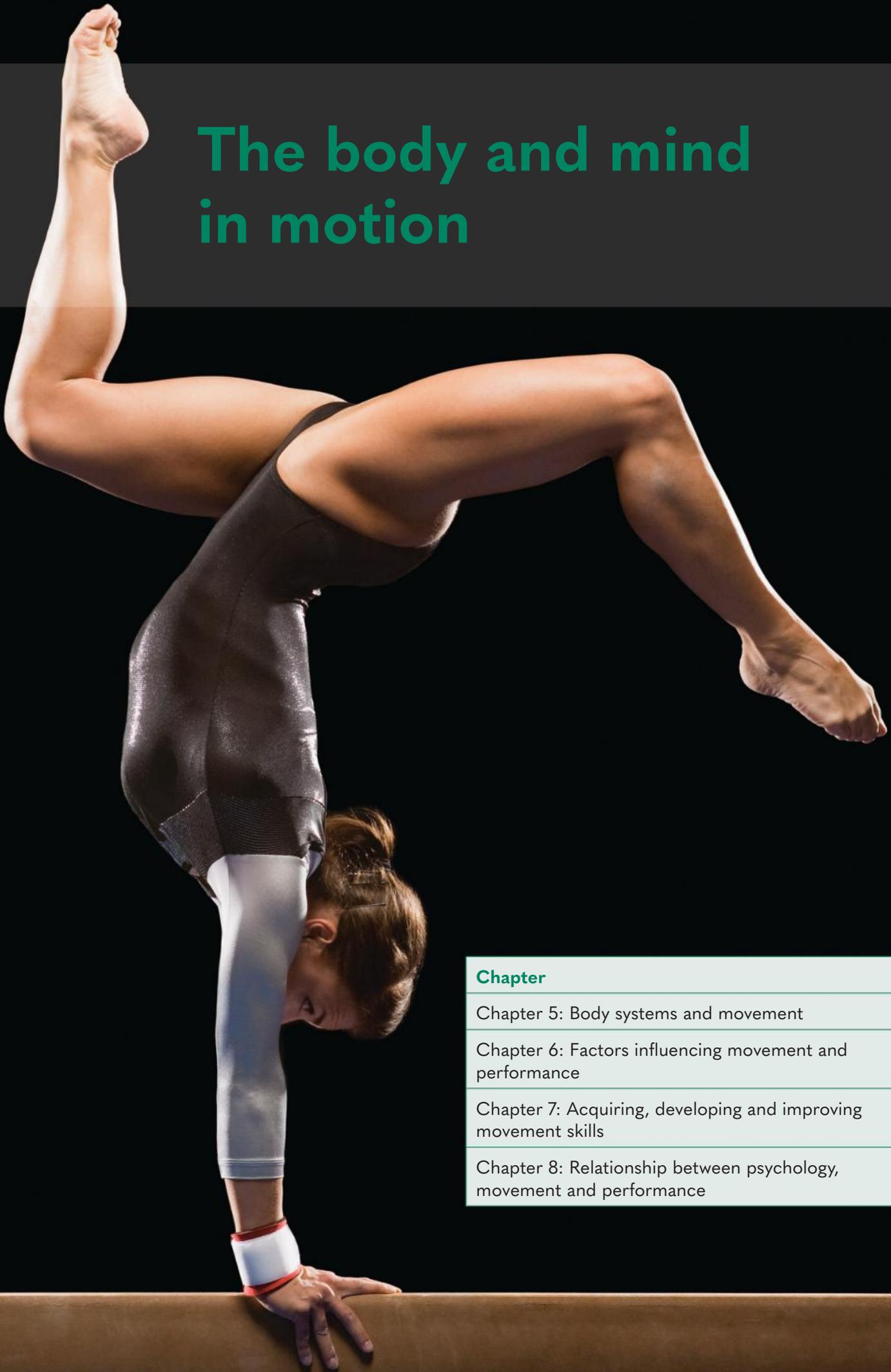
## Multiple-choice questions

- 1 What is advocacy?
  - A a way of resolving conflict
  - B any opinion expressed on social media
  - C an action aimed at gaining support for a particular cause
  - D a policy or law that protects young people
- 2 The Commonwealth Government's responsibilities towards youth advocacy include:
  - A allocating funding to NGOs and state governments for research and health-promotion activities
  - B developing national policies to protect the rights of young people
  - C participating in international health-promotion activities and conventions
  - D all of the above
- 3 The key role of the Office of the NSW Advocate for Children and Young People is to:
  - A develop and ratify state laws and policies relating to children and young people
  - B regulate school and tertiary education facilities
  - C provide legal aid to children and young people
  - D promote the rights and interests of children and young people in NSW
- 4 Which model of health is characterised by the recognition of the impact of the determinants of health and the environment on health?
  - A the Aboriginal and Torres Strait Islander model of health
  - B the sociocultural model of health
  - C the salutogenic model of health
  - D the ecological model of health
- 5 What is the core aim of the Sustainable Development Goals?
  - A to promote Australia into a better economic position than other countries
  - B to develop a universal language system
  - C to promote global equity and sustainability
  - D to determine which countries are the best places to live

## Exam-style questions

- 1 Define advocacy in relation to health. (1 mark)
- 2 Outline the purpose of the SDGs. (2 marks)
- 3 Outline the role of the Ottawa Charter for improving the health of Australians. (3 marks)
- 4 Compare two models of health and identify how they have influenced health promotion in Australia. (4 marks)
- 5 With reference to a global health policy, describe the impact that it has had on health promotion in Australia. (4 marks)
- 6 Using a specific example to support your answer, discuss the role of an individual in advocating for the health of others within their community. (4 marks)
- 7 Examine the relationship between the SDGs and WHO. (5 marks)
- 8 Explain the importance of health promotion in partnership with communities to strengthen the health of individuals. (5 marks)
- 9 With reference to a specific organisation, evaluate how effective it has been in advocating for the health of youth. (6 marks)
- 10 Compare and contrast past and future opportunities for young people to advocate for their health. (7 marks)
- 11 Critically analyse the use of the SDGs in promoting health within a local community in Australia. Support your answer with specific examples. (8 marks)
- 12 Assess the role of governments and non-government organisations in promoting the health of young Australians, including Aboriginal and Torres Strait Islander people. (8 marks)

# The body and mind in motion



## Chapter

Chapter 5: Body systems and movement

Chapter 6: Factors influencing movement and performance

Chapter 7: Acquiring, developing and improving movement skills

Chapter 8: Relationship between psychology, movement and performance

# Chapter 5

## Body systems and movement

### After completing this chapter, you will be able to demonstrate knowledge of:

- the skeletal and muscular systems, and how they influence and respond to movement
- biomechanical principles, and how they relate to muscles, bones and joints for safe movement
- the respiratory and circulatory systems, and how they influence and respond to movement
- the digestive and endocrine systems, and how they influence and respond to movement
- the nervous system, and how it influences and responds to movement
- the interrelationship between all body systems and how they work together in a variety of movements
- the role first aid plays in response to movement.

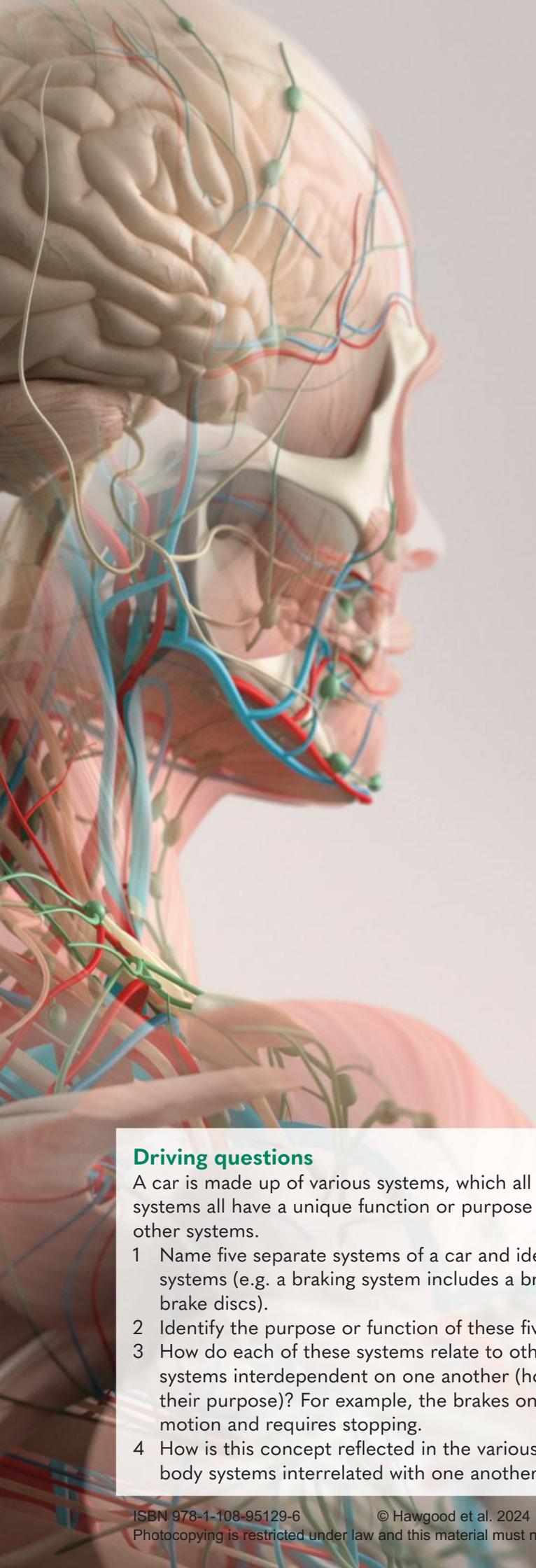
### Key terminology

#### Syllabus terms

biomechanical principles	interrelationship
fluid mechanics	micronutrients
force	macronutrients
	stability

#### Other important terms

agonist	isometric contractions
anatomical position	isotonic
anatomy	kinematics
antagonist	kinetics
appendicular	muscle insertion
axial	muscle origin
circulatory system	muscular system
concentric	nervous system
digestive system	physiology
eccentric	profile drag
endocrine system	respiratory system
haemoglobin	skeletal system
homeostasis	stabiliser



### Driving questions

A car is made up of various systems, which all have their own set of distinct individual parts. These systems all have a unique function or purpose within the car, as well as special relationships with other systems.

- 1 Name five separate systems of a car and identify some of the individual components of these systems (e.g. a braking system includes a brake pedal, brake lines, brake fluids, brake pads and brake discs).
- 2 Identify the purpose or function of these five systems.
- 3 How do each of these systems relate to other systems of the car? In other words, how are these systems interdependent on one another (how do they rely on one another to be able to fulfil their purpose)? For example, the brakes only have a purpose to fulfil if the car can be put into motion and requires stopping.
- 4 How is this concept reflected in the various systems of the human body? In what ways are these body systems interrelated with one another?

# Introduction

**anatomy** the study of the structures of the body and their relationships

**physiology** the study of the functioning of human body systems

When studying the human body, focus is placed either on the **anatomy** or **physiology** of the various components and systems of the human body. Anatomy involves the study of the structures of the human body, whereas physiology is the study of the proper functioning and relationship

between these structures. Understanding how anatomy and physiology are interconnected and affect each other – their interrelationship – helps us understand how health is maintained and movement capacity is maximised.

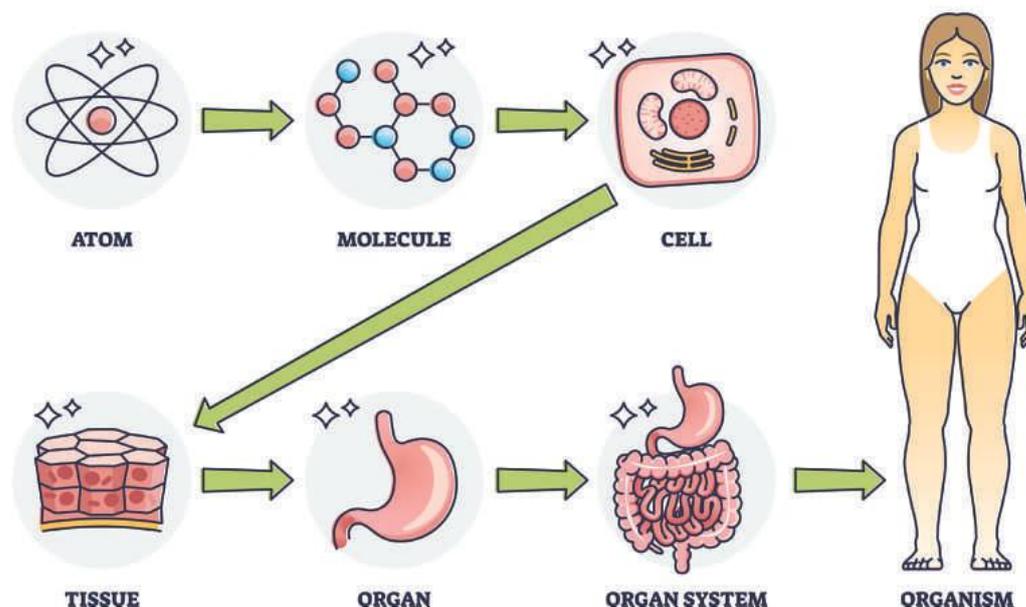
The human body has *six* levels of structural organisation, which increase in size and complexity:

- 1 **Chemical:** Atoms are the smallest particles of matter in the universe, and in the human body. They form molecules and compounds, such as oxygen, water and glucose.
- 2 **Cellular:** Cells are the building blocks of life with specialised structures and functions, and contain specific organelles that have their own function

in the cell. Examples include skin cells, red blood cells, nerve cells and muscle cells.

- 3 **Tissue:** A clump or group of the same type of specialised cells that collectively perform and amplify the function of the cell, such as muscle tissue, blood tissue, skin tissue and brain tissue.
- 4 **Organ:** Two or more tissues that work together to fulfil a specific purpose and function, such as the heart, skin, brain, stomach and bones.
- 5 **Body system:** Two or more organs that work together to perform more specialised functions, such as the muscular system, digestive system or reproductive system.
- 6 **Human body:** All 11 body systems interrelate with one another to sustain life and allow humans to perform daily tasks.

The 11 body systems of the human body are the integumentary (skin and connective tissue), skeletal, muscular, immune/lymphatic, respiratory, digestive, nervous, endocrine, cardiovascular, urinary and reproductive systems. Each of these systems has varying degrees of relationship with human movement and performance.



**Figure 5.1** The structural organisation of the human body

## Activity 5.1

### Human body systems

In groups, analyse one of the 11 human body systems by identifying its component parts or organs, the function and purpose of the system, the way that proper and healthy functioning is maintained, how the system can malfunction, examples of how it interrelates with other body systems, and how the body system may relate to human movement.

**Skills:** collaboration, analysis, communication, creative thinking, problem-solving, research



Depth  
Study



Collaborative  
investigation

In anatomy, descriptions of the human body assume a specific stationary position, called the **anatomical position**. This involves the person standing upright, facing forward with their hands down by their sides with palms facing forward, and legs parallel.

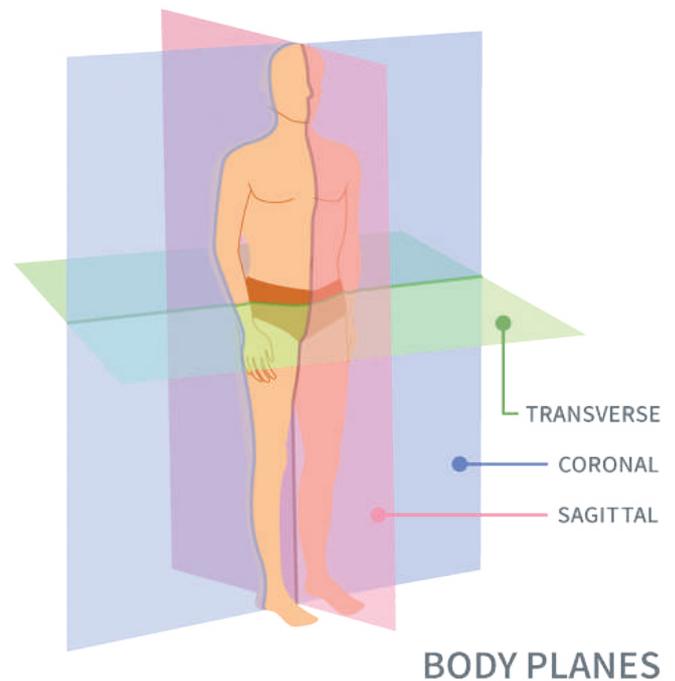


**Figure 5.2** Anatomical position of the human body

The body can be divided up into three planes of reference:

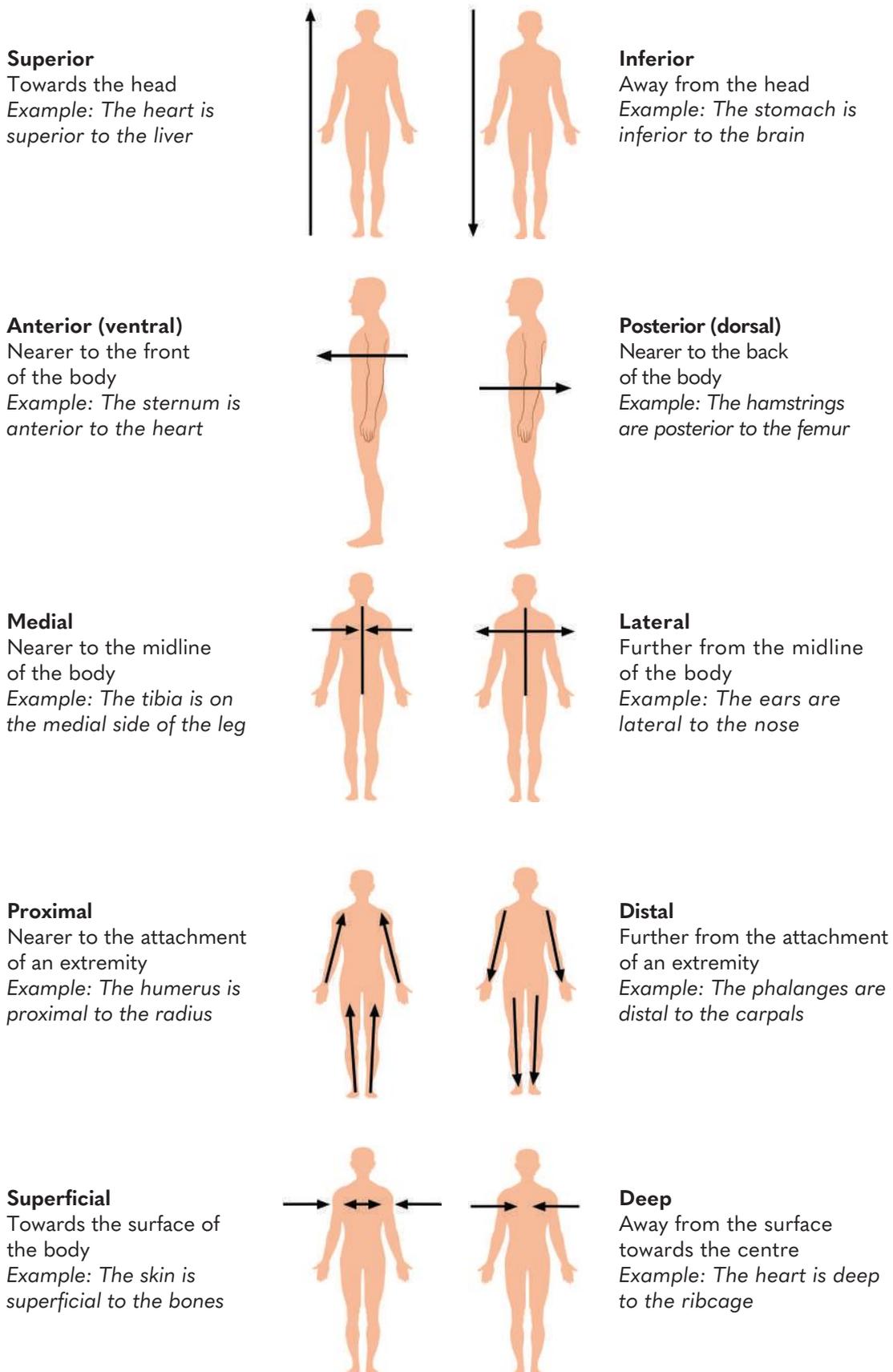
- **Sagittal** (or lateral) plane is the vertical plane that divides the body into left and right.
- **Coronal** (or frontal) plane is the vertical plane that divides the body into front and back.
- **Transverse** (or axial) plane is the horizontal plane that divides the body into top and bottom.

**anatomical position** a standard point of reference used when describing terms and positions of human anatomy and physiology: standing upright, arms by sides, palms facing forward and legs parallel



**Figure 5.3** Planes of the human body

**Directional terms** are also used to help locate various body structures in relation to one another



**Figure 5.4** Directional terms used to describe the location and direction of the human body

## 5.1 The skeletal and muscular systems

### Learning objective 5.1

EXPLAIN how the skeletal and muscular systems interrelate with one another and movement

### Skeletal system

#### Structure and function

The **skeletal system** has a close relationship with the muscular system in influencing and responding to movement. These two systems are often collectively referred to as the musculoskeletal system.

The skeletal system consists of all the bones of the body (including teeth), as well as the connective tissue that provides structural integrity to joints. In adult humans, there are 206 bones and around

360 joints between them. Bones are mostly made up of a hard outer surface of compact bone that forms the external layer. Some larger bones may also have a centre cavity that consists of soft spongy bone and bone marrow.

The human skeleton can be broken into two parts. The **axial** skeleton comprises the head, vertebrae and rib cage, which largely protects the vital organs of the human body. The **appendicular** skeleton includes the shoulder and pelvic girdle as well as the limbs (arms and legs), which are largely designed for movement.

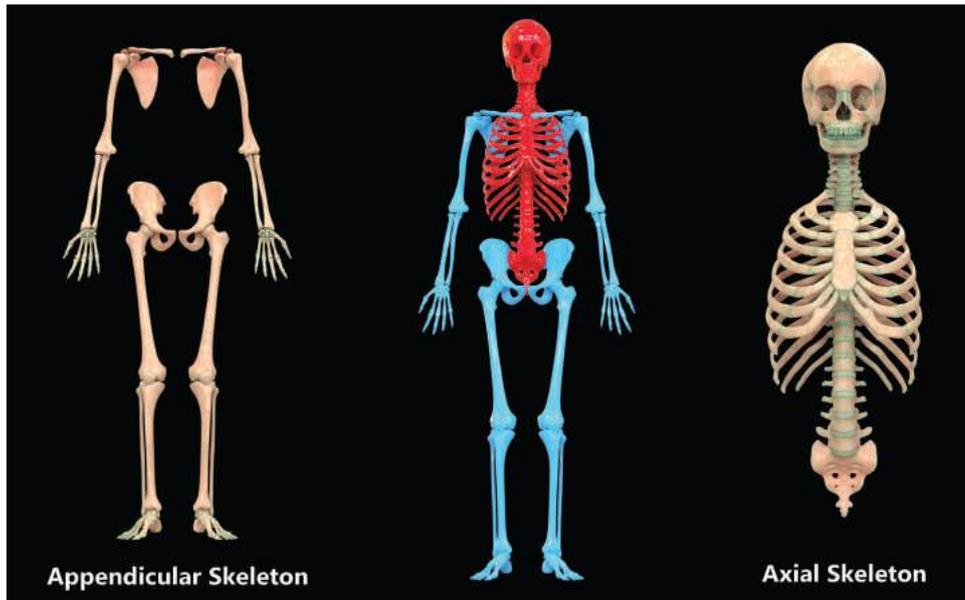
**skeletal system** organs and tissues that form the body's internal framework, consisting of bones, teeth and connective tissue (e.g. cartilage and ligaments)

**axial** the part of the skeleton that comprises the head, vertebrae and rib cage

**appendicular** the part of the skeleton that comprises the shoulder and pelvic girdle, arms and legs



Figure 5.5 The muscular and skeletal systems



**Figure 5.6** The axial and appendicular parts of the human skeleton

The skeletal system has the following functions.

- **Support:** bones provide a framework for the body, allowing it to sustain various positions. For example, the leg bones are vertically stacked through the pelvis to allow for standing.
- **Protection:** bones protect many internal organs from damage. For example, the skull protects the brain.
- **Movement:** skeletal muscles attach and pull on bones to produce movement at joints where two or more bones meet.
- **Storage of energy and minerals:** bone tissue stores several minerals, particularly calcium and phosphorous in the hard compact bone and essential fats in the spongy bone, called bone marrow.
- **Blood cell production:** red blood cells, white blood cells and platelets are formed in the bone marrow of long bones.

### Major bones

There are five types of bones, classified based on their shape:

- **Long bones** have greater length than width and consist of a shaft with a bulbous head on each end. They consist mostly of compact bone encasing spongy bone and they often support weight and facilitate movement (e.g. femur, tibia, fibula, phalanges, humerus, radius and ulna).
- **Short bones** are often cube-shaped, being nearly equal in length and width; they are

spongy bone except for the surface, which is a thin layer of compact bone and are mostly found in the complex structures of the wrist and ankles (e.g. carpals and tarsals).

- **Flat bones** are generally thin and composed of two thin plates of compact bone encasing spongy bone, often used for protection of internal organs (e.g. cranial bones, sternum, ribs and scapula).
- **Irregular bones** have complex shapes to perform very specific functions such as for muscle attachment (e.g. the scapula), organ protection (e.g. the vertebrae) and body structure (e.g. facial bones).
- **Sesamoid bones** are small bones that are embedded within tendons to increase the strength of joints (e.g. the patella).

A typical long bone such as the humerus and femur are essential for movement and consist of the following key components:

- **Diaphysis** – shaft or long portion of the bone
- **Epiphyses** – ends of the bone that contain spongy bone
- **Articular cartilage** – thin layer of cartilage covering the epiphysis where two bones meet and join
- **Compact bone** – hard outer casing around the surface of the bone
- **Medullary** – space within the diaphysis that contains the bone marrow.

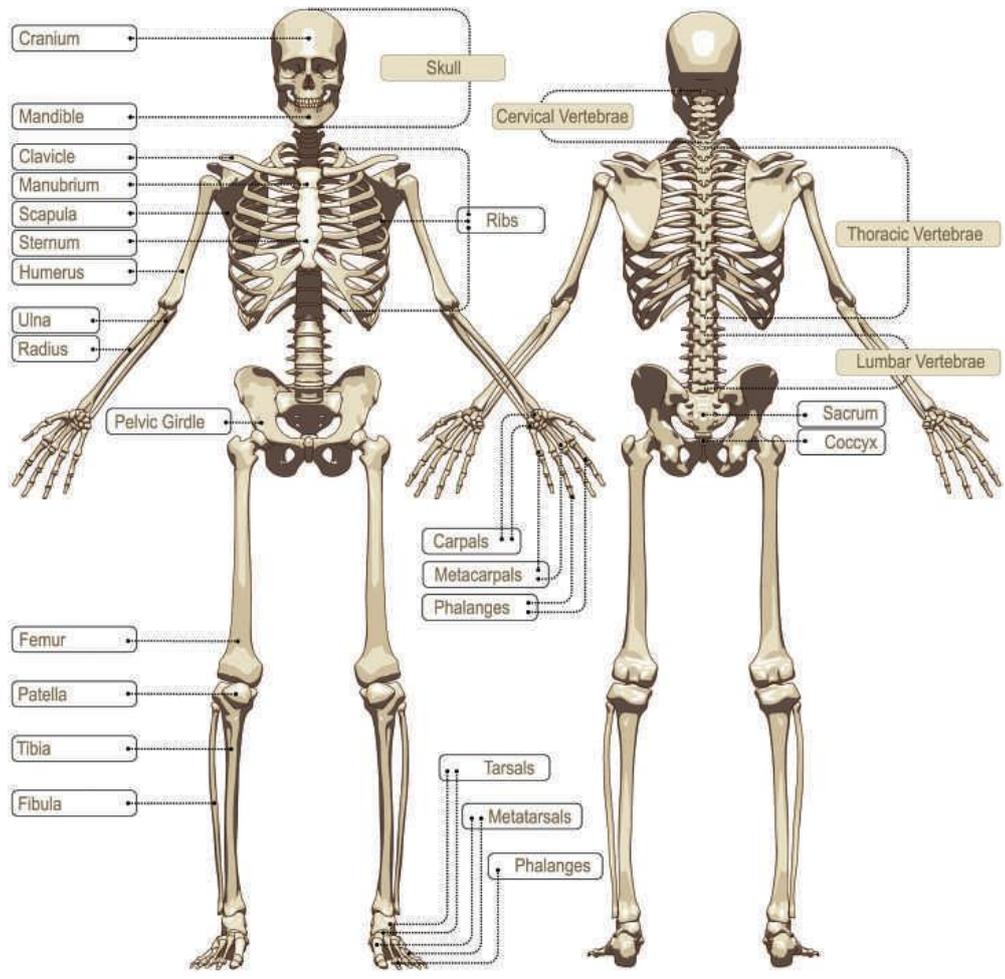


Figure 5.7 Bones of the human body

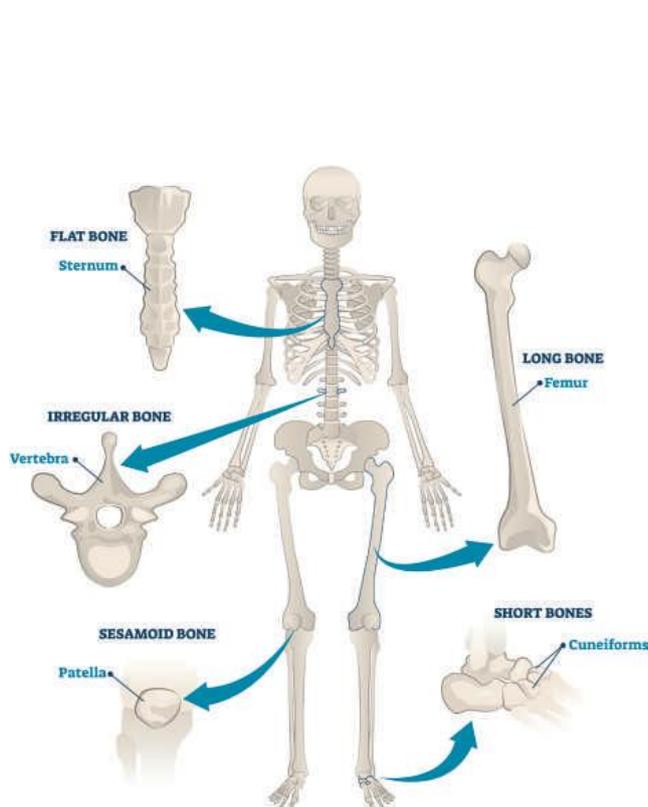


Figure 5.8 Types of human bones

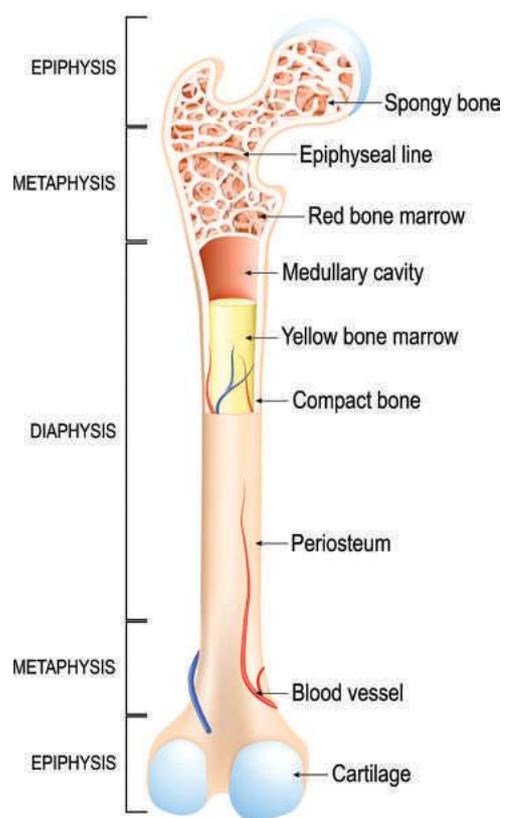
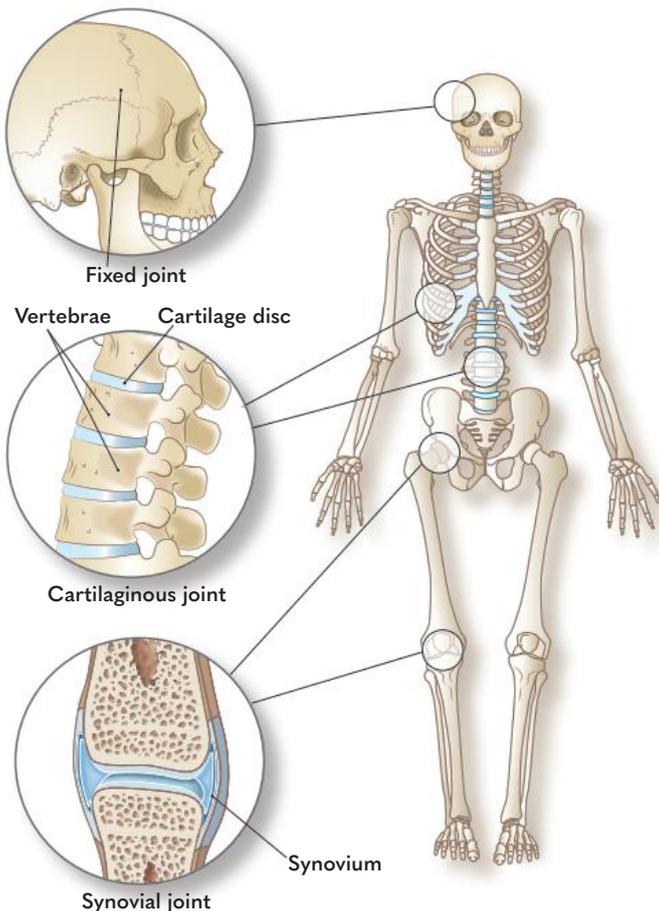


Figure 5.9 Structure of a long bone

## Synovial joints

There are *three* types of joints in the human body.

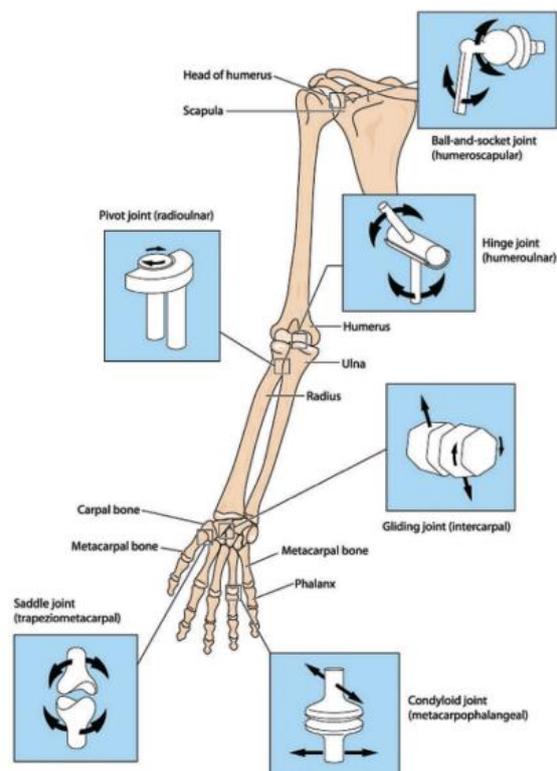
- **Fibrous joints:** adjacent parts of bone are held together by very strong, yet immobile fibrous tissue – for example, skull sutures between the sections of the cranium.
- **Cartilaginous joints:** bones are united with cartilage, allowing for some movement, but are still quite strong – for example, between the vertebrae of the spine.
- **Synovial joints:** these are highly moveable and are found where two bones meet to allow for movement. These have a joint capsule, synovial fluid and supporting ligaments – for example, knee, shoulder and elbow joints.



**Figure 5.10** Types of synovial joints

There are six types of synovial joints in the human body, each with varying shapes of articulating surfaces, and varying ranges and directions of possible movement. These differences ultimately affect the strength and stability of the joints. These synovial joints are essential for movement and are important for understanding the movement potential of the human body.

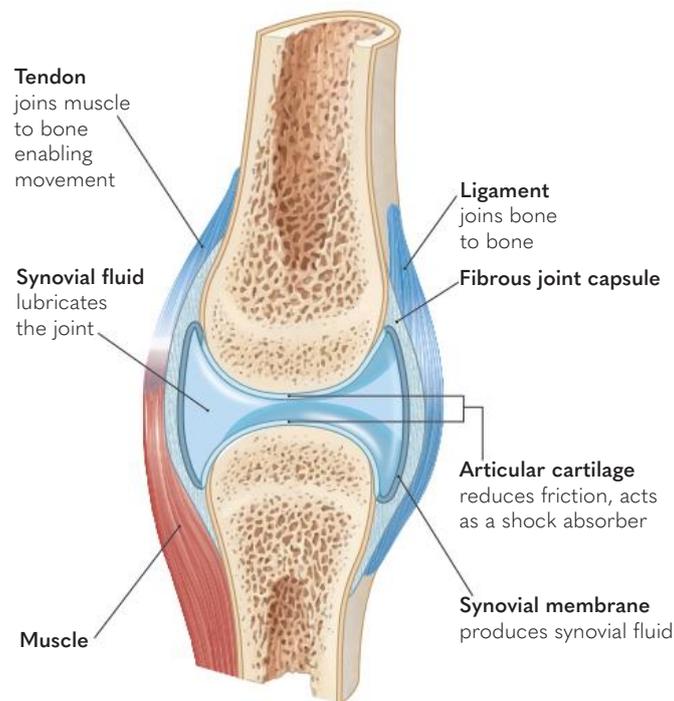
- 1 **Ball-and-socket joint:** these consist of a ball-like surface that fits into a cup-like depression of another. They allow flexion/extension, adduction/abduction, rotation and circumduction. The shoulder and hip are the only examples in the body.
- 2 **Hinge joint:** the convex surface of one bone fits into the concave surface of another. Movement is in a single direction allowing flexion and extension. Hinge joints include elbow, knee and ankle.
- 3 **Gliding joint:** articulating bones are usually flat. Side to side, and back and forth movements are permitted. Gliding joints include the wrist carpals, ankle tarsals and vertebrae.
- 4 **Condyloid (ellipsoidal) joint:** an oval-shaped bone fits into an elliptical cavity of another bone. It allows side-to-side and back-and-forth movement. The joint at the wrist is an ellipsoid joint.
- 5 **Saddle joint:** one bone is saddle-shaped while the other bone is shaped like a rider. Movement is side-to-side and back and forth. The thumb is a saddle joint.
- 6 **Pivot joint:** a rounded surface of one bone articulates with a ring formed partly by another. Primary movement is rotation. In the cervical spine below the cranium, the atlas bone (C1) rotates around an axis (C2).



**Figure 5.11** Joint types in the upper limb

Synovial joints typically have structures that allow for smooth movement and shock absorption, and have soft tissue structures that maintain joint integrity. The shape of the articular surfaces will affect the stability of a joint. An elbow (hinge) joint is very strong and unlikely to dislocate due to the shape of the bones that join, whereas the shoulder (ball and socket) joint is more likely to dislocate, due to the more open nature of the bones that meet. Common structures of synovial joints are as follows:

- **Articular cartilage** covers the end of the bone providing cushioning and reducing friction during movement.
- **Synovial cavity** is space that separates the two articulating bones.
- **Ligaments** join bone and bone together.
- **Synovial fluid** acts as a lubricant within the synovial cavity.
- **Joint capsule** encloses the cavity and contains the fluid.
- **Meniscus** is inward-growing cartilage that absorbs shock and pressure and enhances stability.
- **Bursae** are saclike structures that are strategically placed to alleviate friction.
- **Tendons** join muscle to bone.



**Figure 5.12** Structures of a synovial joint

### Practical application 5.1

#### Bones and joints learning lab

Source the full knee or shoulder joint of a cow from a local butcher. In groups, investigate and locate the various structures around the bones and joints that can be found.

**Skills:** collaboration, analysis, communication



Video 5.1 Joint actions

### Joint actions

All joints move in specific directions that are categorised according to their plane of movement. These terms provide universal and clear language,

which can be used alongside the directional terms, and they assume that the body is in the anatomical position. They are mostly paired with opposing actions.

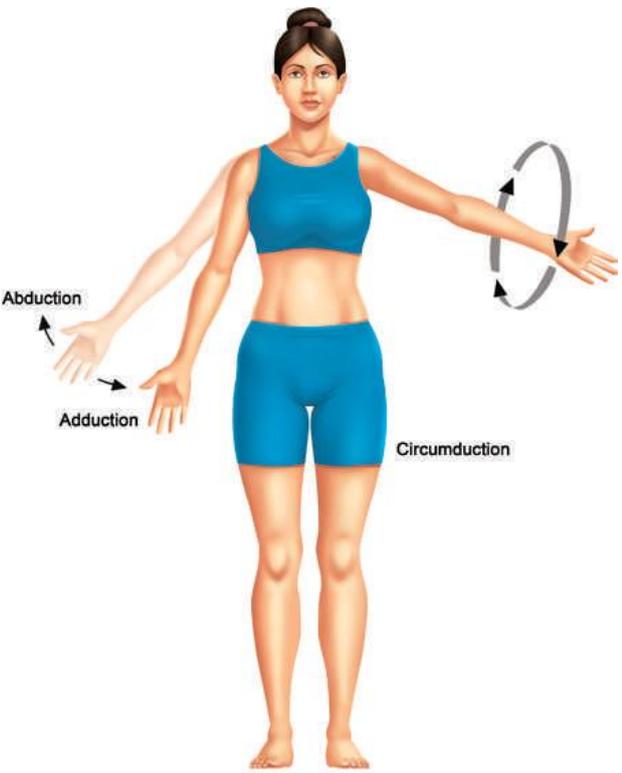
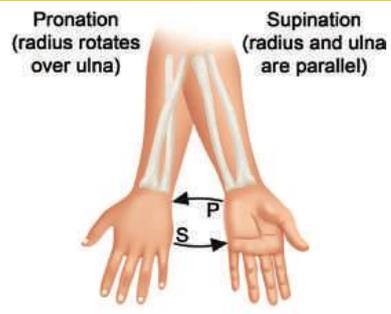
Joint actions are shown in Table 5.1.

Table 5.1 Joint actions

Joint Action	Definition	Illustration
<b>Flexion</b>	Movement at the joint reduces the angle between the bones	<p>Angular movements: flexion and extension at the shoulder and knees</p> <p>Angular movements: flexion and extension of the neck</p> <p>Angular movements: flexion and extension of the vertebral column</p>
<b>Extension</b>	Movement at the joint increases the angle between the bones	

*NB: Flexion and extension move in the sagittal plane either in a forward (anterior) or backward (posterior) direction. Hyperextension and hyperflexion move the joint beyond its normal range of motion.*

<b>Rotation</b>	Movement of a bone or limb around its axis	<p>Rotation of the head, neck, and lower limb</p> <p>Lateral rotation</p> <p>Medial rotation</p>
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Joint Action	Definition	Illustration
<b>Circumduction</b>	Moving the distal (far) end of the body or limb in a circle	 <p>Abduction</p> <p>Adduction</p> <p>Circumduction</p> <p>Angular movements: abduction, adduction, and circumduction of the upper limb at the shoulder</p>
<b>Abduction</b>	Movement of a bone or limb away from the midline of the body (lateral)	
<b>Adduction</b>	Movement of a bone or limb towards the midline of the body (medial)	
<b>Inversion</b>	Ankle movement to point the sole of the foot inward (medial)	 <p>Inversion</p> <p>Eversion</p> <p>Inversion and eversion</p>
<b>Eversion</b>	Ankle movement to point the sole of the foot outward (lateral)	
<b>Supination</b>	Wrist movement of the forearm in which the palm of the hand is turned towards the front (anterior)	 <p>Pronation (radius rotates over ulna)</p> <p>Supination (radius and ulna are parallel)</p> <p>P</p> <p>S</p> <p>Pronation (P) and supination (S)</p>
<b>Pronation</b>	Wrist movement of the forearm in which the palm of the hand is turned towards the back (posterior)	

NB: Abduction and adduction occur across the frontal plane, moving away from the side of the body and back again.

continued

Joint Action	Definition	Illustration
<b>Dorsiflexion</b>	Ankle movement where the foot and toes move towards the tibia	
<b>Plantarflexion</b>	Ankle movement where the foot and toes move away from the tibia towards the ground	

### How does the skeletal system influence and respond to movement?

All movements of the human body rely on the healthy functioning of the skeletal system. Limitations most often occur in the joints, since inactivity, injury and increasing age all act to reduce joint mobility. Bone health also impacts movement, as decreasing bone density from age, poor diet and hormonal changes increase the risk of fractures. Sedentary lifestyles will have a negative effect, leading to structural and postural changes, which can lead to pain and immobility, and possibly the need to replace joints through surgery. A healthy skeletal system allows a person to fulfil daily living tasks, as well as engage in vocational, fitness, recreational and sporting activities. Physical activity will improve the functioning and health of the skeletal system, and when someone regularly performs activity that

supports a healthy skeletal system, they are able to engage in a wide range of daily tasks and physical activities successfully and without pain.

Activity that improves the skeletal system primarily involves weight-bearing, strengthening exercises, as well as movements that challenge the degree of mobility and range of motion in joints. Resistance-based activities build bone strength and density as muscles pull on bones. This could come from having an active job (e.g. a builder), to gardening, bushwalking or weight training. Flexibility, stretching and mobility exercises will help maintain healthy joint mobility and suppleness. Having a healthy diet that includes calcium and vitamin D, and avoiding smoking, excessive alcohol and long periods of inactivity all improve the skeletal system.

## Activity 5.2

### Joints and exercises

In small groups, complete the following table and demonstrate practical examples of each.

Exercise	Joint	Joint type	Bones involved	Joint action (during the effort phase)
Military press	Shoulder			
Push-up	Elbow			
Curl-up	Torso			
Squat	Knee			
Deadlift	Hips			
Bicep curl	Elbow			
Lateral lunge	Hips			
Cricket bowl	Shoulder			
Calf raise	Ankle			

**Skills:** collaboration, analysis, communication

## Muscular system

### Major muscles

The body contains over 700 muscles in the **muscular system**, which are all responsible for some form of movement. There are *three* types of muscle in the human body:

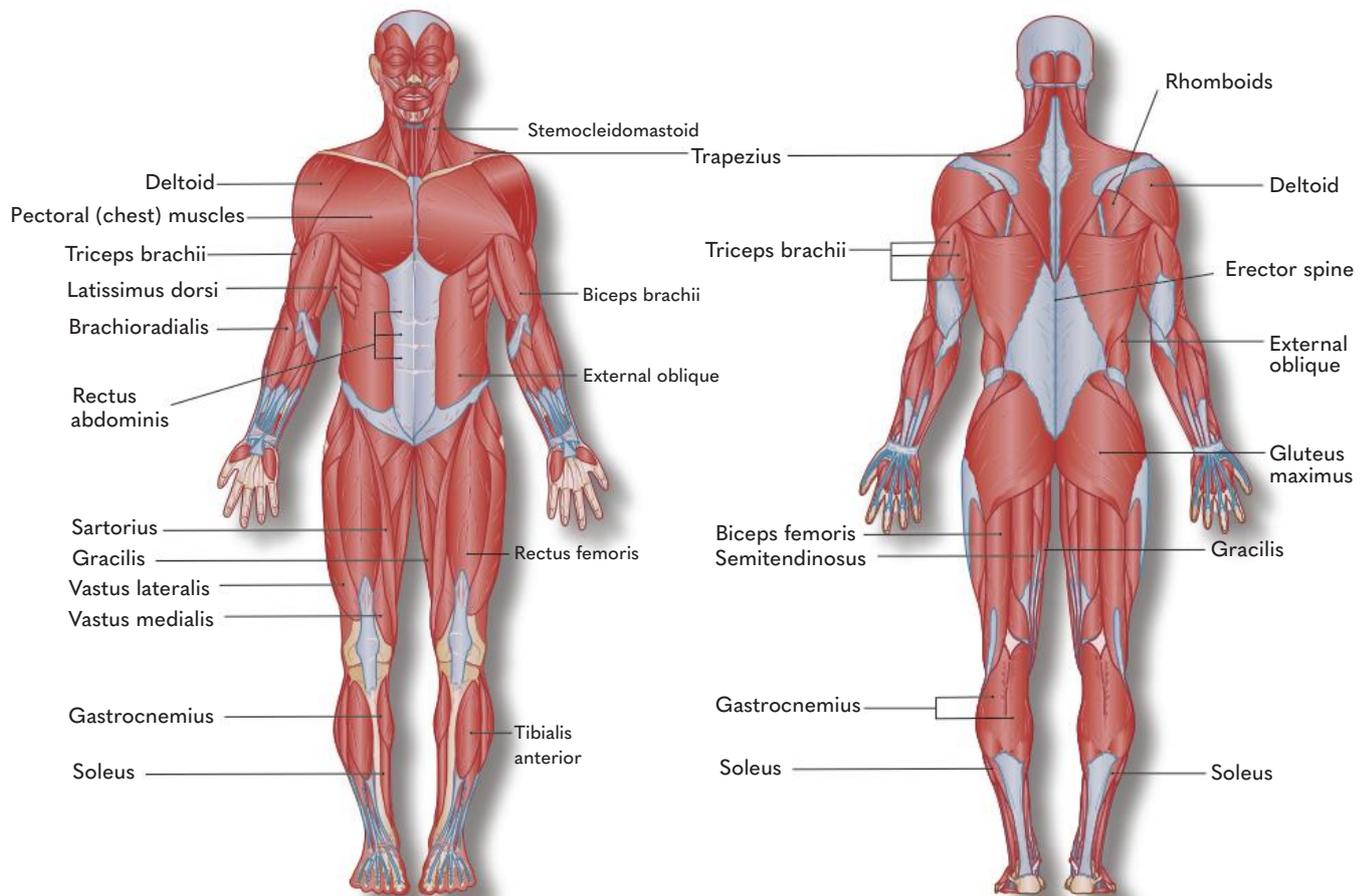
- 1 **Cardiac** muscle in the heart contracts to circulate blood around the body, and is an involuntary muscle.
- 2 **Smooth** muscle lines the digestive system and helps move fluids around the body to aid digestion, and is also an involuntary muscle.

- 3 **Skeletal** muscle connects to bones and crosses joints to produce various movements of the skeletal system, which are generally voluntary in nature (able to be consciously controlled).

Skeletal muscles form over 600 of these muscles and account for around 40% of the body's mass. These are the muscles primarily involved in producing human movement and activity.

### muscular system

a body system consisting of skeletal, smooth and cardiac muscle, the muscular system produces movement of the body, maintains posture and helps circulate various fluids throughout the body



**Figure 5.13** Major skeletal muscles

## Characteristics and functions of muscle fibres

### adenosine triphosphate

the most basic source of energy in the human body – a compound consisting of an adenosine molecule and three phosphate groups

### muscle origin

the muscle bone attachment that does not move; contraction is in the direction towards this point

### muscle insertion

the muscle bone attachment that moves; contraction is in the direction away from this point

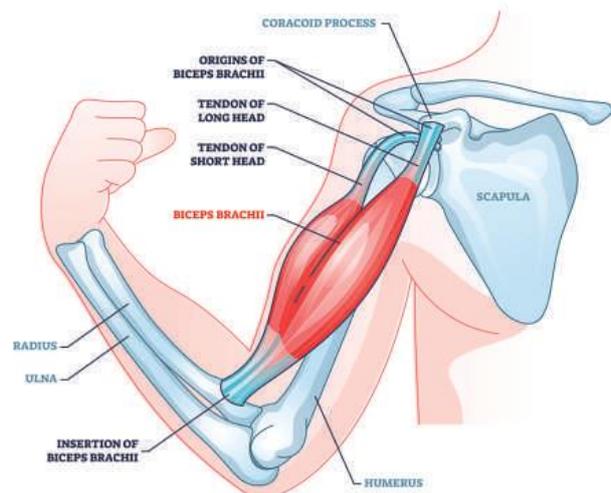
Skeletal muscles attach to bones via tendons, and they primarily contract (shorten in length) to produce movement and maintain stability. This is a complex process produced at the smallest structural unit of a muscle, the sarcomere, which contains thin actin filaments and thick myosin filaments. These filaments attach and slide over one another (called a cross-bridge) using the energy provided by **adenosine triphosphate** (ATP) after the nervous system sends a signal for the muscle to contract. A collection of sarcomeres form myofibrils, and myofibrils are gathered to form muscle fibres. Muscle fibres are then all bundled together and held together by fascia. This is demonstrated in Figure 5.14.

All skeletal muscles have the following four properties.

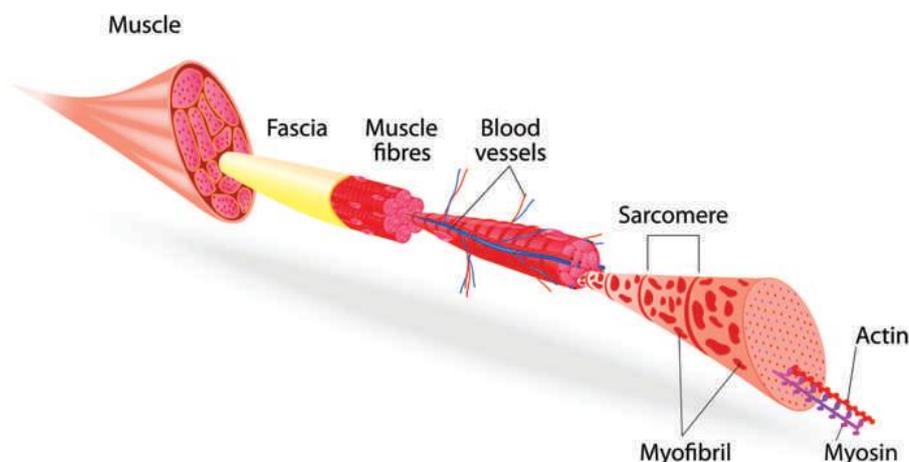
- **Excitability:** muscles can respond to stimuli from the nervous system.
- **Contractility:** muscles can contract or shorten their length.

- **Extensibility:** muscles can be stretched beyond their resting state.
- **Elasticity:** muscles can return to their original length after being stretched.

Skeletal muscle is striated (has the appearance of stripes), which reflects its structure and function. All skeletal muscles (except for the tongue) have two points of attachment, which are known as the **muscle origin** and **muscle insertion**. Muscles can only contract and pull in one direction along the muscle fibre towards the origin of the muscle. In the image below, the origin of the biceps brachii is near the head of the humerus and the scapula, with the insertion on the radius in the forearm. Therefore, this muscle primarily produces elbow flexion when it contracts, as seen in a bicep curl.

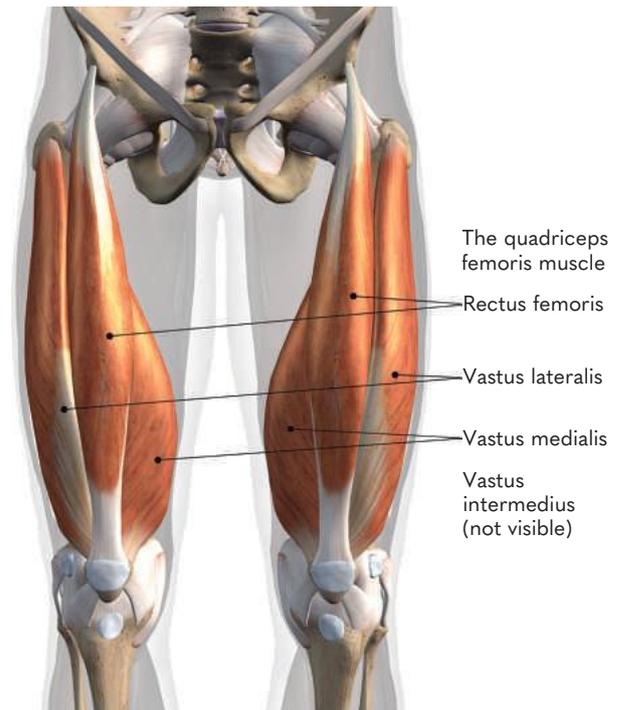


**Figure 5.15** Origin and insertion of skeletal muscles



**Figure 5.14** Structure of skeletal muscle

Commonly known skeletal muscles, such as the hamstrings and pectorals, are generally superficial and lie under the skin. However, when the outer layers of muscle are peeled back, there is a vast network of smaller, deeper muscles capable of producing the variety of movement humans are capable of. Many commonly known muscles are grouped together, and a deeper understanding of the musculature helps reveal this complexity. For example, the quadriceps are made up of four heads (quad = four / cep = head). These each have their own origin and insertion points allowing for greater movement capabilities (see Figure 5.16).

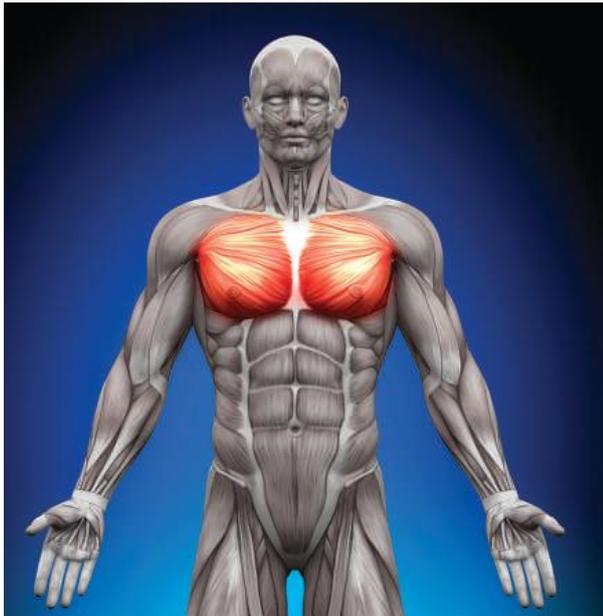


**Figure 5.16** The four muscles of the quadriceps



**Figure 5.17** The surface and deeper layers of the muscular system

Muscle fibres run in varying directions to provide strength in a wider variety of planes of movement. The muscle of the biceps mostly runs in a single vertical direction only, as it is responsible for elbow and shoulder flexion (in one plane only). However, the pectoralis major muscle in the chest has a fan-shaped appearance to allow the muscle to pull along a variety of angles or planes across the ball and socket shoulder joint.



**Figure 5.18** Fan shaped striations/muscle fibre directions of the pectoralis major muscle

### Slow and fast twitch muscle fibres

There are three types of skeletal muscle fibres with different properties and capabilities. The relative percentage of each type is partly an inherited genetic trait, which can give someone greater ability to succeed in either endurance or power sports depending on the make-up of their muscle fibre types. Other factors such as age and training stimulus can affect the development of these muscle fibre types.

#### Slow twitch fibres (Type I muscle fibres):

these muscle fibres are more reddish in appearance due to the higher levels of blood capillaries and mitochondria (the organelles responsible for energy production in cells), and are therefore more aerobic with greater oxidative capacity. They are better suited to endurance sports as they can sustain repeated muscular contractions over a long time and are more fatigue-resistant. However, they have lower levels

of force production and slower contraction speed, as they are smaller in diameter.

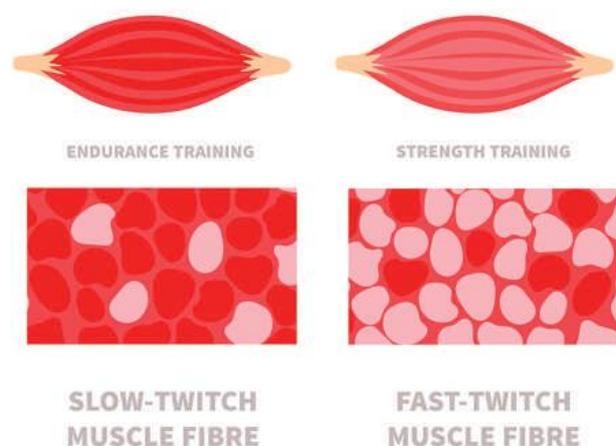
#### Fast twitch oxidative fibres (Type IIa fibres):

these are an intermediate muscle fibre type that can take on more fast or slow twitch characteristics depending on the training stimulus. They are essentially fast twitch muscle fibres with more capillaries and blood supply increasing their oxidative and aerobic capacity, while maintaining a relatively high force production.

#### Fast twitch glycolytic fibres (Type IIb fibres):

these fibres are whiter in appearance due to the lower levels of blood supply and capillaries, and therefore are more anaerobic with less oxidative capacity. They are better suited to power sports as they can produce greater maximal force, and faster contraction speed. They are also much larger in diameter. However, they fatigue quickly and are unable to sustain repeated efforts without increased rest and recovery.

Interestingly, different muscles show different percentages of each type according to their function. Deep postural muscles (such as the soleus in the lower leg, or the psoas muscle around the lumbar spine) have more slow twitch fibres due to their support of standing and walking for long hours. However, phasic muscles, which are used for strong and powerful movements, tend to be fast twitch dominant (such as the gluteal or quadricep muscles, used for jumping and heavy lifting).



**Figure 5.19** Slow twitch fibres (Type I) and fast twitch glycolytic fibres (Type IIb). Fast twitch oxidative fibres are an intermediate type between these two: fast twitch fibres, but with more capillaries and blood supply.

## Types of muscle contractions

There are two major types of contractions that muscles are capable of which produce force; one that involves movement, and one that is stationary.

**Isotonic contractions:** these occur where the muscle length changes as the muscle contracts, producing movement. The load or resistance remains the same (e.g. a 10 kg bicep curl). There are two phases in an isotonic contraction:

- 1 **Isotonic concentric:** this is the phase where the muscle under tension contracts or shortens in length. Using free weights, this is often where the movement will be against gravity. A common example is a biceps curl where the weight is lifted towards the shoulder by the biceps muscle.
- 2 **Isotonic eccentric:** this is the phase where the muscle lengthens under control and tension. Using free weights, this is often where the movement will be travelling in the same direction as gravity. A common example is a biceps curl where the weight is slowly lowered away from the shoulder towards the ground (sometimes referred to as the negative part of the contraction or exercise).

Both phases are important in total muscular development, and eccentric training has been shown to lead to greater muscle development and strength as it leads to increased microtears (e.g. eccentric Nordic hamstring curls). Generally, a muscle can perform 130% 1 RM eccentrically of what it can move concentrically ('RM' is the

repetition maximum, which refers to the maximum weight someone can lift for one repetition of an exercise). It is advised that in most strength training programs the concentric phase should be performed with greater speed and power, and the eccentric phase should be slower and more controlled. Strict eccentric movements can also be used to increase strength if an athlete is unable to perform a full concentric contraction or wishes to overload the muscle (either in general or at the end of a heavy set). For example, slowly lowering the body from the top of a pull up will build the same strength used to perform the pull up. It is important that the correct form and technique is used to ensure effectiveness and safety.

**Isometric contractions:** This is where the muscle length does not change, but the muscle is contracted and under tension. These stationary movements are used to build endurance, postural strength and to focus on specific 'weak points' of a movement such as the bottom of a squat. Examples include a plank, wall sit, dead hang or holding a biceps curl at 90°.



Video 5.2 Isotonic contractions

**isotonic contractions** the shortening and lengthening of a muscle through joint action while under a constant load

**concentric** the phase of an isotonic contraction where the muscle is contracting or shortening while under tension

**eccentric** the phase of an isotonic contraction in which the muscle is lengthening while under tension

**isometric contractions** muscle contraction without a change in the length of a muscle; refers to a stationary contraction

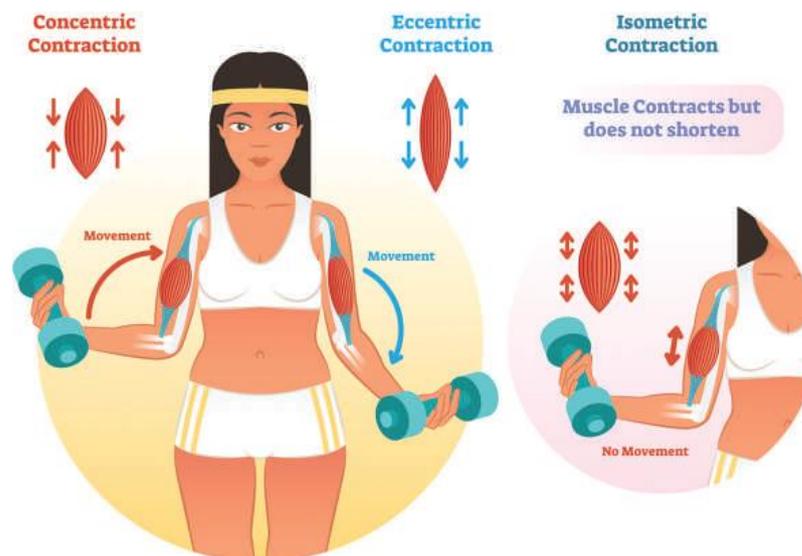


Figure 5.20 Types of muscle contractions



Video 5.3 Muscle relationships

**agonist** the primary muscle that is working during a muscular contraction (may be shortening or lengthening under tension)

**antagonist** the opposing muscle to the agonist muscle, which is relaxed allowing the joint to freely move

**stabiliser** a muscle that helps maintain balance and stability during movement without directly contributing to it

### Muscle relationships

Most movement requires several muscles working together in unison. Most skeletal muscles are therefore arranged in opposing pairs. The muscle that causes the desired action is the prime mover or **agonist**, which is actively contracting (either concentrically or eccentrically). Therefore there is often an opposing partner muscle which is passively relaxing, known as the **antagonist**. A third type of muscle involved in complex movements is known as **stabilisers**. These actively contract and contribute to maintaining stability and balance throughout movement but are not considered to be prime movers.

Using a bench press or push up as an example, the pectorals, deltoids and triceps are all considered to be agonists (prime movers) in this compound exercise involving

multiple joints. The opposing antagonist muscles are the latissimus dorsi and biceps. Stabilisers for this movement would be the core abdominal and forearm muscles that help brace and support the body during both the concentric and eccentric phases.



Figure 5.21 Example of the muscle relationships required for a push up

## Practical application 5.2

### Muscle contractions and relationships

In groups, create a video of the various muscle contraction types and relationships to be used for personal revision.

**Skills:** collaboration, analysis, communication

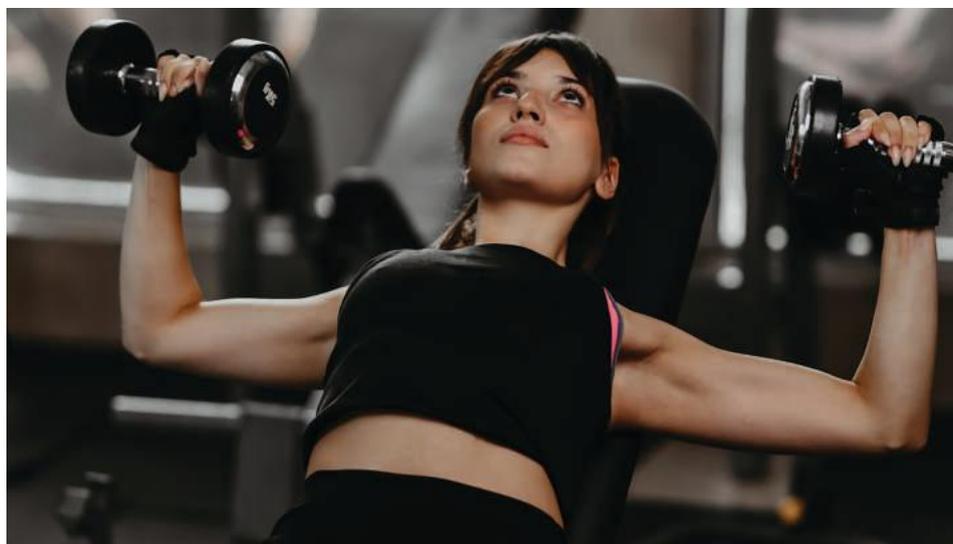


Figure 5.22 Example of the muscle relationships required for a bench press.

### How does the muscular system influence and respond to movement?

All movement of the human body relies on the muscular system to provide the contractions to move the skeletal system. A healthy muscular system allows someone to fulfil and enjoy a wide range of daily tasks, vocational pursuits and recreational activities. These may range from longer endurance-based movement, through to more strength and power-based pursuits. Muscular system limitations result from inactivity, injury and age. Regular and intense activation of all body muscles and movements ensures that the whole system is efficient and strong.

The muscular system can respond in a variety of ways depending on the training and activity

stimulus. Long duration, endurance-based activities (swimming, cycling, rowing) tend to increase the metabolic function of muscle cells, which makes them able to produce more energy with less fatigue. However, short duration maximal efforts requiring strength and power (resistance and high intensity training) have a more pronounced effect on changing the physical nature of the muscle cells, increasing their size and contractility. Stretching and flexibility-based movements are also required to maintain healthy muscle length and suppleness. This in turn decreases injury risk and improves posture and movement quality. Collectively, engaging in a wide range of movements requiring all major movement patterns will improve the health and function of the muscular system.



**Figure 5.23** A healthy muscular system allows someone to fulfil and enjoy a wide range of daily tasks, vocational pursuits and recreational activities.

### Activity 5.3

#### Agonists and antagonists

In small groups, demonstrate and analyse these movements and complete the table.

Exercise	Agonist(s)	Antagonist(s)	Directional movement of the major joint during concentric contraction
Military press			
Push up			
Curl up			
Squat			
Deadlift			
Bicep curl			
Lateral lunge			
Cricket bowl			
Calf raise			

**Skills:** collaboration, analysis, communication



Quiz

### Revise and summarise 5.1

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Define anatomy and physiology.
- 2 Identify the six levels of structural organisation in the human body.
- 3 Identify the basic function of the 11 human body systems.
- 4 Name an example of the 10 directional terms.
- 5 Name five types of bones in the human body.
- 6 Explain the structural and functional difference between the axial and appendicular skeleton.
- 7 Identify the five functions of the skeletal system.
- 8 Describe the features of the three types of joints in the human body.
- 9 Identify six examples of synovial joints in the human body.
- 10 Describe the function of four common parts of a synovial joint.
- 11 Name an example of the 12 (six pairs of) joint actions.
- 12 Name three types of muscle in the human body.
- 13 Define the four properties (capabilities) of all skeletal muscle.
- 14 Describe the characteristics of the three types of muscle fibres with examples of sports they help.
- 15 Explain what an isometric muscle contraction is with examples.
- 16 Explain what an isotonic concentric muscle contraction is with examples.
- 17 Explain what an isotonic eccentric contraction is with examples.
- 18 Using an example of an exercise, describe the agonist, antagonist and stabiliser relationship.

### Think critically and apply 5.1

- 1 Select a complex movement skill (e.g. shot put, clean and jerk lift, tennis serve, basketball shot or gymnastics vault).
- 2 Record or source a video of this skill and select three pairs of still images that highlight a single movement joint action within the movement (similar to a 'before and after' of the limb as the movement is performed).
- 3 Critically analyse these pairs of images and create a visual display demonstrating your understanding of how the body produces movement. Annotate key points on the images and describe in detail how the movement is being produced by the interrelationship of the muscular and skeletal system.

**Skills:** analysis, communication, creative thinking

## 5.2 Biomechanical principles and human movement

### Learning objective 5.2

OUTLINE how biomechanical principles help ensure safe and efficient human movement

bio = human life, living things  
mechanics = the branch of mathematics that deals with forces, energy and motion

The study of biomechanical principles refers to a specialised area of sports science that seeks to apply the natural laws of physics and mechanics to provide an advantage to human performance and increase movement potential, while also enhancing safety. Biomechanics focuses on the development of sports equipment, training innovations and analysis tools to increase feedback and refinement of techniques, especially for more technically demanding sports and activities.

The human body is a highly complex and organised organism, capable of incredible physical accomplishments through the development of the body systems that influence movement. This is particularly true of the musculoskeletal system, as the muscles, bones and joints are the primary catalysts for movement, as they convert the chemical energy of the human body into the mechanical energy of movement. Whenever someone attempts to run, jump, land, twist, kick, hit, throw, swim or perform any other technical and powerful movement skill, they seek to apply and utilise these natural laws and principles of mechanics to accomplish these great feats with their bodies as efficiently, effectively and safely as possible.

Biomechanics is often divided into two categories. The first is **kinematics**, which is the study of objects in motion and how technique adjustments can increase the efficiency of motion to achieve a greater outcome. A simple example is determining the best angle of projection for a shot put to maximise the length of the effort. The second is **kinetics**, which is the study of the body that

creates force and its relationship to the object being acted upon. For example, a gymnast seeks to tuck into a tighter ball while somersaulting in order to rotate faster.

Below is a summary of the prominent biomechanical principles that the human body regularly demonstrates, utilises or engages with through various sports and physical activities.

### Motion

Motion refers to the specific path or movement of a body. In sport, this could be the movement of the human body (e.g. the speed an athlete runs during a running race) or an object that is manipulated by the human body and the force it applies to this object (e.g. a javelin being thrown). While some of these principles of motion are simply observed in sport, others can be targeted to maximise efficiency and lead to the development of improved technique or equipment. The use of these kinematic principles is particularly useful when measuring the effect of human movement through testing. The impact of a strength and power training program for a sprinter (kinematics) will be evident in faster sprint times (kinetics).

### Linear motion

True linear motion can be observed when a person skates or skis in a straight line without moving after initial propulsion. Consider a ski jumper who slides down the ramp, preparing for take-off, where they hold a stationary crouched position until take-off. A swimmer who pushes and glides as far as possible off the wall also displays linear motion. When a sprinter runs from start to finish over 100 m, they run in a straight line to ensure they travel the least distance. Any slight deviations from this linear motion will result in increased distance, and therefore will increase the

**kinematics** the study of objects in motion and how technique adjustments can increase the efficiency of motion to achieve a greater outcome  
**kinetics** the study of the body that creates force and how this relates to the object being acted upon



**Figure 5.24** Ski jumping is an example of linear motion.

time taken to travel along the path. In sports that involve linear motion, athletes aim to minimise any unnecessary lateral, vertical or twisting movements that do not contribute to forward motion. This is true in sprint athletics and sprint swimming.

### Angular motion

The movement of a body around a curved path is very common in sport. Any object manipulated by the body will be projected by either the arms or legs, which have a fixed axis, where the bones rotate at a joint. When a cricket ball is hit back in a straight line, the swinging arms are an example of angular motion that produces the movement of the bat. Walking and running requires the leg to swing under the body. Divers spin their body as they somersault, controlling the angular motion, which is essential to ensure a clean entry into the water.

### General motion

As in everyday life, the majority of sporting skills have a mixture of both linear and angular motion, known as general motion. The swimmers' arms

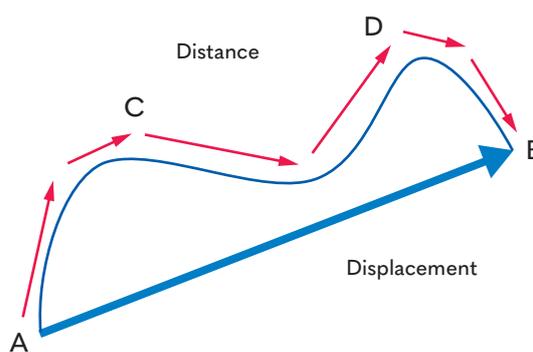


**Figure 5.25** Hammer throw is an example of angular motion as the hammer swings around the body.

represent angular motion, while their hips display linear motion as they glide through the water.

Related to motion is the concept of distance and displacement, which are merely observable features of sport.

If a sprinter ran one lap of a 400 m circular track, the distance (i.e., total length travelled) of their run would be 400 m, but their displacement (i.e., length and direction from the starting point) would be 0 m, since they finished at the same place they started. A runner is only concerned with the distance of the race. However, the length of a discus throw is a measure of the displacement, and not the total distance of the path travelled by the discus. Strategies in sport seek to minimise distance, such as by running around the inside of a corner, and to maximise displacement, by projecting an object such as a ball at the most efficient trajectory.



**Figure 5.26** The difference between displacement and distance

## Velocity

Velocity refers to the speed of an object in a given direction and is calculated by using a simple formula:

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

Generally, this calculation is for objects that move through a curved path – for example, when calculating the velocity of a javelin. The displacement is the length measured from the release point to the landing point along the ground. The velocity of the javelin can be calculated by dividing this displacement by the time the javelin was in the air. A javelin thrower aims to develop the power of their throw, which increases velocity and therefore increases displacement of the javelin.

## Speed

Similar to velocity, speed is calculated simply using:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

For example, a 400 m race run in 66 seconds will have an average speed of 6 m/s or 22 km/h. Calculations of speed are an essential aspect of many sports. In a marathon, the runner with the fastest average speed will win. Where athletes compete against each other in team sports, speed is a great advantage, which can allow one player to escape or catch another. Sprint speed is an excellent example of the role of biomechanics in maximum performance. Athletes must have a highly refined technique to run at their fastest potential speed. Poor technique leads to wasted effort and decreased performance.

## Acceleration

Acceleration refers to the rate of change in speed of a moving object. When acceleration is increasing, it is described as positive acceleration. For example, when moving from a stationary position to a jog and onto a fast sprint. When the opposite occurs and the body in motion is slowing

down, it is called either deceleration or negative acceleration.

Being able to reach maximal running speed as quickly as possible is a significant advantage. In power sports such as rugby, great acceleration over a short distance increases a player's potential effectiveness in the game. Muscle power and speed, as well as some simple biomechanical techniques, such as leaning forward, arm drive and high knees, can increase acceleration. Sports such as sprinting rely on rapid acceleration, which is why blocks are used to position the body into a more optimal position.

## Momentum

Momentum is determined by mass and velocity. The significance of mass is most easily understood by considering the outcome of a collision between a truck and a car both travelling at 60 km/h in a head-on crash. Momentum is an advantage in many sports, especially during collision sports. When two rugby players collide, the athlete with the greater momentum is more likely to be able to get into an advantageous position by pushing their opponent back. However, momentum is only one of many factors that will determine success. Other factors include

- the angle of collision
- tackling technique and timing
- the amount of contact with the ground, which affects stability.

## Angular momentum

Angular momentum is the final aspect that combines the understanding of angular motion and momentum. This is very common in sports where athletes rely on rotational movements to generate power. For example, the longer a lever is or the greater its mass, the greater its angular momentum will be. This is evident in golf, where a longer club such as a driver produces more force than a shorter club such as a 9 iron, if swung with the same force. Centrifugal (centre-fleeing) and centripetal (centre-seeking) forces are evident as objects move through a curved line, such as when a bike rider leans their bike into a corner without falling over.

## Balance and stability

All sports require athletes to consistently maintain some form of steady balance, stability and equilibrium in order to be successful. There are two main types of balance evident in sport:

- 1 **Static:** maintaining balance and equilibrium while stationary (e.g. a diver prior to jumping, an archer as they shoot, or within a beam routine in gymnastics).
- 2 **Dynamic:** maintaining balance and equilibrium while moving (e.g. running and changing direction, cornering on a bike, or a rally in tennis moving quickly around the court).

Some sports are judged on the degree of balance performed (e.g. an ice-skating or gymnastics floor routine), while other sports rely on balance and stability in order to provide an advantage (e.g. a basketballer dribbling past opponents or AFL jumping and landing). Many heavy contact sports rely on disrupting the balance of opposition in order to provide an advantage (e.g. a wrestler trying to force an opponent onto their back or a rugby tackler trying to take the opponent to the ground). All these examples reflect the principles of balance and stability that athletes manipulate and refine.

### Centre of gravity (CoG) and line of gravity (LoG)

The CoG refers to a hypothetical point where all the body's mass is equally concentrated. Standing in the anatomical position, the CoG is approximately behind the naval and slightly towards the posterior. As the body moves and changes position, the CoG will shift, even to imaginary spaces outside of the body. The LoG is an imaginary line that is drawn vertically down from the CoG to the ground.

### Base of support (BoS)

The BoS refers to an imaginary line drawn around the parts of the body in contact with the ground

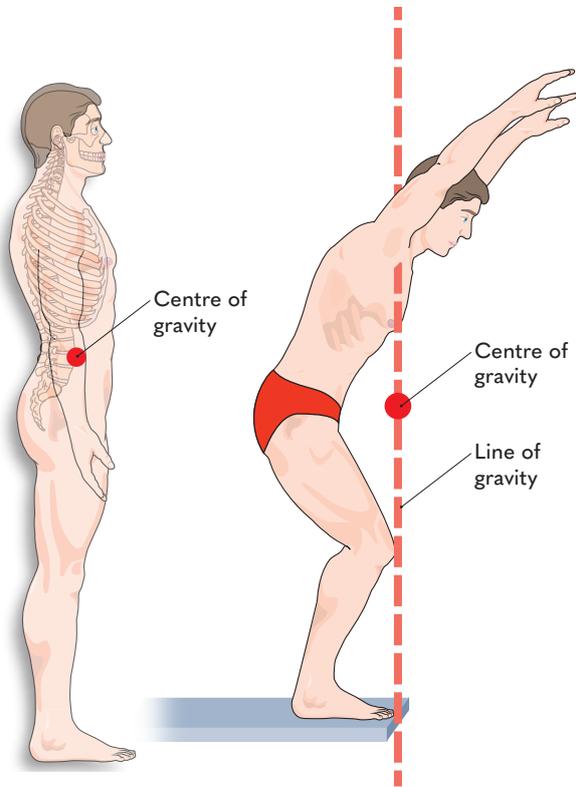
at any given point. When standing on two feet, this would be in the rough shape of a rectangle, whereas on one foot, the BoS would only be the shape of the one foot, which would become even smaller when standing on toes. If a hand and two feet were in contact with the ground, the shape would be a triangle.

When athletes sense their LoG not aligning over their BoS, corrective action must be taken. For example, when leaning too far forward, a quick step must be taken to prevent falling over. In the start of a swimming race, the athlete deliberately loses balance by leaning forward off the blocks, and at a precise moment, forcefully jumps. This leads to maximum force production and the most effective dive possible.



**Figure 5.27** A tackle in rugby league requires the defending team to disrupt the dynamic balance of the player in order to get them to the ground.

Another aspect is the height of the CoG above the BoS. Shorter athletes, who have a naturally lower centre of gravity, are closer to their BoS, which generally means they are more stable. Athletes may lower themselves to a point that increases



**Figure 5.28** The centre of gravity and line of gravity in different body positions

their stability during play; this is evident in most contact sports. Taller athletes can sometimes struggle to be as balanced in contact sports, as a collision can more easily disrupt their equilibrium.

Generally, widening your stance to increase the BoS, lowering the CoG and ensuring the LoG is above the BoS all help create a very stable position (as seen in the basketball image in Figure 5.29). By comparison, the diver has smaller BoS, which is not below CoG and LoG as she is going into the handstand. Even when fully upright, this is a far less stable position.

All athletes are highly skilled in effectively manipulating either their own body position or that of the equipment being used, thus ensuring the centre of gravity is perfectly positioned throughout the movement. However, this is generally an unconscious and automatic response, refined over years of practice. The vestibular system of the middle ear along with the proprioceptive and other sensory neurons helps analyse and maintain balance and stability. As they do this, many of the body's 600 skeletal muscles contract in subtle and coordinated ways to maintain and move the skeletal system into the most balanced and stable position required for the desired movement outcome. This is often the work of the deepest layer of muscle tissues such as the postural muscles around the lumbar spine.



**Figure 5.29** This basketball defender is demonstrating a very stable position compared to a diver preparing to take off from a handstand on the 10 m platform tower.

## Case Study 5.1

## Biomechanics in football

**NEWS REPORT****World Cup: what body type works best for football? A professor of biomechanics explains**

Anthony Blazeovich

*The Conversation*, 2 December 2022

If you've been watching the World Cup, you might have marvelled at the physical fitness and skill of these elite players.

How can they run and run and run for so long? What makes them so good at speedy changes of direction? Biomechanically, is there a certain body type that is perfect for football?

Of course, much of the brilliant play is down to natural talent combined with years of very hard training and practice. But there are certainly some physical features that help a lot when it comes to being able to play football at this level.

**Different features for different positions**

There's no one single perfect body type for this sport; much depends on what position you play.

A central defender, for example, might benefit from a bit of extra height so they can defend against aerial balls in the box.

Midfielders, on the other hand, head the ball less often but need a lot of agility and to run astonishing distances in the game – most will cover more than 10 kilometres, with sprints and direction changes common. That's where having lighter body mass really helps, and that means not being too tall. When you



**Figure 5.30** Poland's Robert Lewandowski struggles to stop Argentina's Lionel Messi during a World Cup match. Having a low centre of gravity can help.

are tall – even if you are skinny – you weigh more, so being very tall can be a disadvantage for these players.

And being shorter means that our centre of mass is lower, so we have more stability and better balance. That makes technical skills with the ball easier to perform and it makes swiftly changing direction easier too.

There is one fairly consistent physical feature across footballers, which seems to be similar across male and female players: an ability to run and run.

They need to have a big engine, so they are physiologically strong in terms of heart and lungs. In a running test, these players will show up with

*continued*

Case study 5.1 *continued**continued*

a very high  $\text{VO}_2$  max (a measure of the maximum amount of oxygen your body can use while exercising). They will also have a high lactate threshold, which means their bodies can cope with high intensity effort for long periods of time.

All this adds up to what we call good repeat sprint ability. That means they can run, then recover, then run, then recover, and so on and so on. Don't forget, they do spend some time standing or walking, so it's the repeated effort to go from low intensity to maximum intensity over and over that necessitates this big engine.

#### **Lighter upper body, strong lower body**

Football players in general are not stocky like, say, rugby players. But while the upper body tends to be fairly light (which saves on mass and helps with speed), they do generally have quite big, strong legs.

That's because changing direction rapidly – and to accelerate and decelerate almost instantly – takes quite a lot of force. You need muscly legs to do that.

Having a large upper body, on the other hand, would be mostly downside with little upside. There's no significant

requirement for upper body strength in this sport, so if you want to increase speed and endurance, you need to maintain a lighter upper body mass. They are not training to get really big in the upper body.

They also generally have very low body fat levels as they need a lighter body mass to run, jump and accelerate.

#### **What about the goalkeeper?**

One position that does benefit greatly from height is the goalkeeper. The Australian goalkeeper, Mark Schwarzer, used his 1.95 metres frame to great advantage. And most elite goalkeepers stand taller than 1.85 metres.

The job of the 'keeper is to leap vertically and laterally. Having long legs can help the 'keeper to jump higher and further because they can push off over a larger distance during the jump. And having long arms helps with reach to tip or catch the ball. So being tall can be a real advantage.

All in all, these players are well built to produce elite performances at the highest levels of the game. While years of hard training has surely contributed to their success, they might also thank their parents for the genes they received too.

- 1 Which biomechanical principles are recognised as being influential in the sport of football?
- 2 How do these influence training programs and equipment development?

**Skills:** analysis, communication

## Fluid mechanics

Fluid mechanics refers to the movement of a body through liquid (water) or gas (air), and the forces that affect it. Any sport involving movement, whether of an object or the human body, is subject to the impact of the fluid it moves through. Generally, sports require this movement through the fluid to be as fast and efficient as possible. Even with regards to water and air, there can be subtle differences in the fluid properties in different locations around the world. Swimming in salt water is different from swimming in fresh water, as the increased salt concentration increases the body's ability to float. Air pressure decreases as altitude increases due to lowering levels of oxygen concentration. This will reduce the resistance of the air on an object flying through it. To enable the most efficient and effective movement possible, both technique development and equipment modification is used.

### Flotation and centre of buoyancy

If you asked three differently shaped people to try to hold a stationary flotation position on their backs in the water, you would see that their bodies behave differently within the water. Some people easily float on top of the water; others slowly sink in a flat position; and others will sink quickly legs first. These differences relate to the principles of buoyancy for that individual.



**Figure 5.31** Some people easily float on top of the water.

When a body is immersed in water and attempts to float, a specific volume of water will be displaced (or forced to change position to accommodate the body):

- If this volume of displaced water is heavier than the body displacing it, the body will float.
- If this volume of displaced water is lighter than the body displacing it, the body will sink.

The human body is not uniform or consistent in shape and density. The legs, which are predominantly comprised of muscle and bone, have a much higher density than the upper torso region, which contain the air-filled lungs. For most people, their legs sink faster, dragging the rest of the body down with them. You can experience this if you hold a static float, lying in the supine position (facing up) with arms and legs spread out. Slowly breathe out and exhale all air out of your lungs and note the way your body sinks (if it sinks). The torso has a larger surface area and fat percentage, which also makes it more buoyant than the legs.

These properties of flotation and buoyancy significantly affect a person's ability to swim. The higher they can float in the water, the easier it is to swim as they encounter less fluid resistance from the water. Efficient swimming technique aims to ensure the body floats as high as possible in the water. This also affects the development and design of equipment such as rowing boats and how they float. The higher a boat can sit in the water, with the least amount of volume submerged, the easier propulsion through the water will be.

Objects with a higher density will tend to sink faster than objects of lower density. The exception to this is boats, where their specific shape adds to their ability to float. For most humans, the density of their body is similar to water. However, salt water, with its higher salt concentration and increased density, promotes greater buoyancy than fresh water. People with increased body fat, which is less dense than water, float more easily. This can be replicated by wearing a low-density personal flotation device, which greatly increases the volume of the body without increasing its actual weight.

### Fluid resistance

Whenever an object moves through a liquid or gas (air), various resistance forces impact on the efficiency of this movement. This resistance is often referred to as drag, and any reduction of drag through technique refinement and equipment development will increase performance.

Drag is an oppositional force, which means it acts against the movement of an object through fluid. In swimming, the water opposes the swimmer's movements, requiring the athlete to overcome this resistance. Because the water is not moving, it must flow around the body pushing through it. This flowing water becomes disturbed and turbulent, which adds even more drag. To reduce this drag, the following can be modified:

- **Equipment and clothing:** clothing should be form-fitting and 'slippery' (e.g. tight swimsuits made of lycra). Even wearing a swimming cap and shaving down can make a difference.
- **Technique:** the shape of the body should be as streamlined as possible. The larger the surface area of an object pushing through water, the greater the drag it will encounter. For example, swimming with your head above water is much slower than putting your head face-down in the water.

These principles also apply to objects and bodies that move through the air, particularly those travelling at faster speeds. Cyclists have highly refined equipment and move into body positions that decrease the drag they encounter, allowing them to ride faster.



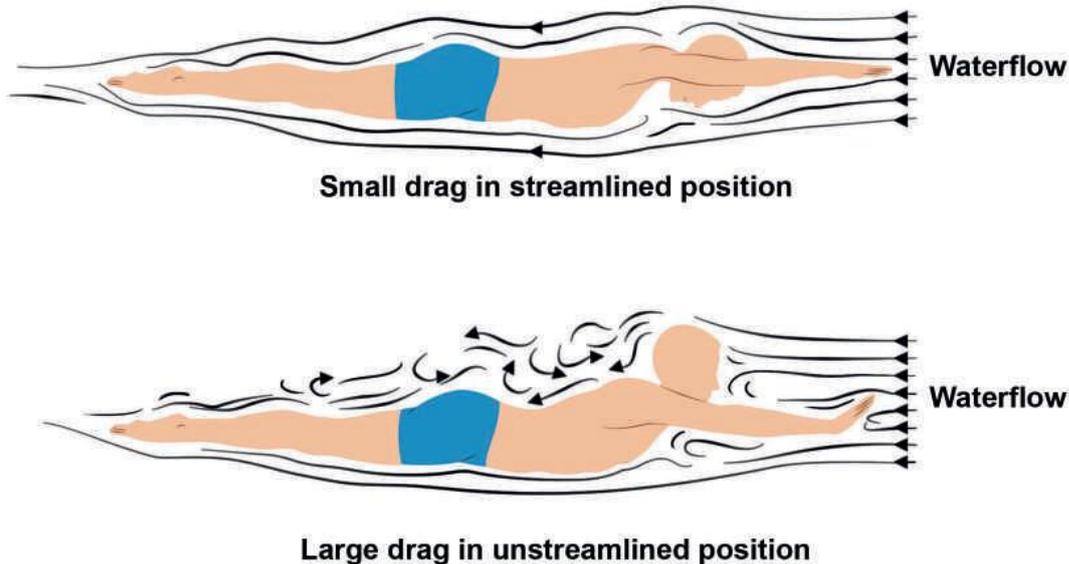
**Figure 5.32** An elite cyclist tucked into an aerodynamic position on a time trial bike

**profile drag** the shape and surface area of the object as it moves through fluid

**Profile drag** refers to the shape and surface area of the object as it moves through fluid. Generally, the aim of most movements is to get into a position (or have a frontal shape) that reduces

profile drag. Considering what happens to fluid particles as they flow over and past the object is also critical. As the fluid passes over the body, it seeks to stay in contact with the surface for as long as possible (which is called laminar flow). However, if this boundary layer of fluid breaks away from the surface it becomes irregular and chaotic (which is called turbulent flow).

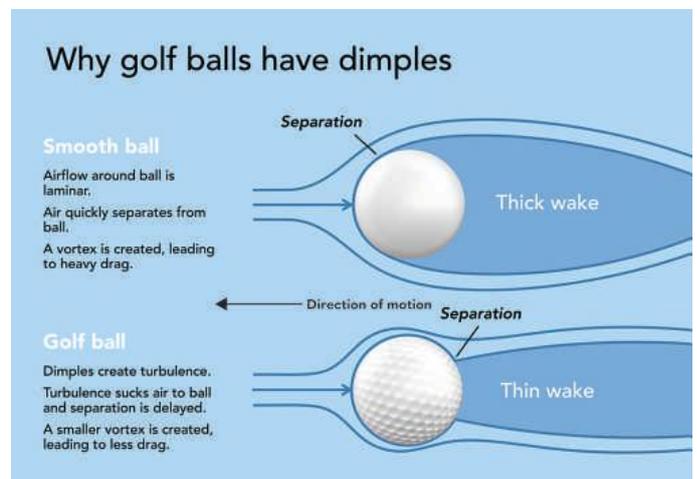
Increased turbulence creates a larger wake behind the object, which increases the drag on the object, slowing it down. Interestingly, spherical shapes have inefficient properties when it comes to profile drag. The ultimate shape to minimise turbulence is the foil wing on an aircraft, which has minimal drag. Many factors can create turbulent flow, from increased frontal surface area to uneven and bumpy surfaces. The only exception to this is the small dimples seen on golf balls. Despite these small irregular divots creating small pockets of turbulence, this tends to help the air 'stick' to the ball for longer, creating a much smaller wake behind the ball and far less drag.



**Figure 5.33** Different swimming positions result in varying amounts of turbulence and drag.

Other examples include a quarterback throwing a gridiron ball or a frisbee being thrown. A flat, smooth throw with the object flying with the smallest surface area possible will fly the furthest. In cycling, time trial bikes have a particular shape, and the rider is positioned in a way that that minimises profile drag. However, some sports demand a trade-off between being streamlined and being stable. Single scull row boats are extremely narrow with a long nose because they only go in a straight line. However, a white-water kayak is less streamlined, as it must be able to change direction and stay afloat in challenging waters. It is wider, shorter, and more stable.

Clothing, equipment and materials are always being developed that are more aerodynamic in nature. Aerodynamics can be measured in wind tunnels.



**Figure 5.34** The effect of dimples on a golf ball

### Magnus force effect

A unique aspect of fluid mechanics is the way sports balls fly through a curved path because of uneven surface drag and friction. When some balls are struck with a rotational (spinning) action as they move through the air, they can deviate from their original path. This is particularly evident in tennis, baseball, cricket and golf.

The spinning ball creates a section of high-pressure airflow on the side of the ball that is spinning towards the direction of its flight. This adds increased surface drag over that side of the ball. On the opposite side of the ball, low air pressure results as the ball is spinning in the same direction as the air flowing past it, where it encounters less drag resistance. As a result, the ball will curve towards the side of low pressure. This is known as the Magnus force effect.

In tennis, players regularly strike the ball in a manner that will produce the Magnus effect. Topspin causes the ball to drop quickly, which is used when hitting a firm groundstroke for a winner (hitting over the top of the ball), whereas backspin tends to make the ball fly slower, but for longer (slicing under the ball). This is used to slow down the play or as a recovery shot. Sidespin can also be applied to curve the ball away from an opponent. In football, players apply spin and

topspin when taking free kicks, as they attempt to curve the ball around the wall into the goals.

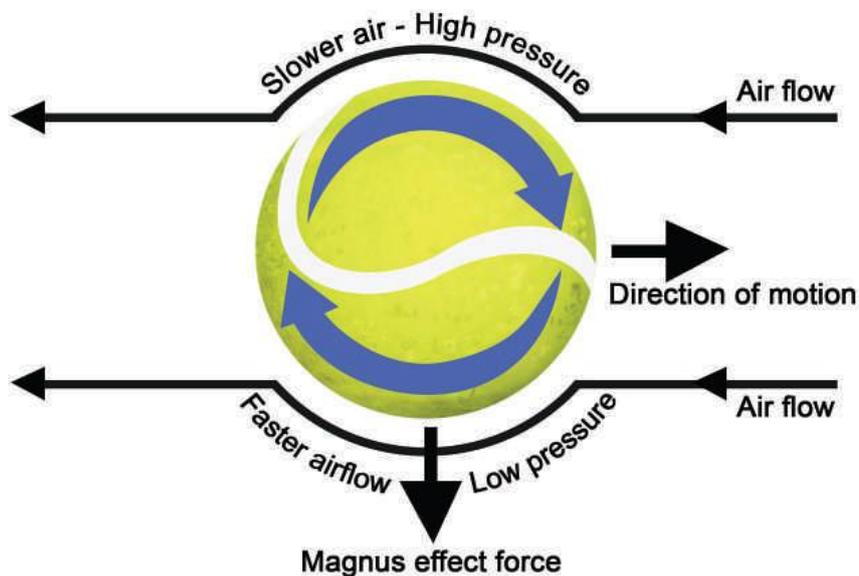
Cricket balls are unique in that the ball over time may become asymmetrical and irregular in its surface properties from one half of the ball to the other. As the bowler shines and rubs one side of the ball, the other side continues to become rough. If the ball is bowled with the seam vertical, the ball will swing towards the rough side, where the surface friction increases the drag.



**Figure 5.35** In football, players apply spin and topspin when taking free kicks, as they attempt to curve the ball around the wall into the goals.

### Spin & The Magnus Effect

*The spin on the ball slows down the air flow on one side and speeds it up on the other side creating a pressure difference and causing the ball to move.*



**Figure 5.36** The effect of Magnus force on a spinning tennis ball

## Force

Force refers to the push or pull upon an object that arises when it interacts with another object, often resulting in a change in motion. Forces that arise from direct and applied contact are called contact forces, such as striking a ball in cricket, and there are also non-contact forces such as gravity.

Newton's three laws of motion are observable when considering the impact of force in various sporting contexts:

- **Newton's first law:** an object remains at rest or in a constant motion unless acted upon by an external force (e.g. a ball on the ground won't move unless something causes it to move such as being kicked, or a rolling ball slows down because of friction and air resistance).
- **Newton's second law:** the acceleration of a body is directly proportional to, and in the same direction as, the force acting on the body. (e.g. the ball being kicked will move at a speed and in a direction proportional to the kick that was applied).
- **Newton's third law:** when one body exerts a force on a second body, the second body simultaneously exerts a force that is equal and

opposite in direction to that of the first body (e.g. a ball that is kicked applies a force back into the player's foot, but because the kick is more powerful than the force of the ball into the foot, there is an unbalance of forces which causes the ball to move away).

## How the body applies force

The body produces force through the coordinated contraction of skeletal muscle, resulting in movement of the skeleton (e.g. deadlift, jump, throw or run). These are known as internal forces, which create an external force. Sport requires the application of these forces against other objects and surfaces in the competitive environment. Maximising internal forces is achieved through specific training programs, aimed at the physical development of the power and strength capabilities of a specific muscle group. In addition to this, efficient movement patterns through technique development will enable an athlete to produce the maximum amount of force application by refining the angles and directions of movement (e.g. the optimum release angle in shot put).



**Figure 5.37** Shot put is an example of a powerful and refined applied force producing maximum motion.

### How the body absorbs force

Often in sport, the body encounters an external force that must be absorbed and controlled. It is the role of internal forces, through the action of muscle contraction and joint flexion, to absorb these external applied forces. For example, when landing from a netball rebound, the athlete will bend and flex through the hip, knee and ankle joints using mostly eccentric contraction to smoothly absorb the force of gravity and minimise the risk of injury. Other skills where the body absorbs force include having ‘soft’ hands that ‘give’ when catching a cricket ball or tackling an opponent in rugby who has high momentum and runs straight at the defender. These skills require practice and technique development to stay as safe and effective as possible.

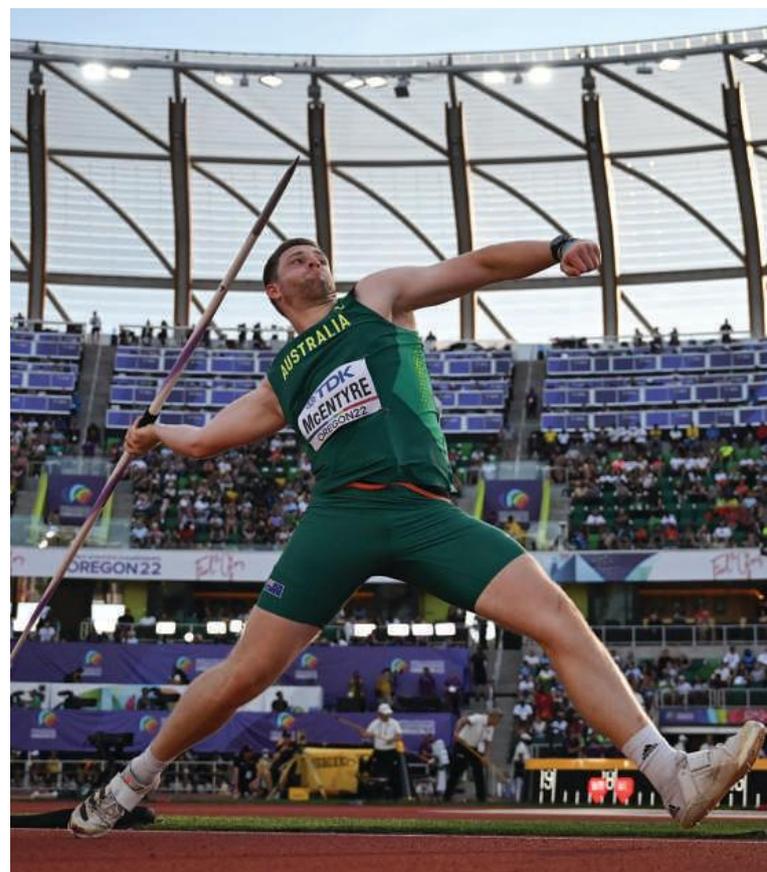


**Figure 5.38** Netball players using the musculoskeletal system to absorb the forces of landing

Friction and air resistance are two other unique forces that act upon the body. As discussed earlier, through refined techniques and enhanced equipment and materials, these forces can be controlled and reduced to improve movement and sports performance.

### Summation of force

Human movement is complex as the joints provide such a wide array of potential movements. The ability to utilise the right movement, at the right power, precisely at the right time, refers to the concept of coordination. Coordinated actions generally involve the summation of a number of internal forces that can produce a maximal external force or motion. Imagine a javelin being thrown but with both feet facing the target, compared to standing side on. Now factor in a run-up and the potential forces that can be amplified through the summation of force.



**Figure 5.39** The summation of forces required for javelin

## Using biomechanical principles for safe and efficient movement

### Safe movements

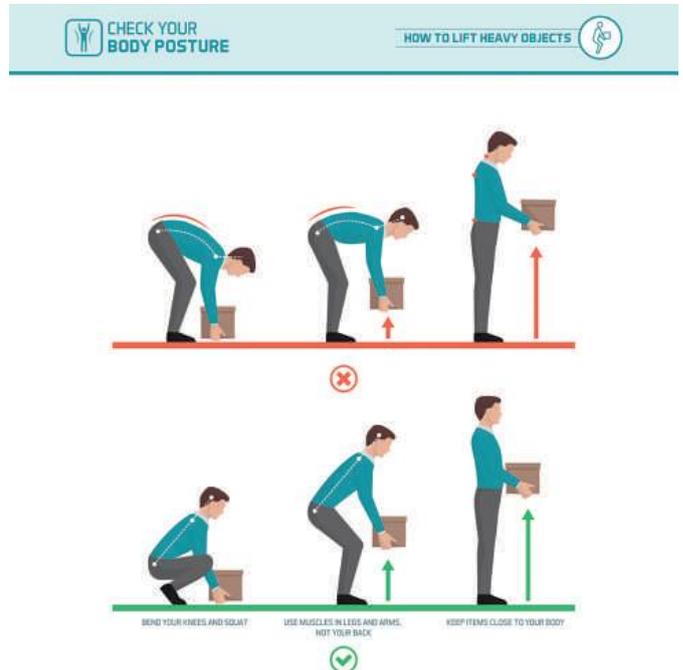
Movements that are unsafe can cause significant damage to the body through both acute (instantaneous and sudden) injuries and chronic injury (occur progressively and gradually over time). Biomechanical principles and analysis can be applied to ensure the forces that are impacting on the body minimise the risk of injury.

Everyday movements, such as walking/running, lifting heavy items or sitting at a desk for prolonged periods can all lead to chronic overuse injuries if the forces on the musculoskeletal system are more than it can tolerate. With these injuries, they often only cause micro damage, which is easily ignored. With insufficient rest, injuries such as tendonitis (itis = inflammation) or stress fractures (small bone fractures) develop over time from the minor but repeated trauma. Because these chronic injuries develop slowly, they can take a much longer time to heal, and the cause of the pain also needs to be

corrected. This is where a biomechanical analysis can help identify potential causes of such injuries. Healthy sitting posture for office workers, safe running technique that minimises the pressure on the joints, using legs and hips to lift heavy items instead of your lumbar spine, and ensuring that tennis racquet grips are the correct size for your hand can help prevent such injuries.

Lower back injuries are an enormous cost to the health of individuals and to the community. Lack of physical conditioning and strength, sedentary lifestyles and anatomical deficiencies such as a weak core all contribute. The simple preventative measure of safely lifting heavy items with good posture uses the body as it is designed to be used and decreases injury risk. These tips include:

- Stand with a wide base of support, looking forward.
- Squat down with hips going back and down with knees over toes, keeping your back in regular alignment.
- Brace first and lift, standing up using your hips and knees, rather than your lower back.



**Figure 5.40** Correct sitting and lifting posture



**Figure 5.41** Correct deadlift technique, which is transferred into everyday lifting tasks.

### Movement efficiency

Have you ever taken note of how effortless skilled athletes appear to be as they perform complex skills? Consider a fast bowler in cricket, a pole vaulter, a marathon runner or platform diver. They seem to move with such ease of movement, which can be described as moving efficiently.

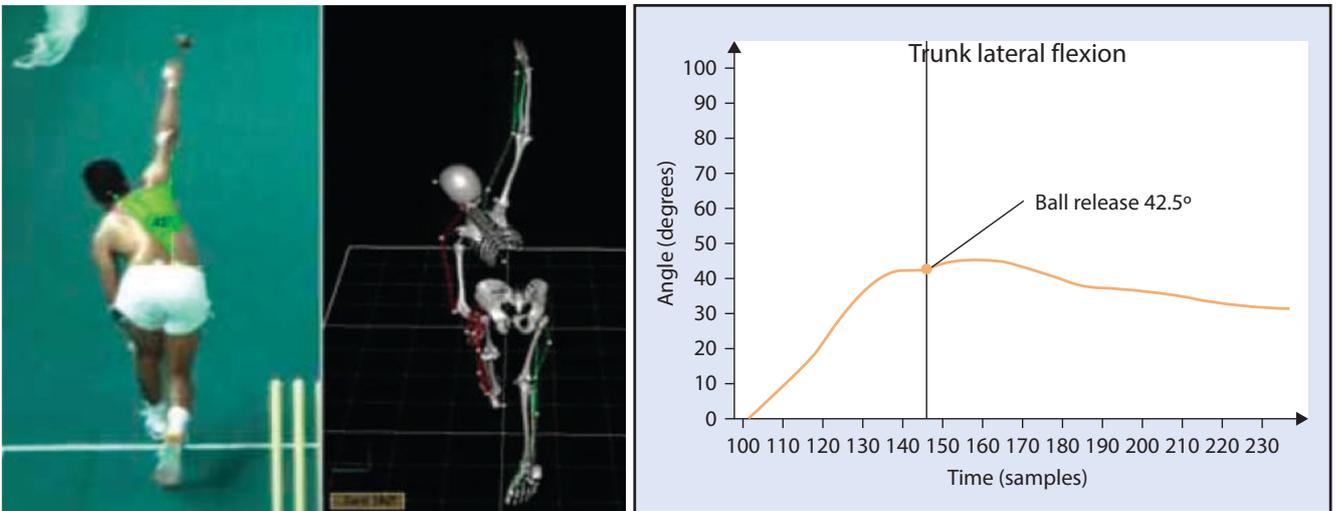
Movement efficiency refers to the specific mechanics of an individual's movement or motor patterns, and whether they can use just the right amount of force to complete an action. It also relates to being energy efficient and using the least amount of energy required to perform a task. Some examples of movement efficiency (and inefficiency) are as follows:

- Two runners of a similar size may cross the line at the same time in a race, but an efficient runner will use less energy to complete this task as they use their body in more refined ways.
- Two similar sized weightlifters may deadlift 100 kg, but one may use less energy in doing so due to increased strength, but also better technique and mechanics, using their hips and not their lumbar spine.
- Inefficient swimmers tend to have a larger frontal surface area and are less aquadynamic, meaning they use more energy and push more water as they swim.
- A sprinter with a subtle side-to-side running action who doesn't bring their knees high enough through the stride, is wasting some of their energy (and time) accounting for this minor zigzag and is not using the full potential of their body's ability to run fast.
- A runner with poor ankle mobility or tight calf muscles will lack fluidity in completing their gait (or stride) efficiently, as they must account for their inability to fully roll the ankle through. This leads to shorter and more frequent strides using more energy, but also requires other muscles to do more work to overcome this, leading to other imbalances and potential injuries.

A biomechanical analysis of an athlete's movement can reveal areas of efficiency and inefficiency. The use of video analysis software and feedback (discussed in more detail in the next section) can aid this process, as the various angles and quantity of force and motion can be measured and visualised, giving the athlete increased data and ability to see how their action is contributing (or not) to the efficiency of their movement. This is then used to improve performance and equally help reduce the risk of injury from inefficient movement. Fast bowling in cricket has taken advantage of this technology, to help promising young elite players to improve their movement efficiency. By making subtle changes to their action, the aim is to ensure that the forces going into the body are as efficient as possible, while also maintaining the effectiveness of the skill. There is a high rate of lower back stress fractures in this playing group, and biomechanical specialists who have a detailed understanding of human anatomy and cricket bowling are helping support the health of these players.



**Figure 5.42** Video analysis of movement efficiency



**Figure 5.43** Video analysis of movement efficiency of a fast bowler in cricket

The force an athlete is able to produce and their degree of motion is another area of biomechanical assessment that has rapidly advanced in recent years to increase movement efficiency. Force plates are able to analyse the ground reaction forces and movements involved in human movement. These are mostly used to measure strength and power while jumping. For example, force plates can compare the relative contribution of the left and right legs during a squat or vertical jump

to determine any imbalance that can affect movement efficiency and lead to injury. Timing gates are highly accurate measurement tools to analyse motion such as speed, acceleration, agility and reaction times. In doing so, athletes can analyse the external output capacity of the musculoskeletal and neuromuscular body systems as a result of the training, ensuring they are developing greater movement efficiency.



**Figure 5.44** Athletes testing their movement efficiency with force plates and timing gates



**Figure 5.45** Developing prosthetics to improve movement efficiency for athletes with a disability

An interesting aspect of developing movement efficiency arises in relation to athletes with a disability. Athletes in wheelchairs or who have prosthetic limbs have a range of physical and biomechanical challenges to overcome. Biomechanical principles can help them overcome these challenges to achieve amazing feats. As with all sports endeavours, the advancement of technology and biomechanical principles is most evident in the equipment used in sport. The development of lighter, stronger materials (carbon/graphite), the use of GPS and wireless technologies to analyse performance and the use of 3D laser scanning and cutting machinery have led to the development of innovative sports equipment to help athletes overcome their disabilities. Carbon wheelchairs and customised prosthetic limbs are examples that have improved movement efficiency.

### Activity 5.4

#### Using biomechanics to develop safer movements in sport

Select a sport of interest, and research specific training and equipment innovations that have been developed to help athletes in this sport to move more safely.

Present your findings to the class, covering at least one example for each area of development and demonstrating understanding of how this effect is achieved.

**Skills:** analysis, communication, research, problem-solving



Collaborative  
investigation



Quiz

## Revise and summarise 5.2

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Provide examples of linear, angular and general motion.
- 2 Explain the difference between distance and displacement.
- 3 Define speed, velocity and acceleration.
- 4 Explain how momentum provides an advantage in sport.
- 5 Describe the relationship between centre of gravity, line of gravity and base of support, and how they can affect the balance and stability needed in sporting performance.
- 6 Describe the principles of buoyancy.
- 7 Explain how equipment and technique can affect fluid resistance in sporting performance.
- 8 Explain drag and how it can affect sports performance.
- 9 Define the Magnus effect and provide examples of how it is used to provide an advantage in sporting performance.
- 10 Summarise how the body applies force.
- 11 Summarise how the body absorbs force.
- 12 Using an example, explain how biomechanical principles can be used to enhance safe movements.
- 13 Using an example, explain how biomechanical principles can be used to increase movement efficiency.



Depth Study

## Think critically and apply 5.2

Engage in a performance lab where the principles of biomechanics can be observed or manipulated. Record video footage so that slow-motion replay can be used for a more detailed and accurate analysis.

In groups, select a sport that is heavily reliant on biomechanics to provide an advantage. Analyse how four specific biomechanical principles are either evident or manipulated to provide an advantage in this sport. Present your understanding in a recorded audio narration over a video of selected actions and movements from this sport.

Examples of activities include:

- Shot put – compare angle of release, angle of projection and use of motion to maximise effort.
- Wrestling – start on knees and get the person on their back.
- Tennis ball/football strike with spin – compare the Magnus effect on a spinning ball.
- Vertical jump variations – compare the summation of force between different conditions and body actions.
- Sprint start – slow-motion comparison of the various effects of starting positions and movement on acceleration.
- Race for 100 m and compare the split speed sections to measure rates of acceleration and speed variations throughout (mobile apps can measure this).
- Investigate swimming flotation and the effect of different body positions on drag.

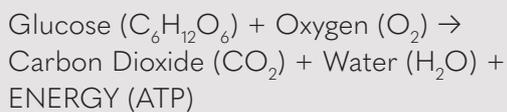
**Skills:** collaboration, analysis, problem-solving, communication, creative thinking

## 5.3 The respiratory and circulatory systems

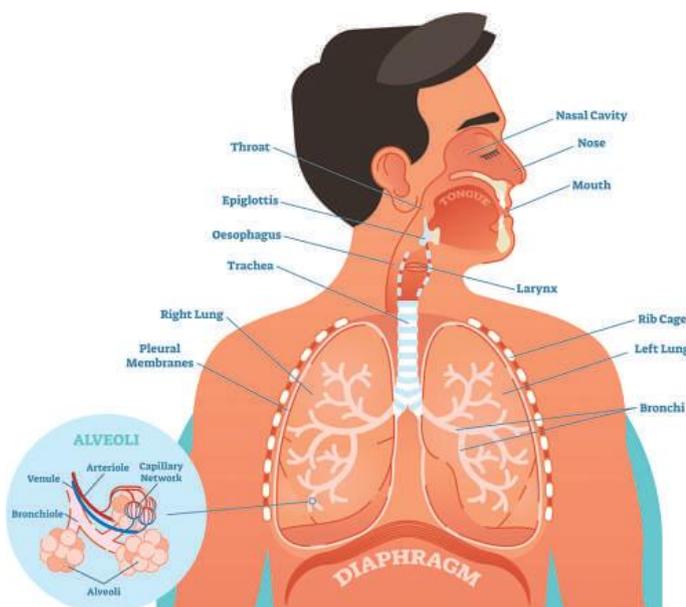
### Learning objective 5.3

EXPLAIN how the respiratory and circulatory system interrelate with one another and movement

The human body relies on aerobic respiration to sustain life. This is reflected in the simple formula:



The **respiratory system** and the **circulatory system** play an integral role in extracting and delivering oxygen from the air we breathe and moving it around the body (along with other nutrients), so that cells can metabolise glucose to produce energy using oxygen (aerobically). The waste products of carbon dioxide and water are then eliminated with the help of these two systems. They are often referred to as the cardiorespiratory system, which reflects their close relationship.



**Figure 5.46** Structure of the respiratory system

### Respiratory system

#### Structure and function

The primary role of the respiratory system is to allow humans to breathe (known as ventilation), by drawing in fresh oxygenated air through inspiration and then expelling waste products (carbon dioxide) through expiration. To achieve this, the diaphragm and other intercostal (rib) muscles draw down, increasing the volume of the space in the pulmonary cavity, creating a negative pressure gradient and drawing air into the lungs. These muscles then relax and the reverse process occurs, 'pushing' the air back out into the atmosphere.

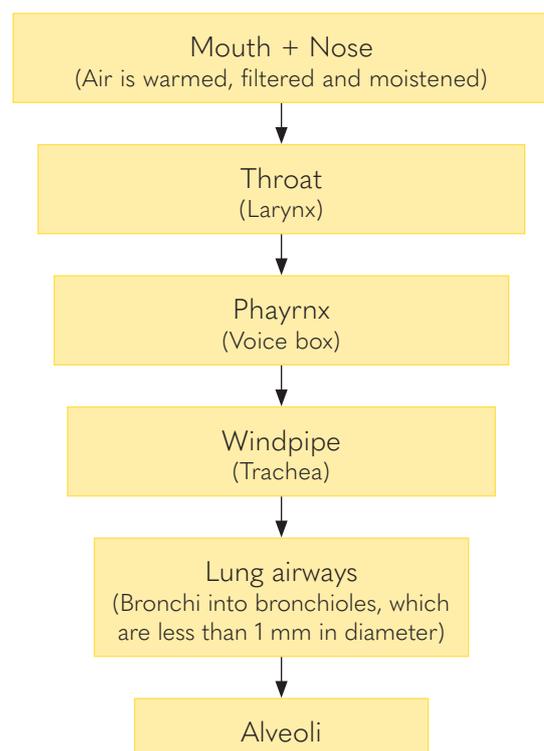
Air travels along a set of tubes that decrease in size. Some of these are shown in Figure 5.47.



**Video 5.5** Breathing

**respiratory system** organs and tissues that allow for the action of breathing, such as lungs, diaphragm, alveoli and the nasal cavity

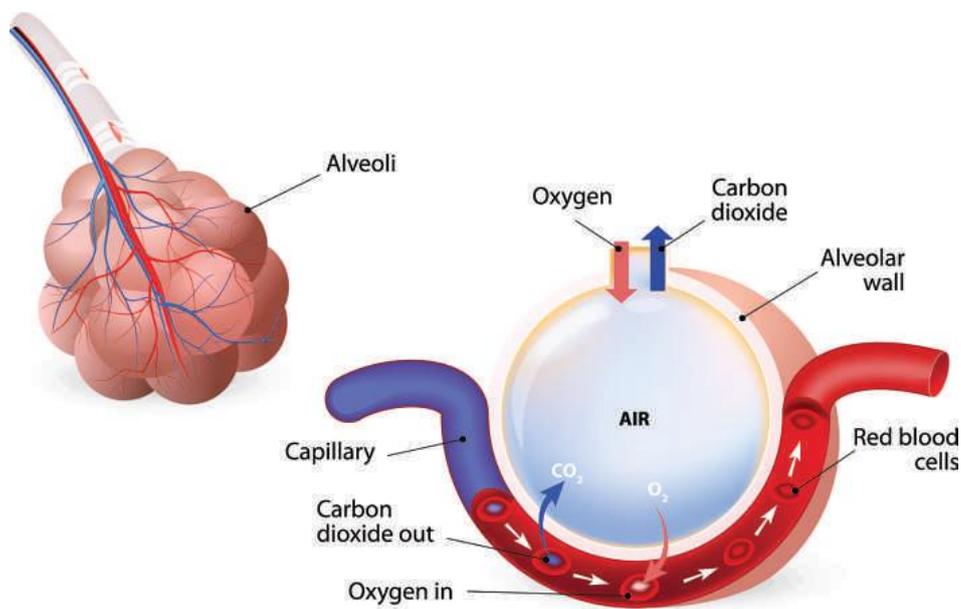
**circulatory system** organs and tissues that pump blood and its contents around the body, including the heart, arteries, veins and capillaries



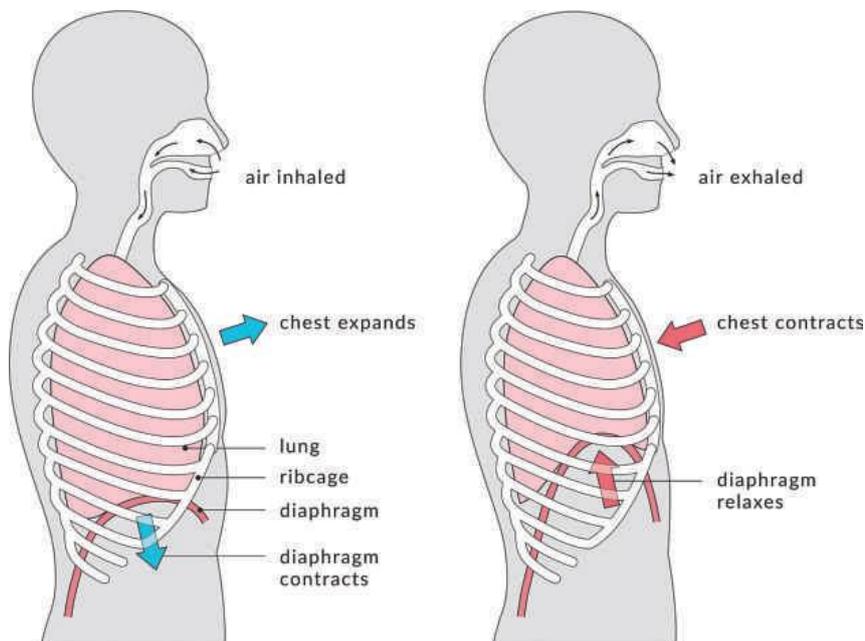
**Figure 5.47** Tubes in the respiratory system

While air is in the lungs, oxygen and carbon dioxide cross the moistened semipermeable membranes of the small sacs of air known as alveoli, as well as the capillaries that allow blood to move across this surface. In doing so, oxygen can enter the bloodstream, and carbon dioxide can exit. This process is known as respiration. The body has about 500 million alveoli, providing a surface area of around 100 square metres – approximately the size of a tennis court. The pressure gradient difference drives this diffusion across the membranes.

The right lung has three lobes, and the left lung has two lobes to accommodate a space for the heart in the cardiac notch. Because the lungs are highly exposed to the external environment, they are susceptible to infection and damage such as infections and diseases from bacteria, viruses and pollutants. The respiratory system can be strengthened through nasal breathing, as well as regular aerobic exercise where respiratory capacity is increased.



**Figure 5.48** Function of the alveoli and gaseous exchange



**Figure 5.49** The process of breathing and respiration

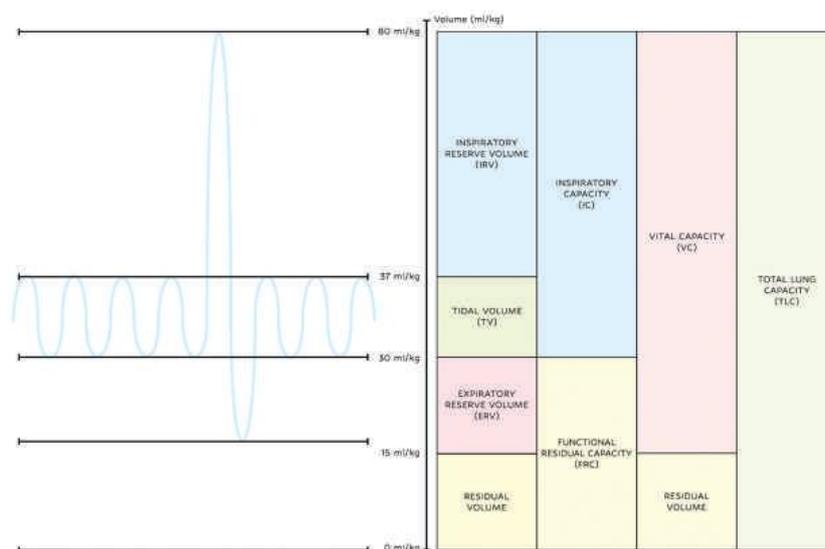
The volume and health of the lungs can be improved with exercise, but can also deteriorate with poor health, especially from lack of exercise and smoking. Various illnesses also affect lung volume such as asthma and chronic obstructive pulmonary disorder (COPD), which all decrease the ability to use the lungs to their full capacity. Figure 5.50 shows the various measurements of lung volumes from spirometry testing.

It is also interesting to note the relative percentages of gases between the atmosphere and the air that is expired from the alveoli. Note that only some of the oxygen is used (which is why a person can breathe into another person's mouth to

give oxygen via CPR), and there is a great increase in carbon dioxide, reflective of how much is produced inside the body from aerobic respiration.

**Table 5.2** Relative percentage of gases between the atmosphere and the air that is expired from the alveoli

Gas	% Atmospheric pressure	% Alveolar pressure
Nitrogen	78	75
Oxygen	21	14
Water	0.04	6
Carbon Dioxide	0.004	5



**Figure 5.50** Lung volume measurements

### How does the respiratory system influence and respond to movement?

As physical activity increases, both the rate and depth of ventilation increases to help deliver more oxygen to the working muscles, as well as to remove the increased carbon dioxide. At rest, adults typically breathe approximately 15 times per minute, which draws in about 12 L of air. This can increase up to between 45–60 breaths per minute, increasing the total volume of air towards 100 L of air.

Any exercise that increases ventilation rate and depth for sustained periods will lead to adaptations such as increased ventilation rate, development of ventilation muscles to breath deeper (diaphragm and intercostals), increased lung capacity and volume, increased number of alveoli and lung capillaries, and improved efficiency of gaseous exchange. Collectively, these all increase the potential oxygen uptake and aerobic capacity of the individual.

## Practical Application 5.3

### Effects of exercise on the respiratory system

Perform a range of activities of varying intensities and note the changes in the respiratory system as the intensity of exercise increases and afterwards during recovery.

**Skills:** collaboration, analysis, communication

## Circulatory system

### Structure and function

The primary role of the circulatory system is to pump blood around the body through various tubes known as **blood vessels**. Blood is a transport agent that carries and delivers essential nutrients and chemicals around the body systems, while also helping to remove wastes. The main components of the circulatory system:

- The **heart** receives and ejects or pumps blood out with every beat.
- **Blood vessels** are a series of connected tubes that could stretch around the world 2.5 times.
  - **Arteries** transport blood away from the heart.
  - **Veins** transport blood to the heart.
  - **Capillaries** connect these two together and are the site where diffusion of nutrients and wastes from organs occur. (If train tracks were arteries and veins, the capillaries would be like the train station, where the train stops, doors open and passengers get on and off.)
- **Blood** is fluid that contains various components and carries a range of compounds and molecules.

**haemoglobin** a protein within red blood cells that binds to and carries oxygen around the body

### Blood

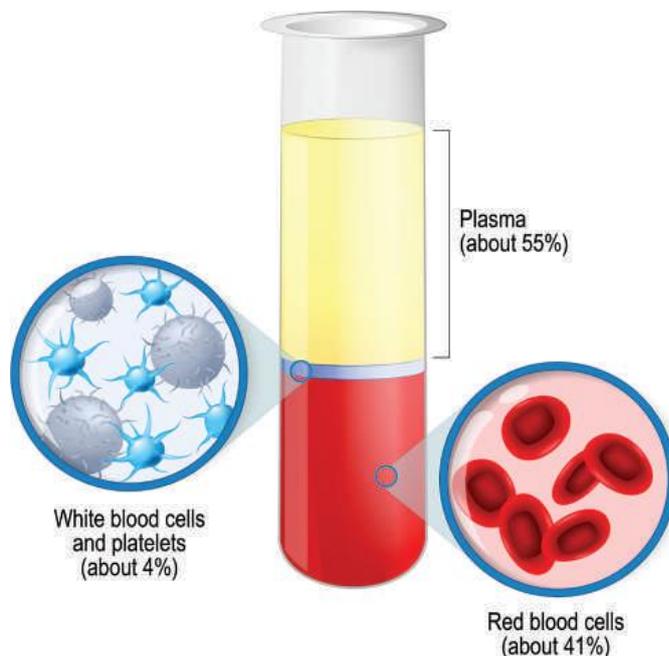
Blood is heavier, thicker and more viscous than water. It makes up approximately 8% of total body weight. The blood volume of an average sized male is 5–6 L and of an average-sized female is 4–5 L. Blood has three important functions in the body:

- **transportation** of vital nutrients such as oxygen, glucose and hormones around the body, while also transporting waste for removal such as carbon dioxide to the lungs, and water to the kidneys
- **regulation** of body temperature, body pH and fluid regulation. Blood can be redirected towards the surface of the skin to remove excess heat (vasodilation) or towards the core of the body away from the skin during cold or emergency situations (vasoconstriction)

- **protection** from external infections by helping to clot and seal broken skin, and transporting immune cells and antibodies to fight infectious invaders.

Blood is comprised of the following components:

- **Plasma:** a straw-coloured liquid of mostly water that makes up 55% of the volume of blood and provides the liquid transport medium to carry the formed elements. It contains and carries waste products, nutrients (glucose), vitamins, hormones and enzymes.
- **Formed elements:** these make up 45% of the volume of blood:
  - **Red blood cells (erythrocytes)** contain oxygen-carrying **haemoglobin** (formed from iron). Red blood cells (RBCs) are highly specialised for oxygen transport. They live approximately 120 days and two million enter circulation per second.
  - **White blood cells (leukocytes)** are immune cells responsible for fighting infections within the body. RBCs outnumber WBCs in a ratio of 700:1.
  - **Platelets** help repair damaged blood vessels and promote blood clotting.



**Figure 5.51** Components and structure of blood

## Heart

As an organ, the heart is relatively simple, performing the sole function of contracting and powerfully pumping blood out to all areas of the body. It is about the size of a closed fist and about two-thirds of it lies to the left of the body's midline within the thoracic cavity. The heart contains various chambers and valves, and it can pump around 7500 L of blood per day, beating around 100 000 times per day on average.

The heart has four chambers. The two superior (upper) chambers are called the left and right atrium, and the two inferior (lower) chambers are called the left and right ventricle. It receives its own supply of oxygen via the coronary artery, which is a small blood vessel that directly feeds oxygen-rich blood into the heart muscle itself. A heart attack occurs when these coronary arteries become blocked, starving the heart muscle of vital oxygen. The heart also has its own supply of electrical signals from the brain, controlling the rate and power of each heartbeat. The sympathetic nervous system increases the heart's activity, while the parasympathetic nervous system slows it down.

*NB: Remember that hearts are viewed from the first-person perspective, so when looking at a diagram from the front, the left-hand side of the heart will be labelled on the right-hand side as the reader looks at the image.*



Video 5.6 The heart in action

## Major blood vessels and valves

The heart has four key blood vessels connecting to it:

- The **aorta** is the largest and most powerful artery in the human body and can absorb the greatest pressure as oxygenated blood is powerfully ejected from the left ventricle and into smaller arteries and arterioles around the whole body.
- The **vena cava (superior and inferior)** is the final and main vein returning deoxygenated blood from the body delivering it into the right atrium.
- The **pulmonary artery** carries deoxygenated blood from the right ventricle to the lungs in order to deliver waste carbon dioxide and pick up oxygen.
- The **pulmonary vein** delivers the oxygenated blood from the lungs back to the left atrium ready to be delivered to the body.

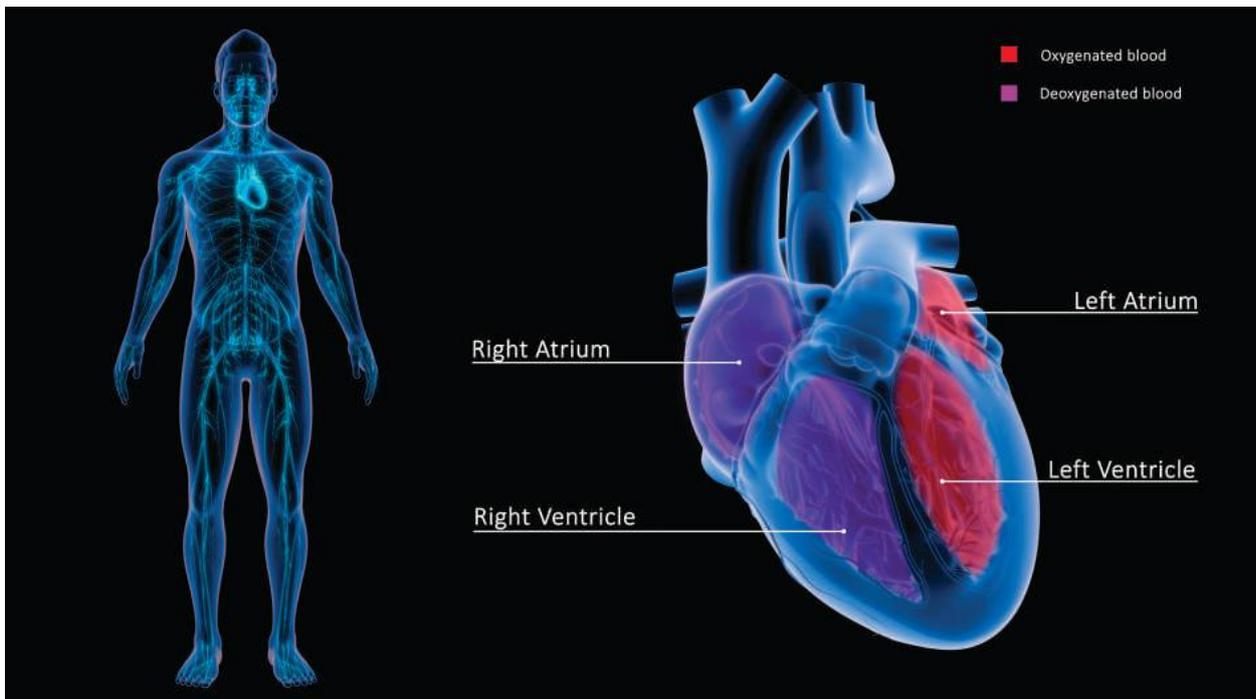
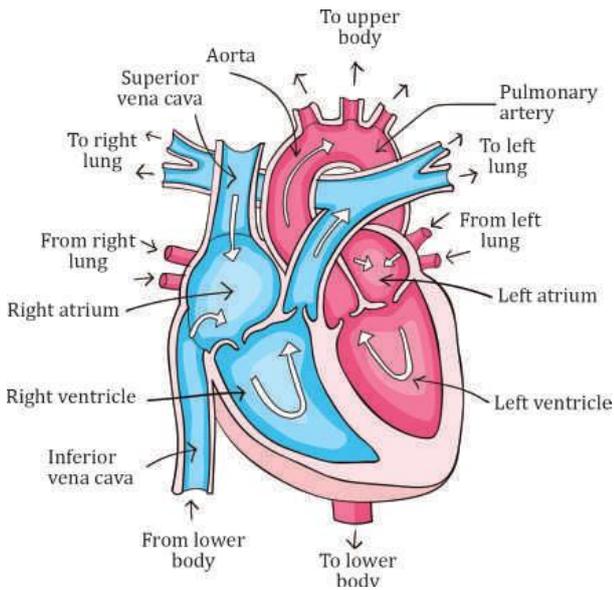


Figure 5.52 Heart chambers, position and rhythm



**Figure 5.53** Main blood vessels of the heart

The heart also has four valves at major junctions to ensure that blood cannot flow backwards. These can be heard opening and closing when listening to the heart on a stethoscope.

- The **tricuspid valve** is between the right atrium and right ventricle.
- The **mitral (bicuspid) valve** is between the left atrium and left ventricle.
- The **aortic valve** is between the left ventricle and the start of the aorta.
- The **pulmonary valve** is between the right ventricle and the start of the pulmonary artery.

### Other blood vessels

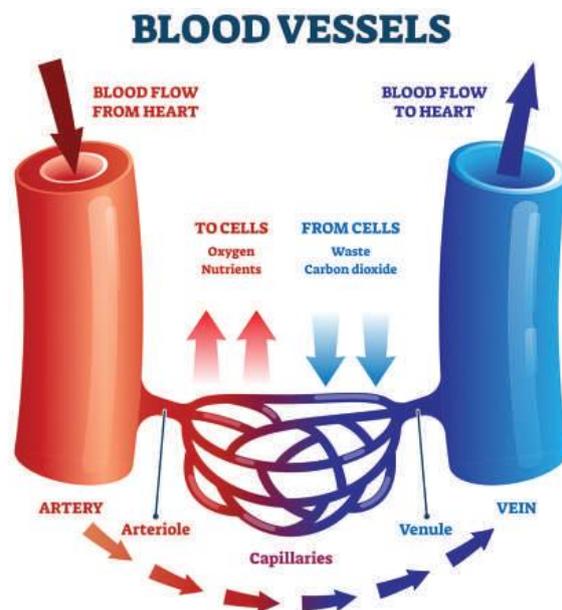
**Arteries:** all blood vessels carrying blood away from the heart are known as arteries. These are sealed tubes able to withstand high pressures from the blood being pushed through them from the heart. Large arteries have thick muscular walls as the blood travels approximately 30 cm in one second. They carry oxygenated blood to the body and deoxygenated blood to the lungs. The largest artery, the aorta, splits off into two directions almost immediately for blood to either go to the brain through the carotid artery or to the rest of the body through the thoracic aorta. From there, arteries continue to branch off into smaller tubes to major organs such as the liver, kidneys, brain and stomach, and to all working muscles. Eventually arteries will be less than one-tenth of a millimetre and are called arterioles, which connect into capillary beds where diffusion occurs. The blood is now moving 1000 times slower than

when in the aorta, giving ample time for various elements to transfer in and out.

**Capillaries:** these microscopic blood vessels surround various cells and have semipermeable membranes to allow for the diffusion of nutrients and waste. These are prominent in the alveoli in the lungs, as well as in muscle cells, where oxygen and carbon dioxide can be transferred.

**Veins:** blood from the capillaries then enter the venous return system to take the deoxygenated blood from the body and the oxygenated blood from the lungs back to the heart. Starting in the microscopic venules, they progressively enter larger veins that eventually connect to the vena cava, which enters the right atrium from the superior and inferior sides. Veins have minimal pressure in them so rely on some rhythmical movement from smooth muscle in the vein walls, internal valves to prevent back flow and movement from skeletal muscles to help ‘squeeze’ the blood back to the heart. At any point, up to 70% of the body’s blood can be in the veins.

*NB: There is a separate system that interacts with the capillaries. Lymph vessels collect some of the plasma from the blood and transport it through the lymph nodes in the form of lymph fluid. Here it is partially cleaned of infectious bodies and will return into the venous system before the vena cava.*



**Figure 5.54** Blood vessel network of the body

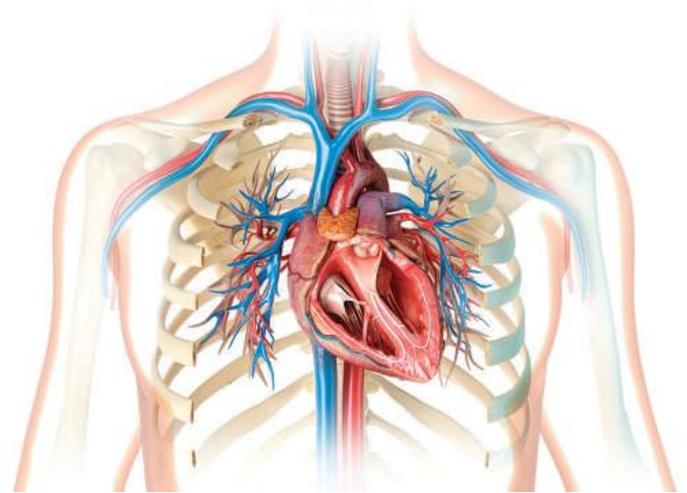
### Pulmonary and system circulation

The human body has two separate circulatory systems. The heart is described as a double pump, with two independent and separate circulatory systems. The right-hand side pumps deoxygenated blood to the lungs (only a short distance) whereas the left-hand side pumps oxygenated blood to the whole body and is therefore more muscular, with thicker walls. The left and right sides of the heart are separated from one another by the septum.

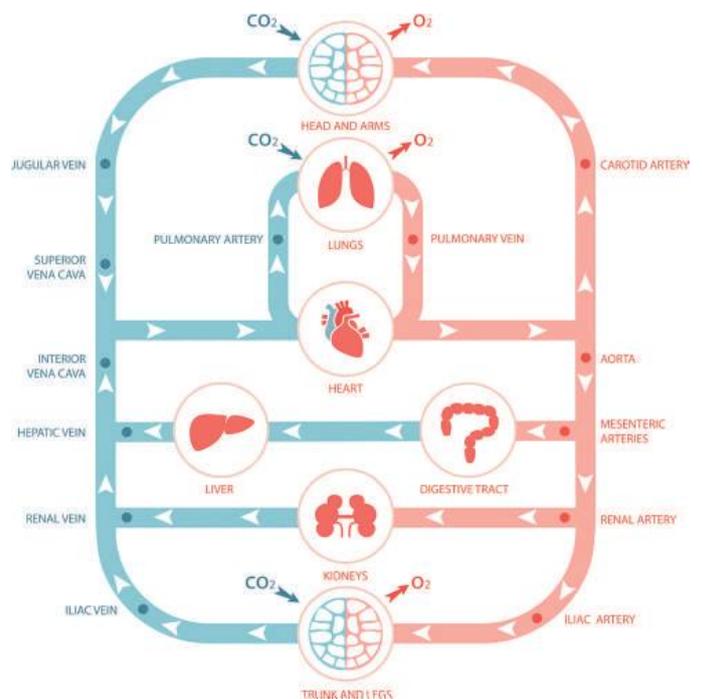
These two circulatory systems are as follows:

- The **systemic circulatory system** carries oxygenated blood and other nutrients to body tissues and removes carbon dioxide and wastes from the tissues (often represented as red in diagrams).
  - Starting in the left ventricle, oxygenated blood is pumped into the aorta and through the arterial system, delivering blood to all capillary beds in the body, except the air sacs within the lungs. The now deoxygenated blood then returns via the venous system and the superior and inferior vena cava into the right atrium.
- The **pulmonary circulatory system** carries deoxygenated blood to the lungs where carbon dioxide and oxygen are exchanged (often represented as blue in diagrams).
  - Starting in the right ventricle, deoxygenated blood is pumped into the pulmonary artery to the capillary beds around the alveoli of the lungs, where oxygen and carbon dioxide are exchanged. The oxygenated blood then returns via the pulmonary vein into the left atrium, ready to start a new cycle within the systemic circulatory system.

*NB: These circulatory systems follow a continuous loop. Therefore, it is helpful to always start at the same point when revising the path of oxygen around the human body.*



**Figure 5.55** Anatomical diagram of the circulatory systems (showing systemic and pulmonary blood vessels)



**Figure 5.56** Diagram of the circulatory systems of the body

### Activity 5.5

#### Structure of the cardiovascular system

Create a physical representation of the cardiovascular system using everyday items to demonstrate the components of the systemic and pulmonary circulations.

**Skills:** collaboration, analysis, communication, creative thinking

## Gaseous exchange

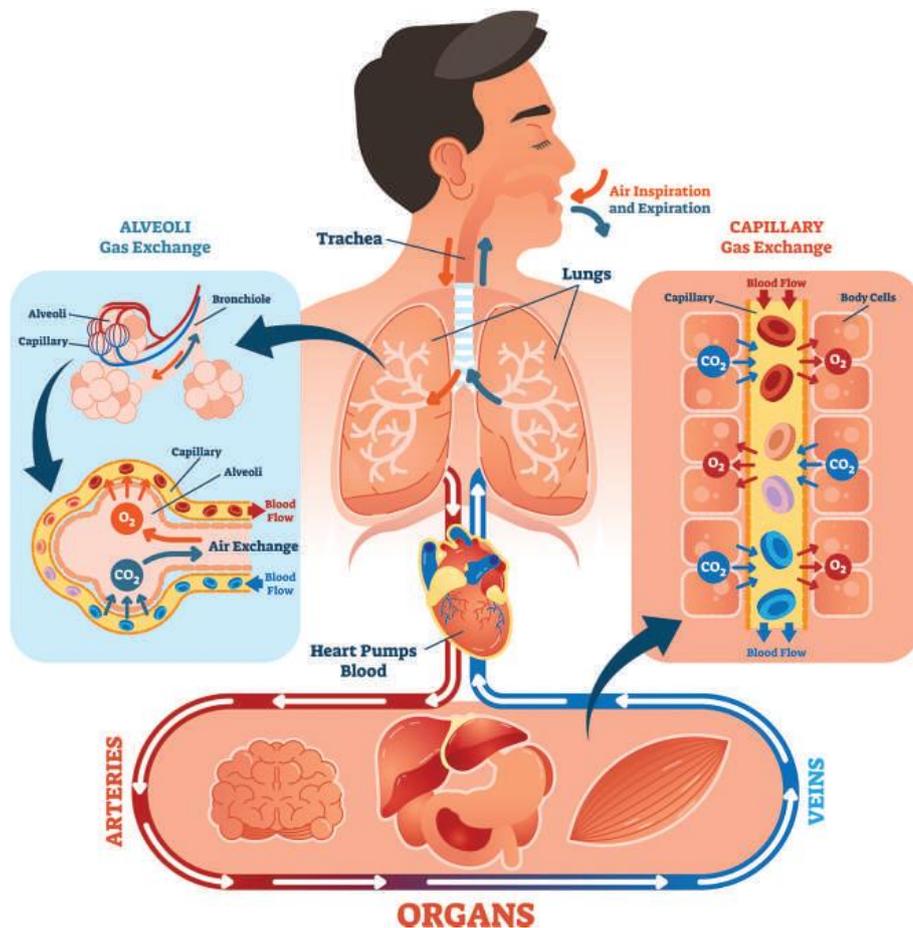
Humans require oxygen to create energy and therefore sustain life. The by-product of this aerobic respiration is carbon dioxide. There are key processes involved in exchanging these natural gases with the external environment, making them available within the internal environment. Interestingly, trees essentially perform the opposite function, whereby they take in carbon dioxide to produce energy, and give off oxygen as the by-product, creating a symbiotic relationship between trees and humans. Gaseous exchange in the body requires a:

- **large surface area** provided by the enormous web of capillaries in the alveoli and body tissues
- **moist environment** that allows for the gases to be dissolved into liquids for ease of movement and transport
- **pressure differential** as areas of higher concentration allow for the natural balancing of pressure gradient differentials, moving from high to low pressures

- **thin and semipermeable membranes**, which allow small elements to pass across, such as oxygen and carbon dioxide.

The process of exchanging gases in the body is known as respiration, and this occurs in two key areas.

- **External respiration in the lungs:** as we breathe through ventilation, oxygen-rich air fills the alveoli where gaseous exchange occurs, and oxygen moves across into the blood capillary to attach to haemoglobin. At the same time, carbon dioxide exits the blood capillary and moves into the alveoli to be breathed out as a gas.
- **Internal respiration in body tissue and cells:** as oxygenated blood moves around the body, it enters capillaries where gaseous exchange occurs, and the pressure differential passively results in oxygen moving out of the capillaries and into the cells of the body, and carbon dioxide moves in reverse out of the cells.



**Figure 5.57** Internal and external gaseous exchange and respiration

### How does the circulatory system influence and respond to movement?

As physical activity increases, the circulatory system and heart increase both the rate and force of the heart's pumping action to help deliver more blood and oxygen to the working muscles, as well as remove the increased carbon dioxide. At rest, healthy adults typically have an approximate heart rate of 70 beats per minute and eject approximately 75 mL of blood per beat (stroke volume), equating to a cardiac output of over 5 L being pumped around the body per minute. With moderate exercise this will increase to 150 beats per minute and 100 mL per beat, equating to 15 L of blood per minute of cardiac output (a threefold increase from rest to moderate activity).

Any exercise that increases circulatory system activity for sustained periods will lead to adaptations such as: increased muscular thickness of the heart, increased stroke volume to pump more blood per beat, lower resting and working heart rates, increased capillarisation in body tissues, increased blood volume and haemoglobin count, improved function of blood vessels and increased efficiency to exchange gases and metabolise energy aerobically using oxygen. Collectively, these all increase the potential oxygen uptake and aerobic capacity of the individual.



**Figure 5.58** Any exercise that increases circulatory system activity for sustained periods will lead to adaptations that collectively increase the potential oxygen uptake and aerobic capacity of the individual.

### Factors that impact the efficiency of the cardiovascular system

#### Vascular disease

Any disease of the heart and blood vessels will impair its ability to function efficiently. There are some non-modifiable risk factors that can increase the risk of these such as family history and increasing age. However, the cardiovascular system is highly influenced by behavioural factors that are modifiable, leading to lifestyle diseases such as coronary heart disease (heart attack), cerebrovascular disease (stroke) and peripheral vascular disease (affecting the arteries and veins of the limbs). Diets high in saturated fats and salts, and low levels of physical activity lead to the development of fatty deposits on the inside lining of arteries leading to blockages of blood flow (called atherosclerosis). Smoking, age and inactivity also decrease the elasticity and hardening of artery walls (called arteriosclerosis). Collectively, these vascular diseases all increase blood pressure and strain the cardiovascular system to efficiently pump blood around the body.



**Figure 5.59** Atherosclerosis and the build-up of fatty tissue in arteries



**Figure 5.60** Reading blood pressure

### Blood pressure

Blood pressure refers to the level of pressure exerted by blood on the wall of a blood vessel, particularly the large arteries that endure 10 times the pressure of that required by veins. It is generated by the contraction of the ventricles, forcefully pumping blood into the arteries, which stretch to accommodate this pressure. The average blood pressure for a healthy adult is 120/80 mm Hg. The first reading of 120 mm Hg is the systolic reading, which is the pressure when the left ventricle is contracting. The second reading of 80 mm Hg is the diastolic reading, measured when the left ventricle is relaxing. Blood pressure is determined by blood volume and cardiac output. A sphygmomanometer measures blood pressure. It uses an inflatable cuff and a stethoscope. You are considered to have high blood pressure if you measure 140/90 mm Hg or higher. Poor diets, physical inactivity, smoking, stress and genetic conditions can all increase the risk of high blood pressure.

### Altitude

High altitudes, generally considered to be over 2000 m above sea level, have decreasing levels of oxygen concentration in the air. This causes both the respiratory and circulatory systems to work harder to maintain and deliver the same volume of oxygen into the working muscles. Ventilation, heart rate and stroke volume all increase. An athlete who lives at sea level, but is then competing at a higher altitude (common for footballers in parts of South America), will have lower aerobic output and capacity and higher levels of fatigue when training at altitude. This can even make the person feel very sick, an ailment known as altitude sickness. Over a period of weeks or months, the body will respond and adapt through altitude training to cope with this better. This can provide an advantage when the athlete returns to sea level with a higher total oxygen uptake capacity (which will also return to normal over time).

### Haemoglobin levels

There are many reasons why haemoglobin (or iron) levels drop to below healthy levels (which for men is 130–180 g/L and women 120–160 g/L). Anaemia or low iron can be caused by poor intake of dietary iron, heavy menstrual bleeding and other diseases. These ultimately lower the oxygen carrying capacity with fewer red blood cells being available to carry and deliver oxygen to working muscles. This can lead to general fatigue and lethargy, as well as negative effects on athletic performance,

particularly aerobic activities. Haemoglobin levels can be increased through performance-enhancing drugs and methods. Artificial erythropoietin (EPO) can further stimulate the production of red blood cells and their haemoglobin count. Likewise, blood doping (injecting donor blood or your own stored blood) will lead to a short-term increase in RBC count. Both are illegal methods of improving performance according to the World Anti-Doping Agency.

### Revise and summarise 5.3

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Identify the function of the key components of the respiratory system.
- 2 Describe the process of breathing.
- 3 Explain the relationship between movement and the respiratory system.
- 4 Describe the process and requirements for internal and external gaseous exchange in the human body.
- 5 Identify the key structures of the human heart.
- 6 Identify the key components of blood.
- 7 Describe the difference between the three types of blood vessels in the human body.
- 8 Summarise the continual looping process of systemic and pulmonary circulation, starting with oxygenated blood in the left ventricle.
- 9 Explain the relationship between movement and the circulatory system.
- 10 Describe the diseases of the cardiovascular system and how they can impair function, referring to blood pressure, atherosclerosis and arteriosclerosis.
- 11 Explain the effect that altitude has on the cardiorespiratory system.
- 12 Describe the relationship between haemoglobin count and performance.



Quiz

### Think critically and apply 5.3

In groups, engage in performance labs to measure the effect of different intensities of exercise on the respiratory and circulatory systems. Record your data and present it in graphical form, showing these effects before during and after various exercises. Summarise your findings, explaining the reasons for the major changes observed.

**Skills:** collaboration, analysis



Collaborative investigation

## 5.4 The digestive and endocrine systems

### Learning objective 5.4

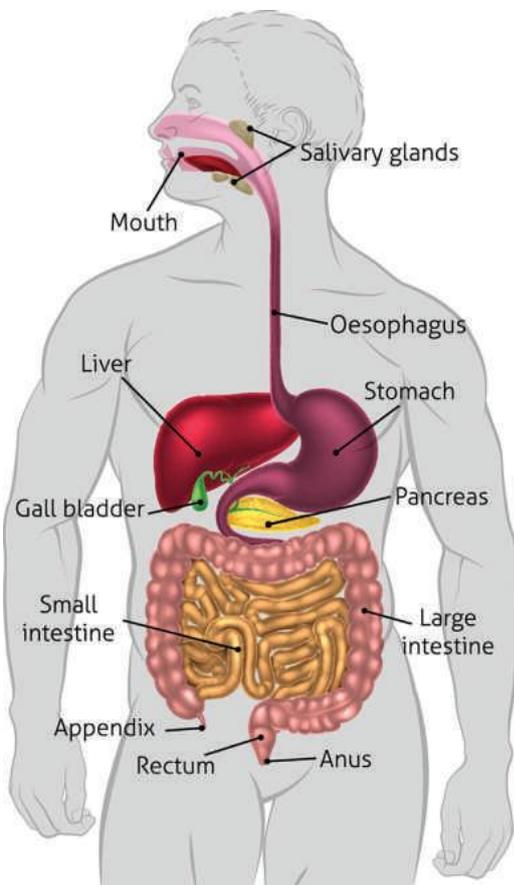
EXPLAIN how the digestive and endocrine system interrelate with one another and movement

### Digestive system

#### Structure and function

**digestive system** organs and tissues that help extract nutrients from the food and fluids consumed, as well as the removal of waste products; it includes organs such as the mouth, stomach and intestines

The **digestive system** has the singular function of transforming the raw materials we eat into useable nutrients and energy to sustain life. On average, an adult will consume between 1 kg and 2.5 kg of food per day. The digestive system consists of 10 different organs, 20 different types of specialised cells and extends over 9 m, making it one of the



**Figure 5.61** Major components of the digestive system

most complex body systems. Digestion is the breakdown of food into the smallest possible units to make absorption, storage and use possible. This involves both mechanical (chewing and stomach movements) and chemical processes (stomach acids and enzymes). The whole system is made up of four major components:

- 1 **Gastro-intestinal tract:** extending from the mouth to the anus, the tract has a surface area of over 30 m<sup>2</sup> through which nutrients are extracted and absorbed as they are transported and moved through various sections.
- 2 **Pancreas, liver and gall bladder:** these accessory digestive organs produce the various juices responsible for the chemical breakdown of food and absorption of various nutrients (e.g. bile, which helps to break down food).
- 3 **Hormones, enzymes, nerves and blood:** these elements all help with the breakdown of food, regulation of digestion, and the absorption and transport of nutrients to their final intended destination in the body (e.g. blood transports glucose to muscle cells to be used as energy).
- 4 **Mesentery:** until recently, the mesentery was only seen as a collection of separate pieces of connective tissue, but is now being considered an organ due to its structure as a singular continuous tissue with the important role of helping hold various parts of the intestines in place by attaching them to the abdominal wall, while also supplying lymph and blood to aid digestion in the gut.

#### Process of digestion

Digestion is a complex process, and most foods take around 35 hours to fully move through the whole gastrointestinal tract. Diet, diseases and other lifestyle factors can influence the efficiency and effectiveness of the digestive system. A summarised version of the major steps of digestion includes:

- 1 Before food is even eaten, the anticipation of food will stimulate the release of saliva to aid transport and enzymes to start to breakdown starches (complex carbohydrates) into more simple sugars (glucose).

- 2 In the **mouth**, mechanical digestion starts with chewing and saliva, which helps form a moist soft lump of food called a **bolus**, which is then swallowed and travels down the 20 cm **oesophagus** with the aid of **peristalsis** (rhythmic muscular movement to help push food down the tube).
- 3 In the **stomach**, the bolus is moved around by the muscles in the stomach into smaller chunks and stomach acids help the breakdown of food into a frothy substance called **chyme**.
- 4 In the **duodenum** of the **small intestine**, hormones and digestive enzymes from the **liver**, **pancreas** and **gall bladder** work on breaking down macronutrients into smaller particles. Fats are broken into free fatty acids, proteins into amino acids and carbohydrates into glucose.
- 5 Continuing along the very long **small intestine**, the chyme passes along many small projections of tissue called **villi**, which have an enormous surface area of semipermeable membranes surrounded by capillaries. This allows these macronutrients and other micronutrients to now be absorbed into the bloodstream to then be transported around the body to their intended target (e.g. glycogen to the liver for storage).
- 6 The left-over fibre, water and dead cells now enter the **large intestine** and colon to be excreted as waste. As the stool moves along, water is removed to produce faeces to be excreted through the rectum and the anus.

### How does the digestive system influence and respond to movement?

Obviously, nutrition is a key aspect of supplying the necessary energy-rich nutrients required for aerobic metabolism, muscular growth and other essential bodily functions that influence physical activity and movement. A well-balanced diet consisting of a variety of nutritious foods in the right quantities will supply the body with its daily requirements. Over-consumption may lead to negative health effects such as increased fat stores, and likewise under-consumption can also lead to health issues such as low iron levels and the development of anaemia. Most lifestyle diseases have some relationship with either the over- or under-consumption of some food type or nutrient.

Regular physical activity also requires an appropriate intake of complex carbohydrates to provide the glucose for aerobic respiration. Resistance training and strength-based exercises require protein for muscle repair and growth. This is very evident for people with very high training loads such as endurance triathletes or power lifters. Fat is also an essential element in various parts of the body, and some is required for good health. Other micronutrients such as vitamins, minerals and fibre also play important roles in various cellular functions. Collectively, a healthy digestive system that is nourished with healthy foods in the right quantities will be able to provide the energy and nutrients to sustain the movement needs of any individual.

## Activity 5.6

### Factors that influence the digestive system

Select one of the following health behaviours, and research the effects that it can have on the digestive system and the rest of the body, and how this can then affect the health or performance potential of the individual:

- eating a low fibre diet
- eating a meal high in salt
- consuming a large amount of sugar in one meal
- fasting for 24 hours
- not drinking any water for a day and becoming dehydrated.

Present your findings to the class.

**Skills:** collaboration, analysis, communication, research



Depth  
Study

## Endocrine system

### Structure and function

The endocrine system has the very broad and complex role of regulating many body processes,

**homeostasis** the stable equilibrium and balance between human body systems

**endocrine system** organs known as glands that produce hormones (or chemical markers), which are released into the blood to travel around the body to act as communication messengers as required

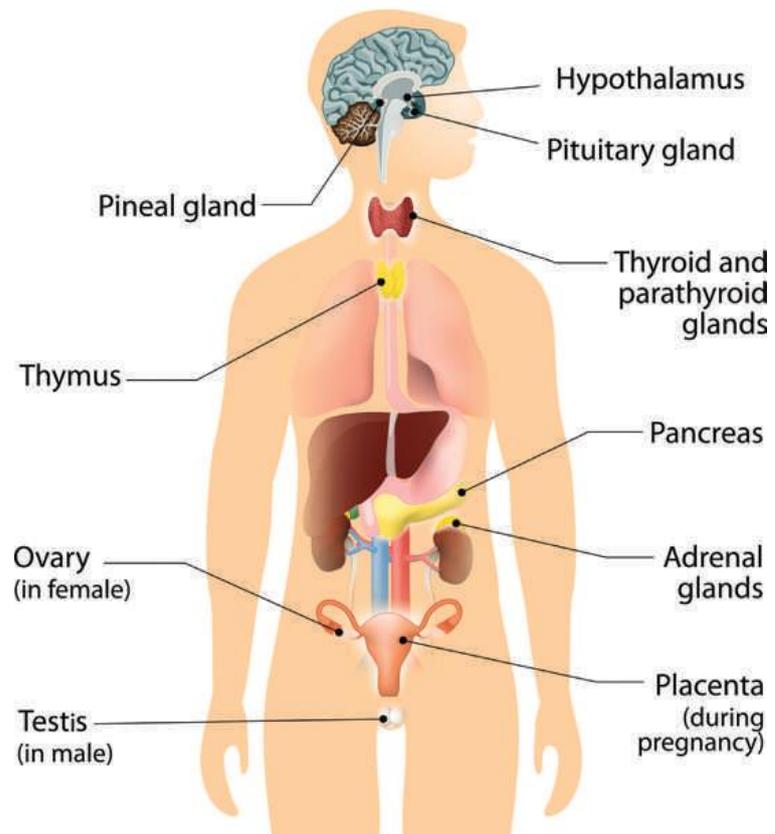
ensuring that **homeostasis** is maintained across all body systems. By secreting specific chemical messengers from glands to travel around the body to target specific cells, the body has a somewhat slow, yet broad and enduring communication system to influence almost every living cell and greatly influence things such as growth, sexual development, sleep, mood regulation and digestion. The signal for chemical messengers to be secreted may come from either other chemical messengers or from an electrical signal from the nervous system.

There are three parts of the endocrine system.

- **Endocrine glands:** these produce and secrete specific hormones. There are three in the brain and seven in the rest of the body. They are surrounded by capillaries to allow for fast diffusion into the bloodstream. (NB: Exocrine glands do not produce hormones but secrete other substances such as sweat and saliva. Lymph nodes are also glands, but these do not secrete anything and are part of the immune/lymphatic system.)
- **Hormones:** these are specialised and complex chemical messengers that travel to find target cells. There are currently over 50 known hormones active in the human body. Well-known hormones include adrenaline, insulin, testosterone, oestrogen, cortisol and human growth hormone.
- **Receptors:** on the external walls of target cells, protein receptors help hormones to locate their target, and then latch on, causing a specific change in the processes of that cell, resulting in either an increase or decrease in activity.

Here is a list of some of the major glands, and some of the bodily functions they regulate:

- The **hypothalamus** is known as the master regulator of other glands, which receive their own chemical communication to stimulate function. Many of the hormones secreted by the hypothalamus are messengers directing other glands to then secrete their own hormones. For example, growth-hormone-releasing hormone is sent to the pituitary gland to produce human-growth hormone.
- The **thyroid** produces hormones that regulate aspects of metabolism, digestion, brain development and bone health.
- **Adrenal glands** produce hormones that regulate aspects of stress responses (flight and flight), testosterone and sexual development, lactation, growth and blood pressure.
- **Gonads (testes and ovaries)** produce hormones that regulate ovulation (females) and sperm production (males), sexual development and puberty.
- The **pancreas** produces hormones that regulate blood glucose levels (insulin to decrease and glucagon to increase).



**Figure 5.62** Endocrine glands in the body

### How does the endocrine system influence and respond to movement?

The pillars of good health – a balanced diet, regular physical activity, strong social connections and routine sleep habits – all positively influence the endocrine and hormonal activity within the body, which in turn will work to maintain good health in all body systems. Exercise particularly increases the overall activity of the endocrine system and level of hormones in the body, as well as the number of receptor cells. The positive effect of regular movement and physical activity has a particularly unique influence on the endocrine system.

Because intense exercise is a stressor and causes a great disturbance to the body's homeostasis, the influence and functioning of the endocrine system is amplified and inadvertently strengthened as it actively works to reset homeostasis. In a sense, this follows the principle of 'use it or lose it'.

Examples of the effects of movement on the endocrine system include the following:

- Aerobic exercise improves insulin sensitivity in the body, helping to decrease the risk of type 2 diabetes.
- Strength training stimulates human growth hormone to strengthen bones, muscles and other tissues.
- High-intensity exercise and strength training increases the amount of testosterone in the body, which has a range of positive health outcomes such as increased metabolism and improved mental health.

The endocrine system also actively supports the body during physical activity, and movement stimulates the release of specific hormones that have important effects. Adrenaline redirects blood flow by constricting some blood vessels and increases blood pressure and heart activity to increase oxygen supply. It also stimulates stored fat cells (triglycerides) to be metabolised and broken down into free fatty acids, which can be more easily used as a fuel source. Glucagon is a hormone released during exercise that triggers the breakdown of stored muscle and liver glycogen into useable glucose for aerobic respiration.

### Factors that impact the efficiency of the digestive and endocrine systems

#### Macronutrients and micronutrients to support healthy functioning

The body requires a sufficient and healthy intake of all key nutrients. In some cases, exceeding the recommended dietary intake can also have negative effects (such as excessive intake of fats leading to weight gain).

Macronutrients are chemical substances that provide energy to the body; they include carbohydrates, fats and proteins. There are many different forms of these energy-rich foods, and it is important that they are healthily sourced and eaten in the correct proportions. They are called macronutrients as they form a large proportion of the nutrients we consume. Water and fibre are also considered to be macronutrients for this reason.

Micronutrients, also known as vitamins, are essential to healthy functioning but are only needed in much smaller quantities. As well as energy production, they assist with a range of specific cellular processes, including blood clotting, growth, immune function and fluid balance. Vitamins are organic substances from plants and animals. They may be either water soluble or fat soluble. Minerals are inorganic compounds found in nature that our body relies on consuming through food. Macro minerals (needed in greater proportions) include calcium, phosphorus, magnesium, sodium, potassium, chloride and sulphur. Micro or trace minerals (needed in smaller proportions) include iron, copper, iodine, zinc and fluoride.

Under- and over-consumption of any nutrient can lead to poor health and performance outcomes. Dieticians are professionals who help advise people on dietary changes and possible supplementation that may be required to achieve optimal health and performance outcomes.

## Stress

Stress can be caused by many psychological and social factors that humans encounter daily. Financial strain, exam anxiety and relational conflict are all common sources of distress, which can have negative effects on body systems. These will increase cortisol levels, which if elevated for extended periods of time have been shown to lead to increased risk of diabetes, heart disease, increased abdominal fat, decreased musculature and lower sex drive. Similarly, elevated adrenaline levels from stress increase cardiovascular activity,

leading to high blood pressure and heart disease. Stress can also affect the digestion system as worry and tension redirect blood away from the gut to prepare for the flight or fight response that comes with increased adrenaline. Interestingly, exercise initially stimulates the release of adrenaline and cortisol through the stress of activity; however, this heightened state actually facilitates a clearing and lowering of adrenaline and cortisol back to normal levels, as opposed to the artificially elevated levels from stressful life events, which do not decrease as efficiently.



**Figure 5.63** Vigorous exercise that is challenging and fun has a positive effect on many body systems.



Quiz

### Revise and summarise 5.4

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Describe the order and function of the major organs of the digestive system.
- 2 Provide examples of mechanical and chemical digestion.
- 3 Describe the relationship between the digestive system and movement.
- 4 Explain factors that influence the efficiency of the digestive system.
- 5 Identify the major components of the endocrine system.
- 6 Describe the function of five hormones in the human body.
- 7 Describe the relationship between the endocrine system and movement.
- 8 Explain factors that influence the efficiency of the endocrine system.

### Think critically and apply 5.4

Select one of the following health behaviours and research the effects that it can have on the endocrine system. Investigate how this can then affect the health or performance potential of the individual:

- poor sleep hygiene and habits
- strength and resistance training
- Buteyko breathing (regular nasal and deep breathing)
- cardio endurance training
- stressful living and relationship conflict
- regular poor diet of low nutritional value.

**Skills:** analysis, communication, research

## 5.5 The nervous system

### Learning objective 5.5

EXPLAIN how the nervous system relates to movement

### Structure and function

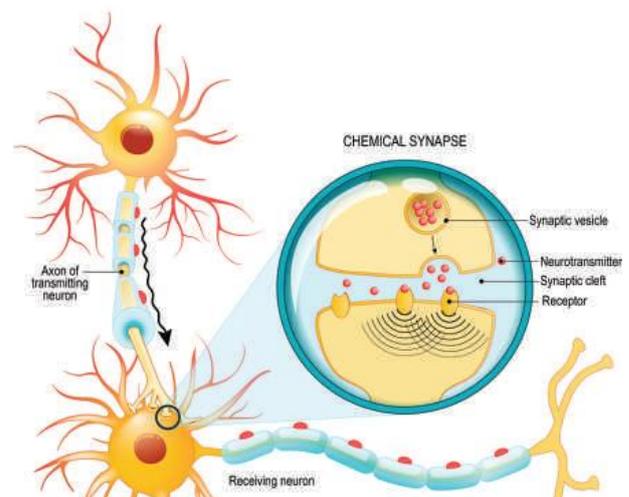
The **nervous system** may be considered the most important of all body systems, due to its direct influence and control over all other systems. All bodily activities are coordinated by the nervous system, as it detects and integrates all sensory information being received, and then makes decisions, responds and adapts to these changes that are occurring inside and outside the body. Another key aspect that sets humans apart from other animals is our ability to have conscious, intelligent thoughts – the ability to know oneself. The human brain, spinal cord and the nerves that connect with it are essential for life.

The nervous system is primarily made up of different types of nerve cells called neurons, which form communication pathways between all parts of the body and are able to send electrical signals at a speed of up to 120 m/s. A neural pathway from the brain to the target tissue (e.g. muscle) will have several junctions along the way. In order to transmit the electrical signal from one neuron to the next, electricity starts in the dendrite and then travels down the axon (protected by a myelin sheath), where neurotransmitters (chemicals) are stimulated to exit

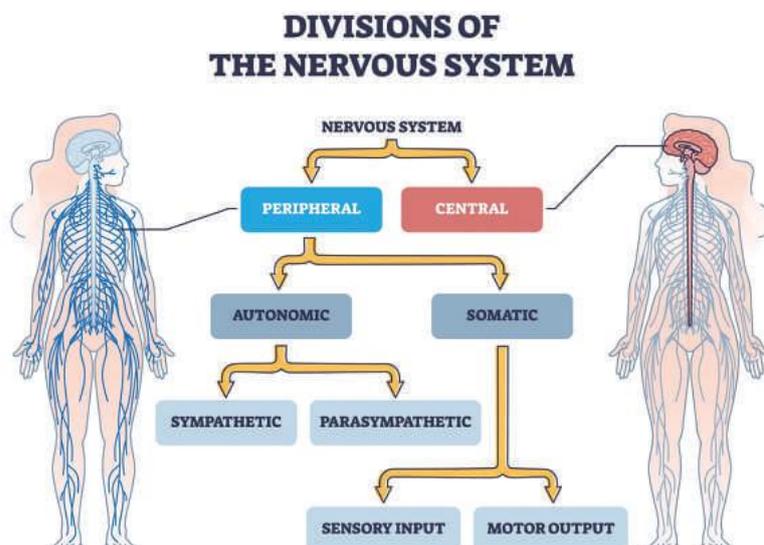
the axon terminal, across the synapse and connect with receptors on the next neuron to produce a new electrical signal.

There are two main parts of the nervous system; the central nervous system (CNS), which includes the brain and spinal cord; and the peripheral nervous system (PNS), which includes all nerves outside of the CNS that extend to all organs and tissues.

**nervous system**  
organs and tissues that help to coordinate sensory information, cognitive processes and various responses around the body such as movement; it includes the brain, spinal cord and nerve cells



**Figure 5.64** An image of a neuron-to-neuron pathway, highlighting the neurotransmitters that move across the synapse to continue the flow of electricity along the nerve



**Figure 5.65** Summary overview of the nervous system

## Central nervous system

The CNS is made up of the brain and the spinal cord.

### Brain

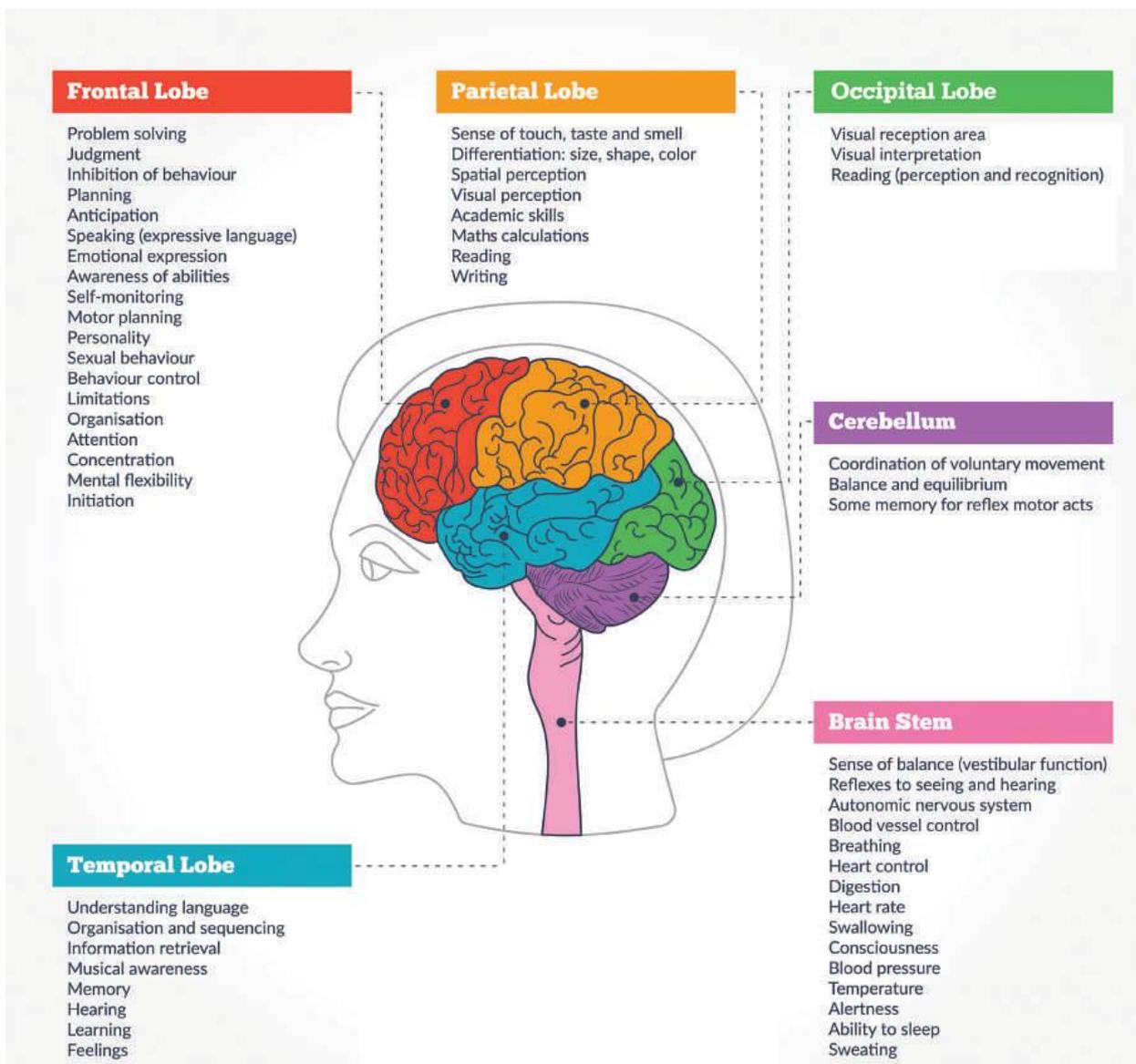
The brain is the main control centre for the whole nervous system and is a remarkable organ. It is the size of two fists, contains about 100 billion neurons and is 75% water. It weighs only 2% of the body's weight yet uses 20% of its energy and oxygen intake. Sixty per cent of the non-water parts are made of fat (cholesterol) and every minute about 1 L of blood flows through the brain.

The structure of the brain is complex. Being surrounded by a few layers of protective tissue including the skull and cerebrospinal fluid, the

brain is encased by a layer of grey matter that contains the body of nerve cells, and the inner white matter is made up of the long axon bodies that conduct the electrical signal.

The six parts of the brain are as follows (see Figure 5.66 for examples of function of each part):

- The **cerebrum** is the outer layer of the brain and is broken into two hemispheres. It has four lobes, each with their own function. This is the part of the brain that is often described as being neuroplastic, as it can change and adapt through life experiences and thoughts.
- The **cerebellum** is a smaller but very dense part of the brain responsible for movement, posture, motor learning and balance.

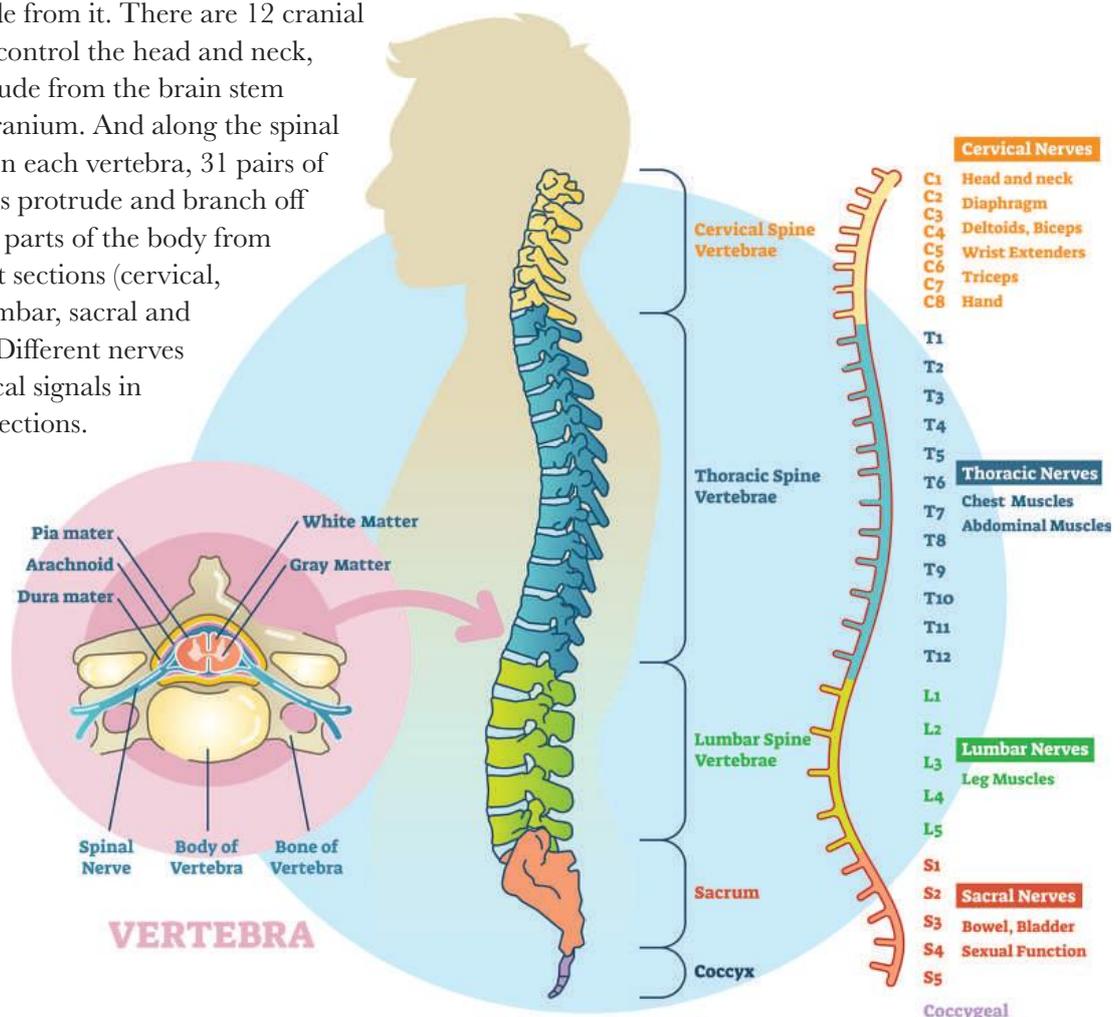


**Figure 5.66** Human brain anatomy and functions of various parts

- The **diencephalon** is a small section of the brain that is central and hidden under the cerebrum. Primarily it is the link between the nervous and endocrine systems. It contains glands such as the hypothalamus and pituitary gland, which release hormones as part of the endocrine system. Being so close to the brain allows nerves to signal when these hormones should be released into the bloodstream.
- The **brain stem** has three sections (**mid-brain, pons** and **medulla oblongata**) are positioned at the top of the spinal cord. They control and regulate involuntary body processes.

### Spinal cord

This thick piece of neural tissue has many branches that provide a connection point between the nerves of the body and the brain. It is protected by the vertebral bones and is divided into various sections, depending on the nerves that protrude from it. There are 12 cranial nerves that control the head and neck, which protrude from the brain stem inside the cranium. And along the spinal cord between each vertebra, 31 pairs of spinal nerves protrude and branch off into various parts of the body from five different sections (cervical, thoracic, lumbar, sacral and coccygeal). Different nerves send electrical signals in different directions.

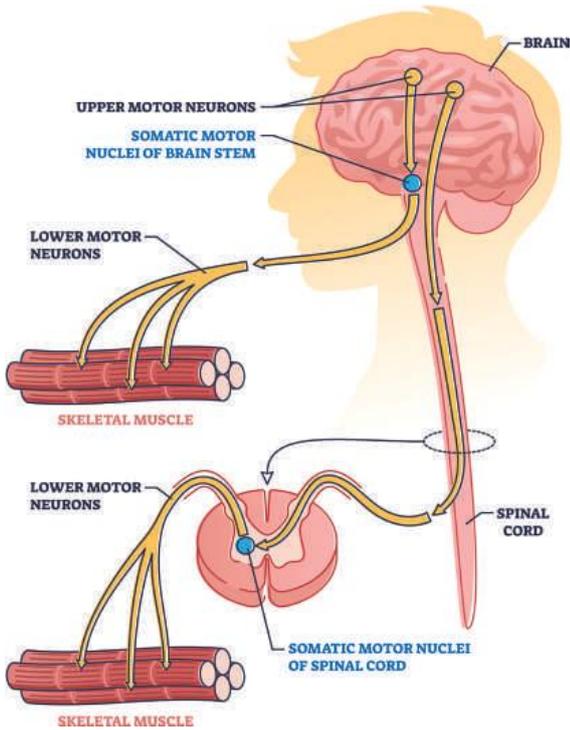


**Figure 5.67** Vertebral column and spinal nerves that branch from the spinal cord

### Peripheral nervous system

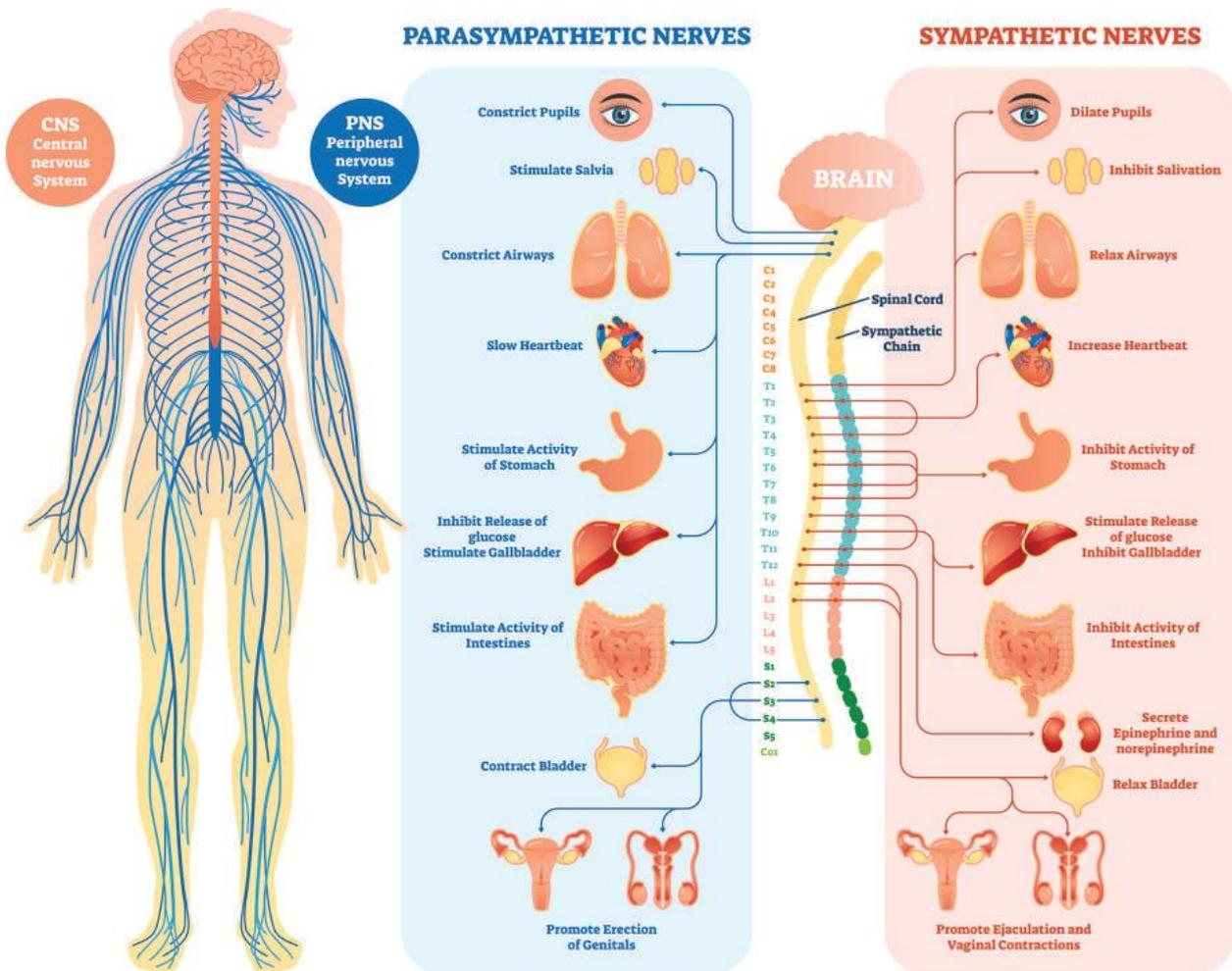
The peripheral nervous system (PNS) has two parts:

- 1 **Somatic nervous system (SNS):** nervous system: the SNS controls all of the conscious and voluntary actions of the body, particularly those that involve movement. There are both sensory nerves (afferent nerves) and motor (action) nerves (efferent nerves). The sensory afferent nerves detect and gather external information and stimulus from the outside world using all the senses of the body. These are then processed in the CNS and a response follows if required using the motor efferent nerves. For example, touching a hot plate sends a signal of danger to the brain to process, and the signal is sent for the muscle to contract and pull the arm away (often before the person is even aware, which is called a reflexive action).



**Figure 5.68** The somatic nervous system controls all voluntary movement of the human body.

2 **Autonomic nervous system (ANS):** nervous system: the ANS controls and regulates the involuntary actions of the body required to sustain life, such as respiration, ventilation, blood pressure, body temperature, heart rate and digestion. There are two parts to the ANS: the sympathetic nerves that increase body activation such as the fight or flight response, and the parasympathetic nerves that return body systems back to their normal resting state where required. For example, the sympathetic nerves of the heart increase heart rate, whereas the parasympathetic nerves of the heart reduce heart rate.



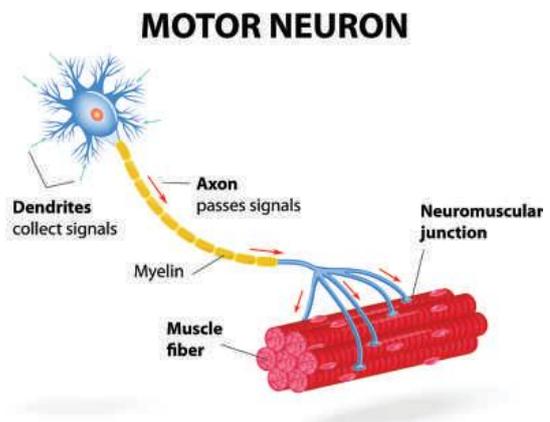
**Figure 5.69** The autonomic nervous system controls all involuntary actions of the human body.

## How does the nervous system influence and respond to movement?

All movements are under the direct control of the nervous system. Power and speed athletes (e.g. long jumpers, sprinters and weightlifters) aim to maximise the speed and power of muscular contractions by developing the neural activation and motor pattern of specific movements.

The nervous system also has a close relationship with the fatigue associated with long duration endurance or high intensity power exercises. The peripheral nervous system fatigues locally within the working muscle, where changes in blood pH (from working anaerobically during sustained powerful contractions) impair the neuromuscular junction. This, in turn, reduces its ability to effectively communicate with the muscle. This is often felt as a burning sensation within the muscle and is associated with muscle cramps. Similarly, these exercises can also fatigue the central nervous system, which in turn will impair ongoing

performance. Active and effective recovery is required to reset the nervous system. Peripheral fatigue requires 1–2 hours to recover, whereas central fatigue can take 1–2 days to fully reset and recover. Sleep, massage, cold water and contrast water therapy, light exercise and stretching are all effective strategies to support recovery of the nervous system following intense physical activity.



**Figure 5.70** A motor neuron is a type of nerve cell that innervates or signals for muscle contraction. The neuromuscular junction is a common site of peripheral fatigue.

### Practical application 5.4

#### Nervous system and neuromuscular pathways

Engage in activities that engage the nervous system and challenge the neuromuscular pathways. Reflect on experiences such as:

- the challenge of replicating precise coordinated movements (juggling, darts, frisbee throw etc)
- reaction time challenges (rats and rabbits, hand slaps, ruler drop, sprint starts etc)
- the effect of high levels of fatigue on muscle contraction potential (Sally up/Sally down squat test, maximal hand pumping until failure etc)
- training the neuromuscular junction using explosive movements (box jumps, 20 m sprints, plyometric bounding etc).

**Skills:** collaboration, analysis, communication, creative thinking, problem-solving, research

### Revise and summarise 5.5

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Describe the order and function of the major organs of the central nervous system.
- 2 Describe the order and function of the major organs of the peripheral nervous system.
- 3 Describe the difference between the somatic and autonomic nervous systems.
- 4 Describe the difference between the sensory and motor pathways of the somatic nervous system.
- 5 Describe the relationship between the nervous system and movement.
- 6 Explain factors that influence the efficiency of the nervous system.



Quiz

### Think critically and apply 5.5

Create and draw a diagram labelling the major components and pathways of the nervous system.

**Skills:** collaboration, communication, creative thinking

## 5.6 The interrelationship of body systems during movement

### Learning objective 5.6

DEMONSTRATE and ANALYSE how body systems work together during movement

Human movement is a complex phenomenon, able to be used for a vast array of purposes and outcomes, including general living, occupational, recreational and performance-based pursuits. Human movement can also be expressed in many different forms and qualities, from long bouts of endurance and powerful bursts of speed and power to great feats of strength, balance, coordination and contortion to achieve a set goal. All body systems have some relationship with movement, particularly the skeletal, muscular, cardiovascular, respiratory, digestive, endocrine

and neural body systems. And as previously mentioned, it is often the *interaction* between these body systems that facilitates and allows these various forms of movement to occur.

Consider the role of the contraction of the muscles during a marathon (muscular system), which receive messages to do so via the brain (neural system), which then pull on the leg bones to produce movement (skeletal system). These muscles use oxygen (respiratory system), which is delivered via blood from the heart (cardiovascular system), as well as glucose as a fuel for movement (digestive system). This movement will also stimulate the release of endorphins, which have positive effects on the brain and body (endocrine system).



Quiz

### Revise and summarise 5.6

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 For each of the systems of the body covered in this chapter, identify its primary function/purpose, and its component parts/organs:
  - a skeletal
  - b muscular
  - c cardiovascular
  - d respiratory
  - e digestive
  - f endocrine
  - g nervous.



Collaborative investigation

### Think critically and apply 5.6

In small groups, select one of the following movement contexts (or any other of personal interest):

- Gymnastics floor routine
- ultra-endurance triathlon
- 100 m sprint
- weightlifting
- boxing
- 1500 m swimming race
- netball (centre position).

Research and comprehensively analyse the contribution and interaction between the seven body systems to help produce this movement, as well as the physiological adaptations that occur in these body systems when this movement is regularly performed. Present a summary of your findings to the class.

**Skills:** collaboration, analysis, communication, research

## 5.7 First Aid

### Learning objective 5.7

DISCUSS the role of first aid in response to movement

While physical activity, movement and exercise all have positive benefits to the health and wellbeing of participants and athletes, there are also inherent risks involved that can compromise physical health. Risk levels vary from sport to sport and can range from mild inconveniences through to life-threatening scenarios. First aid plays a role in helping to minimise the risk of injury and accidents, as well as providing the appropriate follow-up to promote effective medical care and recovery.

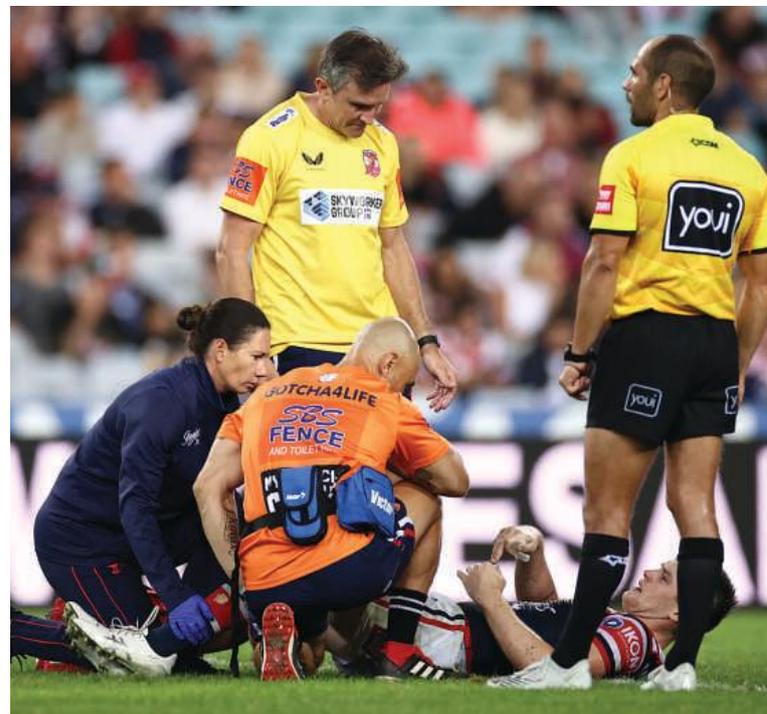
### Situations in which first aid may be required

A range of movement and performance scenarios reveal situations in which first aid may be required.

### Inefficient movement

Biomechanical inefficiencies in movement and individual anatomical anomalies can increase an individual performer's risk of being injured. These may lead to chronic overuse injuries that require first aid treatment. A cricket bowler with tight hamstrings and a weak core who bowls fast with poor technique may require treatment for lower back pain; and people who are new to running can suffer from lower leg issues such as shin splints due to poor running technique and lack of conditioning.

Poor movement technique can increase the risk of injury. Rugby players inexperienced in tackling have an increased risk of serious head and neck injuries.



**Figure 5.71** First aid assessment and treatment to injured players.

## Dehydration

Due to the nature of physical activity and sport, there is a natural consequence of elevated body temperatures and loss of fluids through sweating. Therefore, dehydration can lead to a range of possible first aid scenarios, such as extreme dehydration, heat stroke and illness, as well as the increased risk of injury from dehydration.

## Undue stress on the body

High-level performers face an increased intensity of competition that can increase the risk and severity of injury. AFL players who run faster, jump higher and hit harder can suffer more serious injuries from powerful and contested marks than in lower levels of competition, where which they don't jump as high. Certain sports require equipment that can pose a unique risk

during performance. Cricket balls can cause great damage to the face compared to a volleyball, and falling from a bike going at over 50 km/h does a lot more damage than tripping while running.

Athletes with certain medical conditions may have issues as a result of activity and movement. Asthma, epilepsy, diabetes and heart conditions can all be made worse through certain climatic conditions and activities if proper precautions are not taken. First aid can help relieve symptoms until medical help arrives.

Even without other factors, sports performance environments can be unpredictable and can vary from day to day. For example, rain on a football pitch may increase the likelihood of sliding into another player and causing a leg injury.

## Activity 5.7

### Movement situations requiring first aid

Consider a situation in which first aid was required in response to movement; this could be drawn from your personal experience (e.g. a sports injury that you or a team member suffered) or an incident that has been reported in the media.

- 1 Describe the situation.
- 2 From what you have learnt in this chapter about body systems, biomechanics and movement, identify the body system/s involved.
- 3 Propose what may have been the cause/s – e.g. inefficient movement, dehydration, undue stress, or other causes.
- 4 Suggest strategies that might have been taken to prevent the need for first aid.

**Skills:** analysis, problem-solving, research

## Policies and guidelines

Sporting clubs and organisations are legally required to have a range of safe participation policies and guidelines to ensure the safety of participants, officials and spectators. In today's highly litigious society, it is imperative that risk management procedures are considered ahead of time, and mitigating steps are taken to lessen the risk of identified hazards and injuries. Failure to do so can leave clubs, organisations and individuals exposed to legal penalties if something happens that is deemed to have been preventable.

NSW Rugby League, for example, provides local clubs with guidance policies covering first aid issues such as hydration, playing ages

and exemptions, playing field safety, first aid provisions, blood bin and infection control, head injuries and concussion, as well as modified safety rules for varying ages.

First aid plays a highly significant role in helping to identify and minimise the risk, exposure and severity of potential first aid scenarios, as well as providing the appropriate care and follow-up if a scenario develops.

Most recognised sporting clubs and organisations are required to have adequate first aid facilities and products, and to have a person trained in first aid on hand. There should also be access to professional medical care if required, such as calling an ambulance.

## Activity 5.8

### Sports policies and procedures

Use the Australian Sports Directory to find the website of the national governing body of a major sport in Australia and research the breadth of policies that they have produced for local clubs to use.

**Skills:** analysis, research

### Individual responsibility

On an individual level, people are also responsible for their own health and wellbeing during movement and competitive performance. All sports and activities have their own unique risks, and simple steps should be followed to minimise the risk and severity of injuries if they occur.

People should consider:

- adequate physical preparation for the activity (e.g. skill and technique development, physical fitness for the activity, warming up and warming down)
- following the rules and procedures that are intended for safety (e.g. following the rules about dangerous play in hockey, cycling safely on the roads and being a respectful road user)
- ensuring the use of protective equipment that is correctly fitting and in good order (e.g. using a range of protective equipment for downhill mountain bike racing, and using professionally fitted mouthguards in hockey)
- inspecting facilities, grounds and equipment for safety (e.g. checking for divots and sharp objects on football fields, and ensuring netball courts are dry and free from loose gravel)
- preparing for climatic conditions that can increase the risk of hypothermia due to cold (e.g. correct layers of clothing, and waterproof layers if wet) or hyperthermia due to heat (e.g. adequate hydration, cool clothing and avoiding hottest times of day).
- the use of preventative (prophylactic) taping can decrease risk of joint sprains (e.g. ankle inversion in basketball), and other guards for joints to provide stability and support.



**Figure 5.72** Tennis player having his ankle strapped prior to playing at Wimbledon



Video 5.7  
The DRSABCD protocol

### First aid procedures

For all acute first aid scenarios, simple procedures have been established to help support those attending on the scene to correctly care for the injured or affected person. Two of these are DRSABCD and TOTAPS.



Video 5.8 The TOTAPS protocol

### DRSABCD

For major life-threatening conditions, the DRSABCD protocol (Danger, Response, Send for help, Airway, Breathing, CPR/Compressions, Defibrillation) should always be followed. If the person responds and is conscious, then visible injuries can be attended to using the

next procedure, but they should be constantly monitored until professional medical care arrives if required. Common scenarios include head clashes leading to unconsciousness, near drownings at the beach, major road accidents, and major medical conditions and episodes.

### TOTAPS

TOTAPS (Talk, Observe, Touch, Active movement, Passive movement and Skills test) is an approach to assessing mid-game sports injuries, and deciding whether the player can return to the field. If the injury or issue is assessed to be non-life threatening and the person can be safely moved, then this procedure can be used to determine whether a player is able to continue or whether they should stop play.

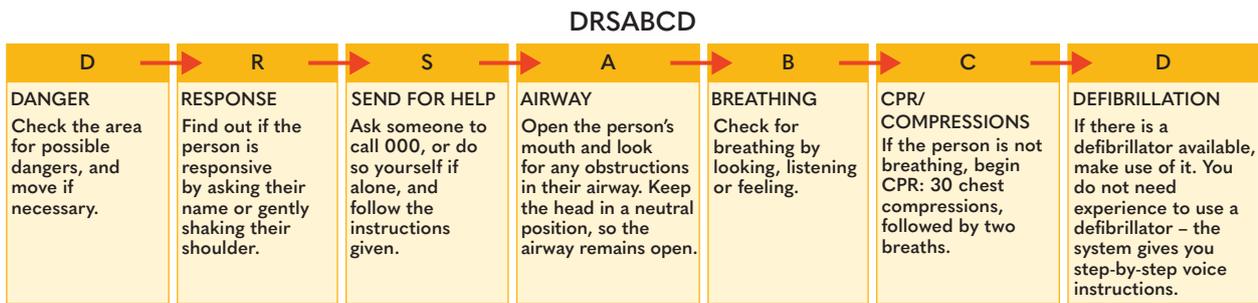


Figure 5.73 The DRSABCD procedure

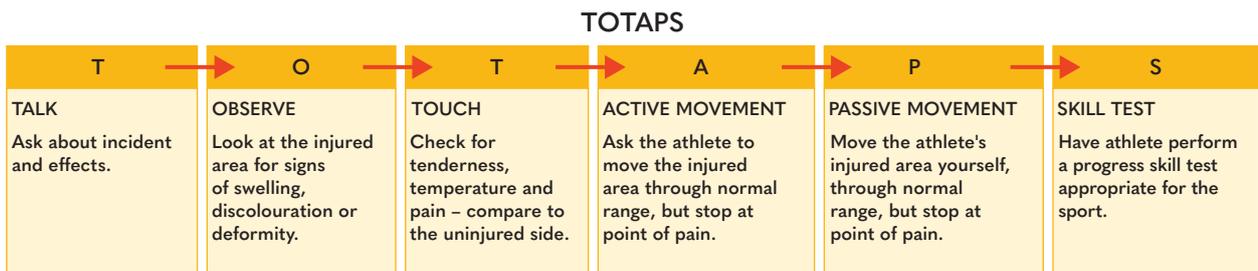


Figure 5.74 The TOTAPS procedure

## Practical Application 5.5

### First aid scenario response

In groups, students are given a scenario card for which they are to prepare a demonstration of the first aid procedures and steps to effectively assess, manage and treat the injuries of the victims involved. These should cover a wide range of movement scenarios involving water, traffic, sporting and recreational contexts. They should demonstrate DRSABCD, TOTAPS, bandaging and slings where appropriate.

**Skills:** collaboration, analysis, communication

### Activity 5.9

#### First aid scenarios and guidelines

Use the Australian Sports Directory to find the website of a national sporting organisation such as Football Federation Australia, Athletics Australia or Basketball Australia. Navigate to the section where they provide health and safety policies for individual clubs to use. Present to the class the range of first aid scenarios or guidelines that have been considered.

**Skills:** analysis, research

### Revise and summarise 5.7

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Outline the basic steps of the DRSABCD procedure.
- 2 Describe four possible factors that contribute to the need for first aid in movement and performance scenarios.



Quiz

### Think critically and apply 5.7

In groups, perform a review of the safety of your school's activity spaces, equipment and facilities, as well as the first aid facilities that can be implemented and used if needed. Make recommendations for potential improvements.

**Skills:** collaboration, analysis, research

## Chapter summary

- The various systems of the human body all interrelate with one another in various ways to maintain life, and several of these have a distinct relationship with movement.
- When referring to the body, anatomical position and directional terms provide universal points of reference and language.
- The skeletal system (bones and joints) provides the structural integrity for movement as well as other functions.
- Different joints provide points of articulation that allow varying degrees of movement.
- Joints have specific joint actions they can perform, which provide categories for movement analysis.
- Specific exercises such as weight-bearing and strength-based movements can improve the health and functioning of the skeletal system.
- The muscular system allows for movement in various ways through coordinated contractions.
- Skeletal muscle is comprised of smaller muscle fibres that are formed from billions of microscopic sliding filaments that contract over one another when stimulated by the nervous system, producing movement.
- Most muscles have a functional pairing, and they extend over joints and connect to bones via a tendon.
- Contraction of a muscle pulls on the musculotendon junction producing movement.
- Slow and fast twitch muscle fibres have varying characteristics that influence their potential for movement.
- Isotonic muscle contractions involve movement and have a contraction phase (concentric) and a lengthening phase (eccentric).
- Isometric contractions occur when muscles contract but do not produce movement.
- During a single muscular contraction and movement, agonist muscles power the effort, while the opposing muscle (antagonist) relaxes passively. At the same time, other stabilising muscles help maintain stability.
- Endurance exercise can improve the metabolic function of muscles and their ability to contract repeatedly.
- Strength exercise can improve the physiological function of muscles and their ability to contract forcefully.
- Flexibility exercise can improve the suppleness of muscles and their ability to relax and stretch without tension.
- Biomechanical principles of motion, balance and stability, fluid mechanics and force are recognised as having a critical relationship with enhancing sporting performance and producing safer movements.
- The respiratory system primarily produces the act of breathing or ventilation through muscular contraction that increases the volume of the lungs, drawing air and oxygen into close contact with the circulatory system.
- Gaseous exchange through respiration occurs across the large surface area of the semipermeable membranes of the alveoli in the lungs. Oxygen diffuses into the blood and carbon dioxide into the lungs to be breathed out.
- The circulatory system primarily pumps and maintains the pressure of blood movement all around the body from the heart and through the network of blood vessels.
- Arteries carry blood away from the heart, veins carry blood to the heart and capillaries provide a large surface area of semipermeable membranes for gaseous exchange where oxygen can move into the cells of the body, and carbon dioxide out.
- Blood is the transport agent that moves oxygen and nutrients around the body, and allows for carbon dioxide and waste to be removed for elimination.

- The heart has two separate pumps separated by the septum. The left-hand side pumps oxygenated blood to the body in the systemic circulatory system, while the deoxygenated blood that is returned via the veins is pumped from the right-hand side to the lungs in the pulmonary circulatory system where it can collect fresh oxygen.
- The respiratory and circulatory systems are strengthened through regular and intense use that stimulates physiological adaptations that improve its structure and function.
- Various factors can affect the function of the circulatory system such as diseases of the blood vessels, high altitude and conditions that can lower haemoglobin count and oxygen-carrying capacity, such as anaemia.
- The digestive system helps draw the nutrients from the food we consume and breaks them into smaller components to be used around the body, while also collecting and eliminating waste.
- Digestion involves the breakdown of food into smaller components and occurs through mechanical and chemical processes.
- The endocrine system coordinates the production of chemical messengers called hormones, which facilitate change in organs and body systems in response to changes in the internal and external environment, to maintain homeostasis.
- Regular and intense movement will disrupt homeostasis of the body, and the response of the endocrine system to restore homeostasis leads to improved functioning of the body. Likewise, sedentary living can lessen the production and effect of hormones, which can have negative effects on health.
- Dietary intake and the quality and quantity of the macronutrients and micronutrients consumed have an influence on the functioning and efficiency of the digestive and endocrine systems, as well as on movement potential through the energy consumed and the availability of nutrients that support health and activity.
- Stress can also lead to impaired function of the digestive and endocrine systems (through either hypoactivity or hyperactivity), which can then negatively influence other body systems such as by causing high blood pressure in the circulatory system.
- The nervous system is responsible for the immediate and central control of all bodily systems and is capable of receiving and sending information to the brain via the complex series of nerves.
- Movement often involves the detection of a sensory stimulus (seeing a moving ball), processing of this information and decision-making within the brain, and a coordinated response through complex and coordinated movement or motor patterns to produce a successful response (catching the ball while running).
- Due to the likelihood of injury from physical activity, it is important that first aid principles be considered, such as seeking to prevent and reduce the likelihood of injury or illness in the first place, and then being able to effectively apply first aid protocols and equipment in the event of a first aid situation occurring.

## Multiple-choice questions

- 1 Which of the following statements about the human body is true?
  - A The nine body systems are all distinct from one another and have their own independent function.
  - B The 11 body systems function through their interdependent relationships with other body systems.
  - C The smallest structures in the body are cells, which form the building blocks of tissues.
  - D All body cells rely on glucose and carbon dioxide to function.

- 2 Which of the following statements about the skeletal system is false?
- A The humerus is part of the appendicular skeleton.
  - B Kicking a ball requires flexion at the hip joint.
  - C Long bones have articular surfaces for smooth joint action.
  - D The pelvis is inferior to the femur.
- 3 Which of the following statements about the muscular system is true?
- A Bicep contraction produces extension at the elbow.
  - B Slow twitch muscle fibres are white in colour and mostly suited to sprinting.
  - C Standing up from a squat position requires an isometric eccentric contraction of the quadriceps.
  - D Standing up on your toes requires plantar flexion with the gastrocnemius muscle being the agonist.
- 4 Which of the following statements about balance and stability is false?
- A A lower centre of gravity increases stability.
  - B A larger base of support can help someone maintain balance.
  - C The body is most stable when the line of gravity is above the base of support.
  - D The centre of gravity is always at a point just above the naval region in the abdomen towards the posterior side.
- 5 Which of the following statements about fluid mechanics is true?
- A By increasing the frontal surface area in sport, drag is increased allowing for faster movement.
  - B Spherical balls are the most aerodynamic shape as air can flow around the ball with minimal turbulence or drag.
  - C The Magnus effect states that a spinning ball will swing towards that side of the ball that is spinning in the same direction as the ball.
  - D Air resistance at high altitude is lower than at sea level, which increases the speed and distance that objects can fly.
- 6 Which of the following statements about the respiratory system is true?
- A Expiration involves contraction of the diaphragm to draw air into the lungs.
  - B The alveoli have semipermeable membranes allowing for external respiration through gaseous exchange.
  - C Expired air has no oxygen left after the body has used it all up.
  - D The right lobe of the lung has two lobes to accommodate the space of the heart.
- 7 Which of the following statements about the circulatory system is false?
- A The atrium is superior to the ventricles.
  - B The pulmonary vein carries deoxygenated blood to the lungs.
  - C Capillaries are the only blood vessel with semipermeable membranes.
  - D The systemic circulatory system is pumped from the left-hand side of the heart to the brain and body.
- 8 Which of the following statements about the digestive system is true?
- A The stomach produces bile to help with the mechanical breakdown of food.
  - B The digestive system relies on gravity and movement to help move food through.
  - C The mouth is not considered a part of the digestive system as it is a part of the respiratory system.
  - D The small intestine is the section of the gastrointestinal tract where most of the nutrients are absorbed into the bloodstream.
- 9 Which of the following statements about the endocrine system is false?
- A Some glands rely on the nervous system to signal when to function.
  - B Hormones are always released very close to the target receptor cells so they can signal a response.
  - C The adrenal gland near the kidneys produces hormones that signal the flight or fight response.
  - D Exercise stimulates the endocrine system into action by disrupting homeostasis and requiring a response.

- 10 Which of the following statements about the nervous system is true?
- A The cerebrum in the brain controls conscious thought, decision-making and memory.
  - B The somatic nervous system is responsible for involuntary actions such as heart rate and breathing.
  - C The peripheral nervous system includes the spinal cord and all nerves that branch off from it.
  - D The speed of the heart is controlled by sensory and motor nerves that signal when to go faster or slow down.

## Exam-style questions

- 1 Explain how the muscular and skeletal systems collectively influence and respond to movement. (5 marks)
- 2 Demonstrate how the shape and structure of different joints influences their function and movement. (6 marks)
- 3 Describe the muscular contractions and joint actions of the ankle and knee while jumping into the air and then landing back on the ground. (6 marks)
- 4 Outline the three types of muscle contraction and provide an example of each. (3 marks)
- 5 Describe how centre of gravity can impact on performance. (4 marks)
- 6 Justify how equipment design has influenced fluid mechanics and improved performance in sport. (6 marks)
- 7 Describe how the body applies and absorbs force. (4 marks)
- 8 Explain how biomechanical principles been used to improve movement safety. (6 marks)
- 9 Explain how the respiratory system influences and responds to movement. (5 marks)
- 10 Describe the sites and requirements for the exchange of gases within the body. (4 marks)
- 11 Explain how the circulatory system influences and responds to movement. (5 marks)
- 12 Compare the systemic and pulmonary circulatory systems. (4 marks)
- 13 Explain how the digestive system influences and responds to movement. (5 marks)
- 14 Explain how the endocrine system influences and responds to movement. (5 marks)
- 15 Explain how the nervous system influences and responds to movement. (5 marks)
- 16 Demonstrate through three distinct examples how body systems interact to influence and respond to movement. (6 marks)
- 17 Evaluate the importance of first aid in ensuring safe movement. (8 marks)

# Chapter 6

## Factors influencing movement and performance

### After completing this chapter, you will be able to demonstrate knowledge of:

- the three energy systems of the human body that resynthesise adenosine triphosphate (ATP)
- nutrition's role in the efficient functioning of the three energy systems
- how anaerobic and aerobic training is different for different sports
- how to design an aerobic or anaerobic training program based on the FITT principle
- the immediate physiological responses to training
- the purpose and outcome of testing for physical fitness for different population groups.

### Key terminology

#### Syllabus terms

fartlek	interplay
first aid	macronutrients
fitness	micronutrients
FITT principle	physical fitness
high intensity interval training (HIIT)	sprint interval training (SIT)
hypothesis	TOTAPS

#### Other important terms

adenosine triphosphate	interdependent
aerobic	interval training
anaemia	lactate threshold
anaerobic	max $VO_2$
carbohydrate loading	maximum aerobic speed
enzymes	physiological adaptations
glycaemic index	reliable
glycogen sparing	valid
haemoglobin	vasodilation
homeostasis	





### Driving questions

In the previous critical inquiry question, we explored *how* the human body's physical structures are organised and operate in order to produce movement. This is similar to describing the various components that make up a car and describing their role and relationship to one another. These key inquiry questions continue to investigate the way in which these systems operate to produce movement and the elements required to power and fuel these movements through varying intensities of movement.

- 1 If cars use petrol for fuel, what is the source of fuel used for human movement?
- 2 Are our bodies like a hybrid car with different fuel sources being able to be used at different times?
- 3 How do these fuel sources operate under different intensities of movement?
- 4 If you started sprinting and continued for as long as you could, how long would you last? What causes you to slow down or stop?
- 5 If you started jogging at a slow pace, and you didn't stop until you collapsed, what would cause this?
- 6 Discuss the phenomenon of fatigue and examine the different ways in which people experience it. Is it more mental or physical? What do you think causes fatigue?

# Introduction

## interdependent

where two or more body systems rely on one another to fulfil their own function

The living human body is a complex machine, consisting of several **interdependent** body systems, such as the cardiovascular, digestive and muscular systems. They are carefully organised and rely

on one another to produce an amazing system characterised by balance (homeostasis), the ability to sustain itself and to produce vast amounts of mechanical and intellectual output. All these functions require a constant source of energy or fuel to enable every cellular process.

## 6.1 Energy systems of the body

### Learning objective 6.1

ANALYSE the three energy systems of the human body that resynthesise adenosine triphosphate (ATP)

It could simply be assumed that the food we eat is directly responsible for providing the vast energy needs of an active human being. Carbohydrates are often described as the body's best fuel source; however, this would be a very

limited understanding of the body's complex energy supplies.

Consider a house, with its many power outlets and electrical devices. Each appliance has a unique function; however, a consistent energy source is needed to enable the use of all of them. Likewise, the human body has a range of specialised cells and organs, such as the heart, brain, digestive system and muscles, each of which carry out a unique function.



**Figure 6.1** It could simply be assumed that the food we eat is directly responsible for providing the vast energy needs of an active human being.

## Adenosine triphosphate (ATP)

The fuel or energy source for all of these separate organs and bodily functions is stored within the high-energy chemical bonds that join atoms together within a particular molecule known as **adenosine triphosphate (ATP)**. As these bonds are broken, energy is released for cellular function – for example, the contraction of a muscle cell that contributes to physical movement.

ATP is a very light, small and efficient form of fuel storage. During a marathon, the total weight of the ATP molecules used to fuel movement is similar to the weight of the person themselves. Obviously, the runner does not store their body weight in ATP fuel prior to a run, which demonstrates the unique way in which the body stores, converts and recycles energy from the food we eat into useable ATP.

It is worth noting that there is a change in the form of energy when the body produces movement. The type of energy provided through foods (primarily carbohydrates and fats) is known as chemical energy (measured in kilojoules or calories). The body uses chemical-based energy systems to fuel muscular contractions and

produce mechanical energy as the body produces movement via the musculoskeletal systems. These energy-dense nutrients undergo a series of chemical reactions to break them down into a form suitable for immediate availability, as well as long-term storage. Protein also has an energy value and is broken down into the form of amino acids, which are used to repair and form new body tissue where necessary. However, the use of protein as an energy source generally only occurs during extreme circumstances, such as a famine, when all other stores are exhausted. Where excess protein and carbohydrates are consumed, they are converted into triglycerides, which can easily be stored by the human body as excess body fat or adipose tissue (stored under the skin).

**adenosine triphosphate** the most basic source of energy in the human body – a compound consisting of an adenosine molecule and three phosphate groups

As mentioned earlier, the primary energy source of the human body lies within the high-energy covalent bonds of a unique molecule known as adenosine triphosphate (ATP). This molecule is present in every living human cell, and it powers the individual functions of every cell, particularly the contraction of the muscle cell.

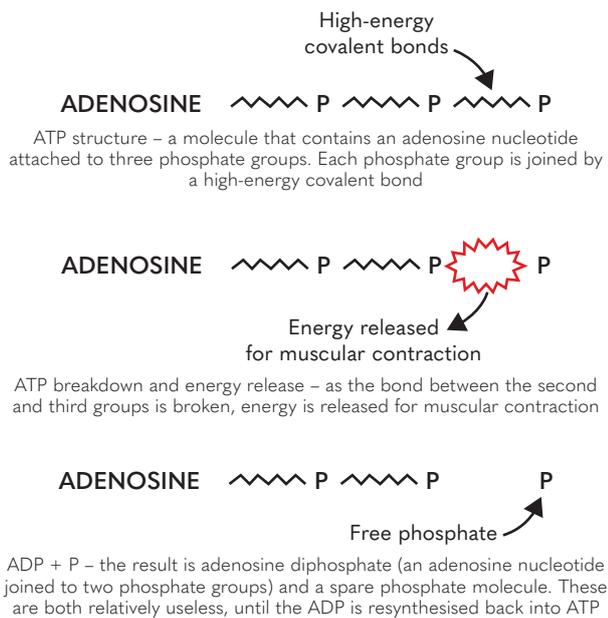
**Table 6.1** Nutrient values, forms and locations

Nutrient	Food example	Basic form	Stored form	Stored location and amount	Energy value per gram
Carbohydrate	Bread, rice	Glucose	Glycogen	<ul style="list-style-type: none"> <li>Blood 20 g</li> <li>Muscle 500 g</li> <li>Liver 100 g</li> </ul>	17 kJ
Fats	Olive oil, butter	Lipids	Triglycerides	<ul style="list-style-type: none"> <li>Adipose tissue (body fat) over 12 kg</li> <li>Muscle triglyceride 300 g</li> </ul>	37 kJ
Protein	Meat, dairy, nuts	Amino acids	Building blocks of all body cells	<ul style="list-style-type: none"> <li>Excess stored as triglyceride in adipose tissue</li> <li>Proteins make up 16% of body mass</li> </ul>	17 kJ

**anaerobic** metabolic processes that occur in the absence of oxygen

**aerobic** metabolic processes that occur in the presence of oxygen

Adenosine triphosphate, as the name suggests, is a molecule that contains an adenosine nucleotide attached to three phosphate groups. The bonds between these are high-energy covalent bonds which, when broken down (known as hydrolysis), release energy for muscular contraction (and the rest as heat). This process is outlined in Figure 6.2 and Video 6.1.



**Figure 6.2** ATP hydrolysis and energy release



**Video 6.1**

ATP hydrolysis and energy release

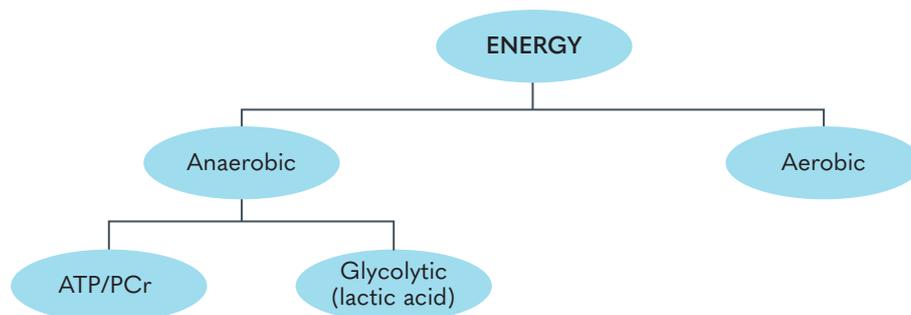
Interestingly, the human body only has enough ATP to survive for approximately 10 seconds, and less if it attempts to produce intense movement (2–5 seconds). It is estimated that in our entire body there is approximately

70 g of ATP (which equates to trillions of ATP molecules). During a marathon, the body will require about 60 kg of ATP. A similar amount is needed to power an adult through a regular day.

So how is it possible to use the equivalent of over half our body weight in energy in a single day if we have such a small and limited supply? This is where the stored fuel or energy reserves in the body are efficiently utilised to power the resynthesis of ADP into ATP. There are three distinct energy pathways or systems that are used to ensure the body is never depleted of its ATP stores:

- 1 **ATP-PCr** energy system (sometimes known as the **phosphocreatine** or **phosphate system**)
- 2 **Glycolytic** (lactic acid) energy system (sometimes known as **anaerobic glycolysis**)
- 3 **Aerobic** energy system (Sometimes known as the **oxidative** energy system)

Each energy system plays a unique role in helping the body to have sufficient ATP molecules and energy at various intensities and duration of activity. The first two pathways are unique, as they function in the absence of oxygen – otherwise known as an **anaerobic** pathway – whereas the third system relies on the presence of oxygen and is therefore known as an **aerobic** pathway. It should be noted that these three systems do not work independently of one another, but as an overlapping and coordinated response involving all energy pathways, working together to varying degrees to supply ATP at different intensities and durations of effort.



**Figure 6.3** Overview of the three energy pathways that fuel the resynthesis of ADP into ATP

### Analysing the ATP-PCr energy system

The initial system used to resynthesise ATP is called the ATP-PCr or the phosphocreatine energy system. Other names for this are the creatine phosphate system or the alactacid system. The

energy from this system is stored within the high-energy bond that joins a creatine and phosphate molecule together, called phosphocreatine (PCr). As the bond between these is broken, energy is released to help rejoin a spare phosphate group to an ADP molecule. This process is outlined in Figure 6.4 and Video 6.2.



Video 6.2

ATP resynthesis through the phosphocreatine system (ATP-PCr)

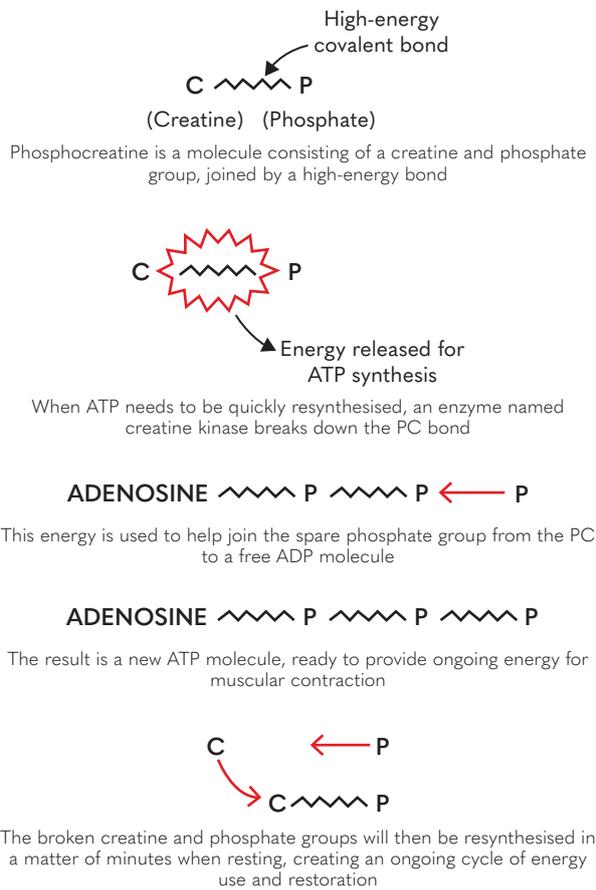


Figure 6.4 ATP resynthesis through the phosphocreatine system (ATP-PCr)

The ATP-PCr system’s greatest advantage is the speed at which it can provide energy for ATP resynthesis. This characteristic is essential during maximal activity, where ATP stores can be depleted in less than five seconds and must start to be resynthesised within a few seconds before the ATP runs out. However, the downside of this

is that only a limited supply of PCr can be stored within the muscle cells of the body. Therefore, maximal and high-intensity activity can only be sustained for up to 10 seconds before PCr stores are fully depleted. PCr is the dominant energy source for the first five seconds, after which the second energy system has been activated and is starting to supply energy to resynthesise ATP as well. After the PCr stores are exhausted, two to three minutes’ rest is required to fully replenish the PCr stores.

Athletes in sports that involve short and maximal effort focus their training on the development of the ATP-PCr system. Examples include 100 m sprints, weightlifting, shot put and high jump. For this reason, emphasis in training is placed on anaerobic interval training with a work:rest ratio of 1:10+, which allows enough time for PCr stores to reset before the next effort. For sports of longer duration, the ATP-PCr system will be used following a break in movement where the PCr levels have been able to be restored.

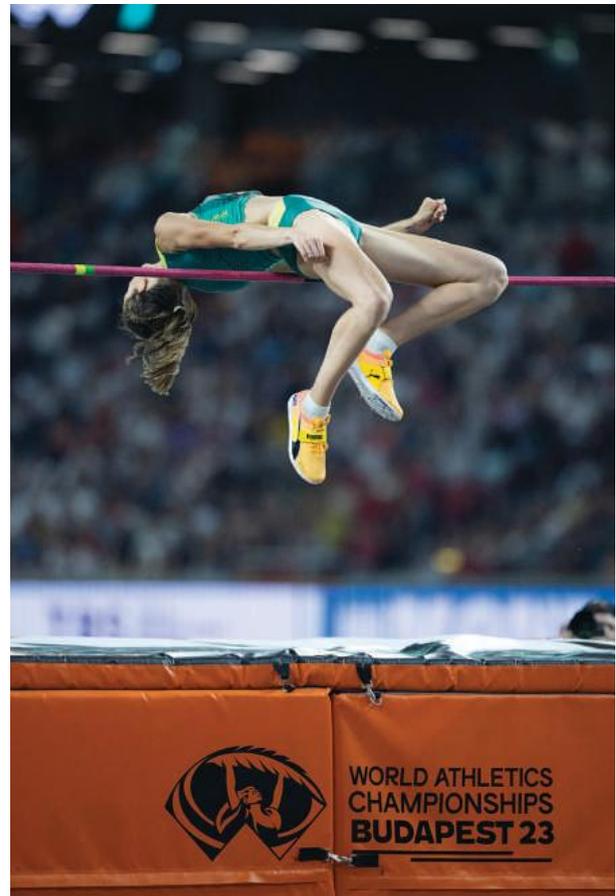


Figure 6.5 Sports such as high jump require a short and maximal effort.

**Table 6.2** Summary of the ATP-PCr energy system

Syllabus point	Characteristic of energy system	Description
Fuel source	Phosphocreatine (PCr)	The energy is stored within the bond of the PCr molecule. As it breaks, energy is released.
Efficiency of ATP production (Speed of production and amount of ATP resynthesised)	Very fast 0.7 ATP molecules per reaction	Instant supply of PCr available, and a simple chemical reaction means that it is a very efficient pathway in terms of speed; however, it produces the least amount of ATP per reaction of all three energy systems.
Duration the system can operate	0–10 seconds	For the first 5 seconds of maximal activity, it is the dominant supplier of ATP, and it will be fully utilised after 10 seconds.
Intensity of activity	Maximal	PCr is best suited to all-out maximal efforts where the body requires an instant source of fuel to resynthesise ATP.
Rate of recovery (How does the system recover for subsequent efforts and how long does it take?)	2–3 minutes PCr resynthesis through rest	The resynthesis of PCr occurs very quickly at rest, with close to half being restored within 30 seconds. This is why people should rest between sets of heavy resistance training or sprints to ensure the body has enough energy for the next set to enable work at maximal capacity.
Cause of fatigue (What causes the system to either slow down or stop, and what effect does this have on the athlete?)	Depletion of PCr stores	As the PCr stores become depleted to the point of exhaustion, the body will be able to supply energy through the second pathway, which will have been activated by this point. The athlete will not recognise fatigue directly as a result of this, but from other sources such as local neuromuscular fatigue.

**Figure 6.6** Sports that predominantly rely on the ATP-PCr system

## Analysing the glycolytic (lactic acid) energy system

The second system used to resynthesise ATP is called the glycolytic energy system.

Another common name for this is the lactic acid energy system. However, most sources now recognise this as somewhat of a misnomer as lactic acid is not actually found in the human body in its exact form, and is often confused with **lactate**, which is found in the human body, hence this system being also known as the lactate system.

The energy from this system comes from the breakdown of the simple sugar glucose ( $C_6H_{12}O_6$ ), which is known as glycolysis. When this process occurs in the absence of oxygen, it is known as anaerobic glycolysis (anaerobic = without oxygen / glyco = glucose / lysis = breakdown).

The body is only able to store a small amount of glucose in the blood, and any excess is converted to its stored form of glycogen, which is stored in the muscle and the liver. As specific **enzymes** break down glucose, the energy released is used to resynthesise ATP. The by-product of this reaction is called pyruvate.

Both ATP hydrolysis and glycolysis release hydrogen atoms. If insufficient oxygen is being supplied to the working muscle, the increasing accumulation of hydrogen atoms slightly decreases the pH within the muscle, leading to

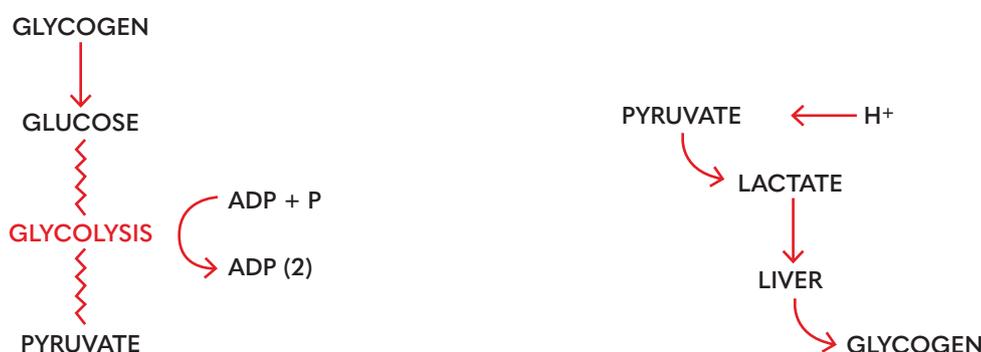
a marginal increase in acidity (people describe intense work as ‘feeling the burn’). This decrease in pH and increase in metabolic waste products interferes with the muscles’ ability to forcefully contract repeatedly, leading to feelings of heaviness and fatigue, as well as reduced power output.

During this type of intense exercise, pyruvate plays an important role in helping buffer against the increasing muscle acidity by helping bind to the free hydrogen atoms, creating a new substance called lactate. During moderate- to high-intensity exercise, lactate is transported out of the muscle to the liver, where it is metabolised and turned back into glycogen, able to be used again as a fuel source.

However, if there is either insufficient or partially occluded (blocked) blood flow due to strong and very regular muscular contractions, then the rate at which lactate can be cleared out of the muscle decreases, leading to its accumulation. It is often assumed that the increased lactate is the cause of increasing muscle acidity; however, it is merely evidence that the person is working anaerobically. The lactate is in fact helping to reduce the fatigue by removing the metabolic waste product of hydrogen ions.

**lactate** a naturally occurring by-product of cellular respiration, which is associated with the fatigue related to high-intensity exercise

**enzymes** proteins that help speed up metabolism and chemical reactions



Anaerobic glycolysis – glycogen is converted to glucose, which is then broken down. This releases energy for the resynthesis of two ATP molecules and the by-product is pyruvate.

If insufficient oxygen is available to the working muscles, the pyruvate binds to pH-decreasing hydrogen atoms, forming lactate. This is transported to the liver to be metabolised and converted back into glycogen.

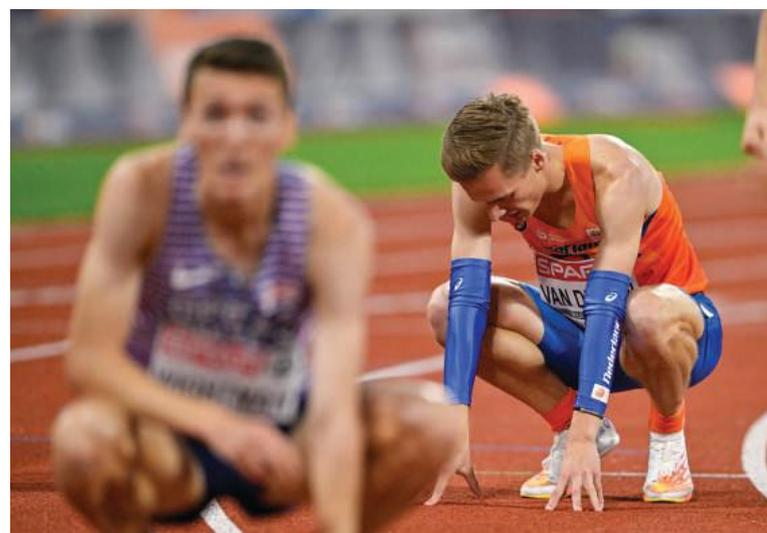


**Video 6.3**  
ATP resynthesis through the anaerobic glycolysis system

**Figure 6.7** ATP resynthesis through the anaerobic glycolysis system

Sports that rely heavily on anaerobic glycolysis are very intense. They may be a short sprint lasting 30 seconds to 1 minute (for example, a 400 m sprint or 100 m swim). Sports where the athlete is working between intervals of very high intensity

and low levels of intermittent recovery also heavily utilise anaerobic glycolysis (e.g. 800 m runners, 200 m swimmers, football and AFL midfielders, netball centres and rowers).



**Figure 6.8** Sports that predominantly rely on the anaerobic glycolytic energy system

**Table 6.3** Summary of the characteristics of the glycolytic (lactic acid) energy system

Syllabus point	Characteristic of energy system	Description
Fuel source	Glucose (stored as glycogen)	Stored glycogen from the liver and muscles is quickly converted into glucose to be used as fuel.
Efficiency of ATP production (Speed of production and amount of ATP resynthesised)	Fast 2 ATP molecules	While not as fast as ATP-PCr (due to a more complex set of chemical reactions), the cells are able to break down glucose quickly, with more glucose being made available from the muscle and liver glycogen stores if necessary. In comparison to the amount of glucose used, only a few ATP are resynthesised when working anaerobically.
Duration the system can operate	10–75 seconds	While this system begins to operate after 5 seconds, it reaches full capacity at 10 seconds, taking over from the ATP-PCr system for maximal activity. This can be sustained for up to 75 seconds before muscular fatigue and a reduction in power causes the athlete to slow down. At sub-maximal efforts above 85% effort, activity can last around 3 minutes, with anaerobic glycolysis providing most of the energy.
Intensity of activity	High or sub-maximal	Athletes utilising this energy system will often be working at a level just below their maximal speed and power output. They are able to sustain this for a short time before they need to slow or stop to bring their heart rate and fatigue back down, as well as to clear excessive lactate in the muscle.
Rate of recovery (How does the system recover for subsequent efforts and how long does it take?)	Lactate removal Repeated effort: 2 to 5 minutes Complete lactate removal: 30 minutes to 2 hours	During team sports, an athlete can use anaerobic glycolysis after 2 to 5 minutes of rest following a long and intense effort (e.g. sprinting the length of the field). After intense anaerobic exercise has stopped, the body must continue to transport the lactate to the liver to be converted back into glycogen and clear away all remaining hydrogen ions and metabolic waste products. To support both scenarios, an active recovery will help maintain blood flow to flush the lactate out of the muscle as quickly as possible (e.g. keep jogging and have a gradual cool-down or recovery interval).
Cause of fatigue (What causes the system to either slow down or stop, and what effect does this have on the athlete?)	Increasing muscle acidosis	If the pyruvate is unable to remove the hydrogen at the rate of accumulation, the pH inside the muscle leads to acidosis and interferes with muscle contraction. This causes feelings of fatigue, as well as impairing the ability of muscles to effectively contract at full power.

## Analysing the aerobic energy system

The third system used to resynthesise ATP is called the aerobic energy system. This energy system is by far the largest producing energy pathway in the body, as it is used to fuel activity ranging from sedentary activity right through to longer endurance exercise at moderate intensity. As the name suggests, this energy pathway is dependent on a constant and adequate supply of oxygen, and therefore interplay with an efficient cardiovascular and respiratory system is needed. Out of the three energy pathways, it is also the most complex, requiring a range of intricate chemical processes to produce energy.

### Fuels

Different fuels can be utilised to produce energy from the aerobic energy system, each being used at various levels of intensity and duration.

### Carbohydrates

Carbohydrates are broken down and used in the form of glucose, which is stored as glycogen. This is the most efficient source of fuel for aerobic exercise and is also known as aerobic glycolysis. Most athletes focus on this pathway to some degree, as glucose is the dominant and preferred source of fuel while exercising at a sustained and moderate level, or when play intermittently cycles between periods of moderate and high intensity.

### Fats

Fats are stored as lipids and can also be used as fuel. The lipids are broken down into free fatty acids, which can be metabolised aerobically. This is known as aerobic lipolysis. Generally, while a person is resting and sedentary, they use fats as their primary fuel source as their oxygen demand is very low. However, a gram of fat contains more than twice as much energy as a gram of carbohydrate, and yields 10 times as much ATP. Therefore, sedentary activity tends to burn very few grams of fat because it is such an energy-rich reserve. The logical assumption is that lipids must therefore be a better fuel source than glycogen. However, the oxygen demands required to burn fat as a fuel render it totally ineffective for aerobic exercise above moderate levels, as the demands on the cardiovascular system to supply the increased oxygen would lead to a dramatic reduction in power output. The only time that fats are used

during exercise, is if the intensity is kept to a light to moderate level, or if the glycogen stores have been completely exhausted and exercise continues (generally after 2 hours of constant activity without refuelling).

### Protein

The last fuel the body can use is protein, in the form of amino acids. However, this would only occur in an extreme situation, where both the glycogen and lipid reserves had been exhausted (such as during a famine). This is a potentially dangerous situation, as the amino acids are sourced from the breakdown of actual muscle tissue. This leads to extreme weight loss and can cause harm to the body as dangerous toxins are released.

There is a coordinated interplay between the use of carbohydrates and fats as a fuel for exercise, which is stimulated by the intensity of exercise. The body will use fats for as long as it is more efficient, with the aim of preserving glycogen stores for as long as possible until they are needed. Elite endurance athletes aim to perform using fats for as long as possible in a race, to ensure they have sufficient glycogen stores as the intensity increases. Athletes often transition from using fats to glucose as an energy source at about 60–70% intensity.

While using glucose, the aerobic energy system can resynthesise 38 ATP for each completed chemical pathway. If the athlete is using lipids because they have either run out of glycogen (commonly known as a 'bonk' or 'hitting the wall' in cycling) or are at moderate to resting levels, they can produce up to 460 ATP; however, this requires an immense amount of oxygen, which is not available when working above a moderate intensity (over 70% maximum heart rate; MHR).

Sports that typically rely on the aerobic energy system either require very low physical exertion, such as archery, or a sustained and moderate level of power output. Typically, most team sports require a strong aerobic base to provide foundation to their anaerobic fitness. This is particularly true for sports such as tennis, football and AFL where players are active for 1 to 3 hours, and can cover over 10 km in a game. Of course, longer distance events such as marathons or ultra-ironman triathlons are predominantly powered by aerobic energy pathways.

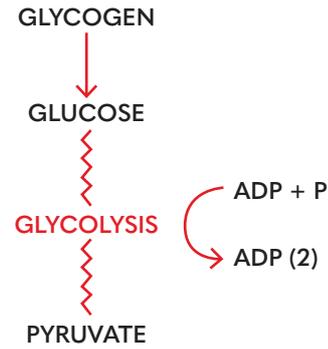
**Components**

There are three significant components of the aerobic energy system:

- 1 aerobic glycolysis
- 2 the Krebs cycle
- 3 electron transport chain.

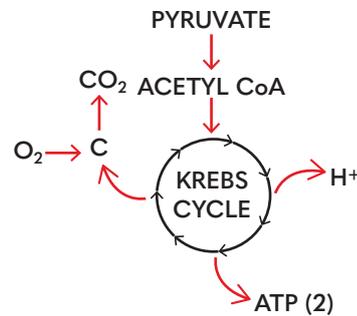


**Figure 6.9** Sports that predominantly rely on the aerobic energy system

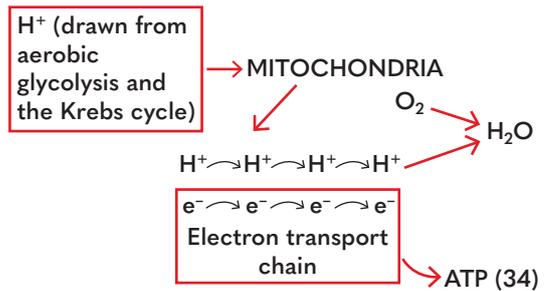


**Video 6.4** The aerobic energy system

Aerobic glycolysis operates in the same manner as anaerobic glycolysis. A glucose molecule is broken down, providing enough energy for the resynthesis of two ATP molecules. However, because there is sufficient oxygen available, the pyruvate does not need to attach to pH-decreasing hydrogen atoms, and instead is used in the second component of the aerobic energy system.



In the Krebs cycle, the pyruvate is converted into an enzyme called acetyl coenzyme A (acetyl CoA), which enters a complex set of reactions known as the Krebs cycle. The Krebs cycle itself resynthesises a further two molecules of ATP, and the resulting hydrogen electrons are then transported to the third component. In addition to this, carbon is another by-product of the Krebs cycle; it joins with oxygen to form carbon dioxide, which enters the bloodstream to eventually be breathed out.



Three energy systems provide the fuel for ATP resynthesis during exercise. The hydrogen electrons from the Krebs cycle enter the electron transport chain, sometimes described as oxidative phosphorylation. These electrons undergo a series of reactions and are eventually reduced to water, which is removed as a waste product. The result of these reactions is a large amount of energy that is used to resynthesise 34 ATP molecules.

**Figure 6.10** The aerobic energy system

**Table 6.4** Summary of the characteristics of the aerobic energy system

Syllabus point	Characteristic of energy system	Description
Fuel source	Carbohydrates (moderate to high intensity) <i>and</i> Fat (rest to low intensity)	Carbohydrates in the form of glucose are primarily used for aerobic exercise, when the intensity increases towards and above 70% of maximum heart rate (MHR). MHR can be calculated by subtracting a person's age from 220. At lower intensities (and at rest), fat is the preferred fuel as it is dense in energy. Fat as a fuel requires a lot more oxygen to be metabolised, which is why it is inefficient above 70% MHR.
Efficiency of ATP production (Speed of production <i>and</i> amount of ATP resynthesised)	Slow 38 ATP	The time taken for energy to be produced aerobically is slow when compared to the other pathways. However, once functioning, the yield of ATP is far greater. This is even more so when fat is the fuel source, with over 460 ATP being produced. However, the excessive oxygen required means this is best used at rest or low intensity.
Duration the system can operate	60 seconds plus	It takes at least 60 seconds for aerobic glycolysis to start providing energy, as there are more chemical reactions and the increased oxygen demand has to be delivered via the cardiovascular system. However, once these pathways are established, the aerobic energy system can continue working for hours on end as long as fuel sources are consistently replenished (such as in a 24-hour mountain bike race).
Intensity of activity	Low to moderate	This system is best suited to moderate intensity activities or for recovery between higher intensity efforts. An endurance triathlete will race at a moderate aerobic level for most of the race, whereas a rugby league player takes advantage of breaks in play to recover and return to an aerobic level between the maximal efforts when they are directly involved in play.
Rate of recovery (How does the system recover for subsequent efforts and how long does it take?)	Replenish fuel stores: 24 hours	Following a bout of sustained and intense exercise, athletes must ensure they eat adequate amounts of food to replenish depleted fuel stores. This primarily involves eating 50 to 100 g of carbohydrates within 30 minutes of exercise. Many athletes will also consume carbohydrates during an event where possible to top up glucose stores (e.g. half-time energy gels). The process of fully restoring liver and muscle glycogen can take up to a full day, but must start within 20 minutes of finishing exercise.

*continued*

**Table 6.4** Summary of the characteristics of the aerobic energy system *continued*

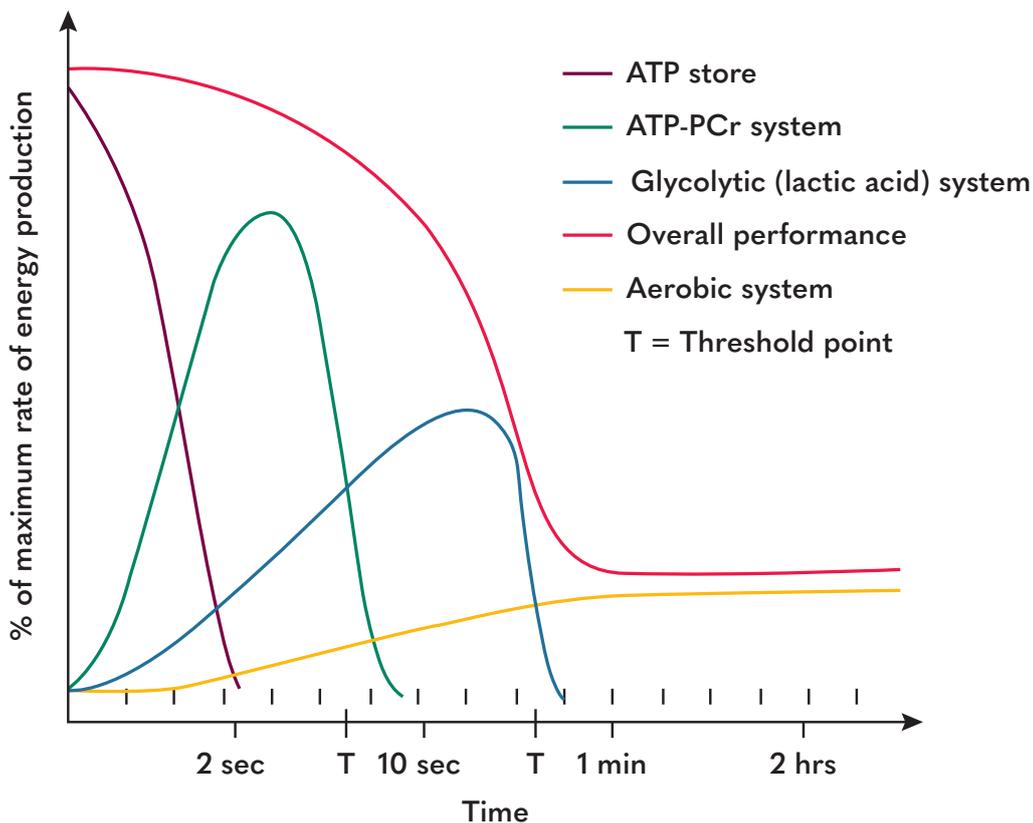
Syllabus point	Characteristic of energy system	Description
Cause of fatigue (What causes the system to either slow down or stop, and what effect does this have on the athlete?)	Depleted fuel sources	A consistent level of moderate intensity can be sustained for over 2 hours if glycogen stores are full. If these are not regularly replenished, then the athlete will switch to using fats, causing the athlete to quickly fatigue and have to slow down due to the increased oxygen demand. Other causes of fatigue are general neuromuscular and mental fatigue, as a result of the sustained activity.

### Interplay of the energy systems

The body’s use of each energy system represents a complex interplay of fuel supply, as the resynthesis of ATP seamlessly draws energy from all three energy systems to varying degrees. They do not operate independently of one another, with one switching off and the other switching on. At certain intensities and times within a sport or training session, the body may rely more heavily on one energy system over an other; however, the other energy systems can be used almost instantly if required. Figure 6.11 below demonstrates the time

and relative contribution of the energy systems. Examples of changes in energy pathway can be seen in the following scenarios:

- A boxer at rest completing five burpee tuck jumps instantly uses the ATP-CPr system as the dominant source of energy, before skipping for two minutes where they return to aerobic levels.
- An AFL forward performing a 60-second 400 m fast run around a track will rely on mostly anaerobic glycolysis following the use of PCr reserves for the first 10 seconds.



**Figure 6.11** The interplay of the three energy systems in providing energy over time

- A triathlete jogging for 5 km at a steady moderate pace of 4.5 min/km may require a sustained 70% MHR and will predominantly use the aerobic energy system to fuel the activity. But the initial start was fuelled by ATP-PCr and then a short period of anaerobic glycolysis as the body recalibrated the required oxygen supply for this level of activity. If the runner picked up the pace to 3.5 min/km for the final 500 m, then they would rise above 85% back into an anaerobic pathway.
- A cyclist riding comfortably and aerobically at 28 km/h attacks up a hill and their heart rate lifts to over 95% MHR, before returning to 28 km/h once at the top. After a minute their heart rate is back below 80% where they start to work aerobically again.
- After a two-minute break in play following a try, a rugby player will initially use their ATP-PCr system for the restart of play before moving back into aerobic glycolysis as play continues. A sudden burst requires anaerobic pathways before a period of jogging where they return back to an aerobic level.
- A midfielder in football will move in and out of various aerobic and anaerobic pathways depending on the requirements of the particular game. They may cover 12 km in a

90-minute game; however, this only represents a pace of 7.5 min/km. Comparatively, a 42 km marathon ran in 3 hours will have an average pace of 4.5 min/km. One might assume that the footballer uses less energy than the marathon runner. However, an analysis of the various speeds and distances ran show that footballers actually exert a significant amount of energy. While they spend a large proportion of this total distance walking or slow jogging, they also perform many repeated fast runs and sprints that require anaerobic pathways.

Athletes that can exert more regular and faster efforts for longer periods have a distinct advantage over opponents due to their high aerobic and anaerobic capacities, and ability to recover faster between efforts. Targeted training methods that replicate the specific physiological requirements of a sport will contribute to greater success as the athlete develops the unique adaptations required for this sport. Table 6.5 outlines the relevant contributions of various energy systems. It should be noted that sports with more stoppages in play often have higher than expected contributions of ATP-PCr.

**Table 6.5** Energy system contribution of a variety of sports

Sport	ATP-PCr/glycolytic (%)	Glycolytic/aerobic (%)	Aerobic (%)
Athletics (field)	0	90	10
Basketball	60	20	20
Distance running	10	20	70
Football	50	20	30
Golf swing	95	5	0
Gymnastics	80	15	5
Rowing	20	30	50
Sprints	90	10	0
Swimming 1500 m	10	20	70
Tennis	70	20	10
Volleyball	80	5	15

### Practical application 6.1

#### Interplay of energy systems

Participate in a range of physical activities that exclusively use each energy system, as well as an invasion-based team sport where there is a challenging interplay of energy systems. Examples may include:

- ATP-PCr: 40 m sprint, shot put, high jump, 3 RM deadlift
- Glycolytic: 400 m sprint, Tabata HIIT, 20 × burpees, 30-second max on Assault Air Bike or similar
- Aerobic: 1.6 km run, 3-minute step test to cadence
- Mixed: ultimate, floorball, football, endball (pause intermittently to assess which current energy system is probably being used based on perceived rate of exertion based on heart rate, breathing rate, feeling of fatigue and ability to speak normally without interruption from the need to breathe).

After each activity, discuss and reflect on what the use of each system feels like as well as the recovery process.

**Skills:** collaboration, analysis

### Revise and summarise 6.1

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook. Revise each energy system by identifying the characteristics and features of each aspect.



Quiz

Syllabus point	ATP-PCr	Glycolytic energy system	Aerobic energy system
Fuel source			
Efficiency of ATP production			
Duration the system can operate			
Intensity of activity			
Rate and process of recovery			
Cause of fatigue			
Sports examples			

### Think critically and apply 6.1

For a selected sport, use an open access site such as Google Scholar to research academic scholarly articles and present an overview of the various contributions of energy systems to performance in the sport (in the form of data and graphs that visually display the physical requirements for this sport). Then provide examples of specific training activities that will develop the energy systems that are required to power these specific efforts in this sport.

**Skills:** analysis, communication, research



Depth Study

## 6.2 The relationship between nutrition and energy systems

### Learning objective 6.2

EXPLAIN nutrition's role in the efficient functioning of the three energy systems

A healthy diet provides the recommended daily intake (RDI) of the following two categories of nutrients (seven in total):

- **Macronutrients** are required in larger quantities (grams) and provide most of the energy (measured in kilojoules) and building blocks for the human body. These include carbohydrates (glucose), fats (lipids) and proteins (amino acids). Water and dietary fibre



**Figure 6.12** A healthy diet provides the recommended daily intake (RDI) of macronutrients and micronutrients.

are also considered macronutrients due to the larger quantities required each day, but these do not provide energy.

- **Micronutrients** are required in smaller quantities (milligrams or micrograms) and support a wide range of specific bodily processes and functions such as growth, disease prevention and chemical functions. These include vitamins and minerals.

For the energy systems to function efficiently, an athlete must consume the right quantities of macro and micronutrients to match the specific requirements of their sport. Sports dietitians are best trained to assess and advise all athletes on what they should consume for optimised performance.

### Macronutrients

Regarding an athlete's energy intake from macronutrients, there are two main considerations:

- First, what is the total energy intake required for the training and competitive demands of a particular sport? Sports with high volume and intensity in training and performances require a much higher intake of total energy (e.g. an AFL player), whereas some sports do not require more energy than a regular healthy diet (e.g. archery).
- Second, what are the specific and relative contributions of the three macronutrients to this total energy intake? In other words, what

### Activity 6.1

#### Dietary guidelines

Compare the Australian Dietary Guidelines for Australians with recommendations for athletes with moderate to heavy training loads. What are the major differences between the regular diet and that of an elite athlete, and what purpose do these differences have?

**Skills:** collaboration, analysis, communication, creative thinking, problem-solving, research

percentage of the energy from carbohydrates, fats and proteins should contribute to this total amount? Again, the nature of training and performance will determine this.

To provide a baseline starting point, the macronutrient guidelines in Table 6.6 are approximate recommendations for all non-athletes for general health and wellbeing. In Tables 6.7 and 6.8, targets are expressed in terms of grams intake per kilogram of body weight, per day (g/kg/day).

Athletes (or very active people) who have moderate to heavy training loads will require more than this. They often need to increase the total amount of kilojoules eaten per day and also adjust the relative contribution of the energy sources depending on the nature of training. For example:

- Moderate to heavy training schedules require an increase in total energy intake (12 000–18 000 kJ).
- Regular endurance training over 60 minutes requires more energy from carbohydrates (65–70%).
- Heavy strength training requires increased protein intake for muscle hypertrophy (35–40%).

**Specific guidelines**

Another way to ensure that macronutrient RDIs are met is to measure the amount of carbohydrates and proteins eaten according to your weight (for fats, the recommendation is to eat healthy fats, but in moderation). It is recommended that people eat the amounts listed in Tables 6.7 and 6.8, depending on their level of daily exercise volume (determined by duration, time and distance) and intensity.

**Table 6.6** Macronutrient guidelines

Total energy intake for general health	Carbohydrates (17 kJ/g)	Fats (37 kJ/g)	Proteins (17 kJ/g)
8000–10 000 kJ per day	50–60% Approximately 5500 kJ 320 g per day	15–20% Approximately 1800 kJ 50 g per day	15–30% Approximately 2000 kJ 120 g per day

**Table 6.7** Daily carbohydrate targets for fuel and recovery

Situation	Carbohydrate targets
Light Low-intensity or skill-based activities	3–5 g/kg/day
Moderate Moderate exercise program (~1 hour/day)	5–7 g/kg/day
High Endurance program (i.e. moderate- to high-intensity exercise of 1–3 hours/day)	6–10 g/kg/day
Very high Extreme commitment (i.e. moderate- to high-intensity exercise of >4–5 hours/day)	8–12 g/kg/day

**Table 6.8** Daily protein targets for fuel and recovery

Situation	Protein targets
Light General health and low intensity exercise (power walking)	1.0–1.2 g/kg/day
Moderate Moderate sports and exercise levels (tennis)	1.2–1.4 g/kg/day
High High intensity endurance and training loads (triathlon)	1.4–1.6 g/kg/day
Very high Heavy resistance training to increase strength and bulk (weightlifting)	1.6–2.0 g/kg/day

## Relationship of macronutrients to energy systems

The fuel for the ATP-PCr energy system is phosphocreatine. Creatine is naturally found in animal protein sources. A healthy intake of organic lean meats, such as beef and fish, plus nuts and dairy will provide adequate creatine sources for most adults. For vegetarians or athletes undertaking heavy strength and power training, creatine supplementation may be of benefit to

ensure their stores are maximised.

### carbohydrate loading

consuming an increased quantity of carbohydrates in the final days before an endurance event to maximise glycogen stores

**glycogen sparing** using fats as an energy source for as long as possible during exercise to preserve glycogen for higher intensity and longer duration events

### haemoglobin

a protein within red blood cells that binds to and carries oxygen around the body

The fuel for the anaerobic glycolysis energy system and the aerobic energy system is glucose, which is stored as glycogen. For athletes, a diet high in carbohydrates will ensure that glycogen stores can power anaerobic and aerobic pathways for over 2 hours. The body can store up to 400 g in muscle and 100 g in the liver. Events lasting longer than 2 hours require consumption of glucose during the event to top up their stores. An example of this is a 5-hour stage riding in the Tour de France where athletes ensure they eat at least 50–100 g of glucose every hour while riding. Many professional teams also consume glucose gels and drinks at half time.

**Carbohydrate loading** for a 2 to 4 days before an endurance event will maximise glycogen stores.

Athletes in some long endurance events such as ultra-triathlon or riding in the bunch at a flat stage in a cycling race can also utilise fats as an energy source at lower levels of intensity (<60% MHR). This promotes **glycogen sparing**, ensuring that glucose is available for later in the race when the intensity increases.

## Micronutrients

Athletes generally have the same recommended dietary intakes for micronutrients (vitamins and minerals) as non-athletes. Due to the nature of elite training and competition, it is essential that a wide variety of nutritious food is consumed to ensure there are no deficiencies in the diet that could affect performance. Vegetables, fruit, nuts, legumes and lean meats provide most of these micronutrients and trace elements, which contribute to the optimal functioning of all body systems and chemical processes in the body. Supplementation of micronutrients is generally not advised, unless there is a specific cause of deficiency or for athletes who cannot eat a particular food group due to intolerance or preference. Natural food sources are always preferred as they are more effectively absorbed and used within the body.

## Relationship of micronutrients to energy systems

The impact of micronutrients on the efficient functioning of energy systems is less obvious than macronutrients that provide the fuel and energy. For non-athletes, small deficiencies of micronutrients are also less obvious. However, small impairments and deficiencies in micronutrients in elite athletes can have a significant impact on performance as increased metabolic turnover and energy usage can highlight deficiencies.

### Iron

Red blood cells contain iron, which is found in the protein **haemoglobin**. This transports oxygen from the lungs to body tissue for aerobic cellular respiration. Iron deficiency can lower oxygen-carrying capacity, causing a large decrease in aerobic efficiency in the human body, leading to increased fatigue and lethargy outside of training. Athletes aim to perform as much of their physical work aerobically as possible, as it is less fatiguing.



**Figure 6.13** Carbohydrate loading for 2 to 4 days before an endurance event will maximise glycogen stores.

Therefore, iron is a key mineral and athletes must ensure they meet their recommended daily intake (RDI). Female endurance athletes or those that require low body fat levels are at most risk of **anaemia** and the negative effect of low iron levels, which can be compounded by menstruation. Lean red meat is one of the best sources of iron, so vegetarians need to also ensure they consume iron-rich foods. Athletes with low iron may need to take supplements.

### Calcium

Calcium plays a key role in bone growth and density, as well as for muscle contraction. While regular strength-based exercise promotes increased calcium levels and bone density, high intensity training can decrease oestrogen levels in female athletes, which will promote the loss of calcium, leading to the increased risk of bone stress fractures. Calcium is also a key element required for muscle contraction. If there is a deficiency, the body will draw what it needs from the bones, further compounding the loss of bone density. Supplementation is possible, but natural food sources are preferred.

### Antioxidant vitamins

High intensity training or unfamiliar training can lead to micro muscle damage and the accumulation of metabolic waste products, including free radicals. It is believed that these may delay recovery and can damage body cells. Antioxidants often found in the different colours of fruit and vegetables help remove these free radicals and therefore are assumed to benefit recovery. This is an emerging area of research, and it is generally believed that a healthy diet of varied nutritious foods will supply adequate amounts.



**Figure 6.14** Antioxidants are often found in the different colours of fruit and vegetables.

### The nutritional needs of active people

Active people's nutritional needs may vary, depending on the type of activity they are involved in. For example, aerobic and anaerobic activities have different requirements, as do elite athletes compared to recreational athletes.

**anaemia** a condition where the red blood cells, iron or haemoglobin levels are at low levels, affecting oxygen carrying capacity

### Predominantly anaerobic versus predominantly aerobic activities

Predominantly anaerobic activities (such as weightlifting, rugby, shot put and gymnastics) have a greater need for increased total energy intake, particularly protein. The nature of anaerobic training leads to higher degrees of micro tissue damage and forced adaptation, leading to larger and more powerful muscles. In order to supply the necessary building blocks for these adaptations, which occur during the recovery phase of training, a diet rich in protein is required – for example lean meats, nuts and dairy. Protein supplements (powdered drinks) can also help anaerobic athletes to achieve the goal of consuming 1.6–2.0 g/kg/day. Regular intake of carbohydrates for an active athlete should be sufficient.

Comparatively, predominantly aerobic activities use more stored glycogen, and therefore people involved in these activities need to ensure they eat a high energy diet that's rich in complex carbohydrates that provide a sustained slower release of glucose into the

bloodstream. Foods with a lower **glycaemic index** (GI) should be regularly consumed throughout the day (e.g. oats, brown rice and wholegrain breads), and high GI sugary foods should be largely avoided apart from immediately prior, during and after

**glycaemic index** a rating system for the effect that different foods have on blood sugar levels, with pure sugar (glucose) being 100

performance or training to promote immediate glycogen recovery. Again, aerobic athletes should aim to consume 6–12 g/kg/day. Protein is also required for these athletes to help repair damaged muscle tissue following intense training.

Finally, water is an essential nutrient vital for the basic functioning of the human body. Different levels of dehydration are shown to have marked effects on anaerobic and aerobic performance. Training at a moderate level will lead to the loss of 1 L of bodily fluid per hour, and more in hot conditions. Regular RDI is 2 L/day, and athletes need to consume more than this to ensure they stay hydrated throughout activity. Hydration starts before training and should be sustained throughout as well as afterwards. Typical guidelines are:

- Drink an extra 500 mL to 1 L over 2 hours before training.
- Drink 150 mL per 15 minutes during performance if possible.
- Drink the equivalent of 150% of the body weight lost via dehydration (1 L lost would require 1.5 L of water).

Athletes routinely weigh themselves before and after training to monitor water levels. Heavy aerobic training and excessive sweating can also lead to a loss of electrolytes and salt imbalance. Sports drinks help to restore electrolyte balances.

### Recreational versus elite athletes

Professional and elite athletes often train for multiple sessions on most days of the week, and at a volume and intensity far above the levels at

which recreational athletes may perform. This requires a significant increase in total energy and nutritional intake; however, the balance of nutrients and energy intake is often similar to that of recreational athletes. Even non-athletes who are training to increase strength and bulk will require a similar amount of protein as an elite athlete.

An area that often differs is the use of macronutrient and micronutrient supplementation. Many athletes take the approach that it is better to ‘make sure’ and may over-consume certain nutrients, but this can have a detrimental effect on health and performance (e.g. fat-soluble vitamins can be over-consumed and stored in the body, leading to negative health effects).

Most elite athletes also require very precise body composition levels of lean muscle mass and body fat percentage to maximise performance. Carrying excessive weight, even a few kilograms, can be highly detrimental to performance (consider a triathlete over 2 hours of activity). For this reason, athletes will only increase their energy intake to match the energy output from training. Different training cycles may require an adjustment in RDI to match the volume and intensity of training; otherwise they may over- or under-consume the nutrients they require.

## Activity 6.2

### Recovery meals

Bring to class a recovery meal that would be suitable for an athlete after a competitive sports game and that can be prepared ahead of time. Research and present the macronutrients, micronutrients and quantity of fluids included in the meal.

**Skills:** analysis, communication, problem-solving, research



Quiz

## Revise and summarise 6.2

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 What are the differences between macronutrients and micronutrients?
- 2 How do the seven nutrients the human body needs relate to the three energy systems and sports performance?
- 3 Summarise the main differences between the nutritional needs of predominantly anaerobic versus predominantly aerobic activities.
- 4 Summarise the main differences between the nutritional needs of recreational and elite athletes.

## Think critically and apply 6.2

Using academic articles, research and compare the specific nutritional requirements of an anaerobic strength or power athlete with those of an aerobic endurance athlete. Select a specific sport for each. Use this table to assist.

**Anaerobic athlete (e.g. 200–400 m sprinter, weightlifter, long jumper, 50 m sprint swimmer)**

	Advice	Food example and quantity	Reason
Specific macronutrient requirements			
Specific micronutrient requirements			
Nutritional requirements <i>before</i> training and performance (1–3 hours)			
Nutritional requirements <i>during</i> training and performance			
Nutritional requirements <i>after</i> training and performance (1 hour)			
Hydration guidelines			

**Aerobic athlete (e.g. triathlete, endurance cyclist, open water swimmer)**

	Advice	Food example and quantity	Reason
Specific macronutrient requirements			
Specific micronutrient requirements			
Nutritional requirements <i>before</i> training and performance (1–3 hours)			
Nutritional requirements <i>during</i> training and performance			
Nutritional requirements <i>after</i> training and performance (1 hour)			
Hydration guidelines			

**Skills:** analysis, research



Depth Study



Collaborative investigation

## 6.3 Aerobic and anaerobic training

### Learning objective 6.3

COMPARE how aerobic and anaerobic training is different for different sports

**Aerobic training** entails producing energy with, and in the presence of, oxygen. Typically this is low to moderate intensity exercise where the oxygen demands and needs of the working muscles can be supplied and met via the cardiorespiratory system.

**Anaerobic training** entails producing energy without, and in the absence of, oxygen. Typically this is higher to maximal intensity exercise where the oxygen demand and needs of the working muscles cannot be supplied and met via the cardiorespiratory system.

All training and conditioning programs rely on aerobic pathways and, to varying levels, anaerobic pathways. Before undertaking a new training program, athletes (and non-athletes) need to identify their desired performance and fitness goals, which will determine the intensity and structure of their training. These goals may include:

- weight loss and improved cardiovascular health
- base aerobic conditioning
- increased performance levels for endurance activities (e.g. 5 km parkrun)
- muscle toning and improved posture and muscular endurance
- increased lactate tolerance, recovery and ability to perform high-intensity intervals to improve competitive performance
- increased **max VO<sub>2</sub>**

**max VO<sub>2</sub>** the maximum amount of oxygen a person's body can absorb during exercise. Measured in millilitres of oxygen absorbed into the muscles per kilogram per minute

#### physiological adaptations

metabolic or physiological changes within cells and tissue in response to training stimuli

Clarifying these performance goals and desired **physiological adaptations** allows a suitable training program to be designed. The choice of training will sit

somewhere between sustained and moderate intensity exercise for a longer period focused on aerobic training, right through to sub-maximal to maximal work intervals with periods of rest that require focused anaerobic training (or a blend of each somewhere in between).

The desired physiological adaptations are also dependent on the specific requirements of various sports. Consider the differences between racing over 100 m, 1500 m or 42 km. Even within team sports, individual requirements can vary greatly depending on the positional requirements. Consider the goal keeper and centre in netball, where the intensity of efforts made can vary greatly, which therefore requires specificity within aerobic and anaerobic training programs.

To ensure specific performance goals are met, it is important to be able to measure when the person is training both aerobically and anaerobically. A person's working heart rate while exercising can indicate when they shift from aerobic into anaerobic work. However, there are many variables that can influence these calculations such as age, gender and fitness levels. Experienced trainers can personally detect these differences through the perceived rate of exertion (PRE) and fatigue from the exercise being performed. Typically, these measurements are determined as a percentage of a person's maximum heart rate (MHR). While not always allowing for individual differences, some common measurements used to determine MHR include:

**220 – age:** the easiest and most commonly used formula, though variables can decrease accuracy

**206.9 – (0.67 × age):** a more accurate formula for people over 40 years of age

**211 – (0.64 × age):** a more accurate formula for generally active people.

*NB: Women often have MHRs 5–10 beats faster than men.*

Many athletes are familiar with the use of the Rate of Perceived Exertion chart (RPE), which allows them to more accurately self-assess their own intensity level to help ensure they are working at the right intensity.

RPE zone	Name	Effort intensity	Repetition duration	Maximum duration	Percent MHR (approximate)	Type of training	Performance benefits and adaptations
10	Sprint	Maximum 'all out'	0–15 secs	10 mins	95–100%	Sprints	<ul style="list-style-type: none"> <li>↑ neuromuscular power through</li> <li>↑ size/strength of fast twitch muscle fibres</li> <li>↑ CP stores</li> </ul>
9	Sub-sprint	Near maximum	15 secs–2 mins	10–20 mins	90–95%	Short interval	<ul style="list-style-type: none"> <li>↑ anaerobic capacity and speed endurance,</li> <li>↑ Max VO<sub>2</sub></li> <li>↑ rate of recovery</li> <li>↓ perception of fatigue</li> <li>↑ lactate tolerance/clearance</li> </ul>
8	Fast run VO <sub>2</sub> max	Very Difficult	2–10 min	20–40 mins	85–90%	Moderate – long interval	
7	Lactate threshold	Difficult hard	10–30 mins	30–60 mins	80–85%	Aerobic interval / fartlek	<ul style="list-style-type: none"> <li>↑ Lactate threshold zone</li> <li>↑ lactate clearance</li> </ul>
6	Tempo runs	Fast aerobic	30–60 mins	60–120 mins	75–80%	Fast continuous / tempo runs	<ul style="list-style-type: none"> <li>↑ muscle capillarisation</li> <li>↑ aerobic capacity, stroke volume, cardiac output</li> <li>↑ ventilation</li> </ul>
5	Aerobic	Moderate aerobic	60–90 mins	90–180 mins	70–75%	Moderate continuous	<ul style="list-style-type: none"> <li>↑ aerobic capacity</li> </ul>
4	Endurance	Light aerobic	60–120 mins	24 hours	60–70%	Light continuous	<ul style="list-style-type: none"> <li>↑ muscle glycogen stores</li> <li>↑ RBC count</li> <li>↑ Slow twitch muscle fibre size</li> <li>↑ mitochondrial stores</li> </ul>
3	Recovery	Slow jog	NA	24 hours	50–60%	Recovery interval	NA
2	Easy	Easy fast walking	NA	24 hours	40–50%	Recovery interval	NA
1	Rest	Rest slow walking	NA	24 hours	30–40%	Recovery interval	NA

Figure 6.15 Rate of Perceived Exertion (RPE) zones

Another important metric to measure and understand is the point at which an athlete transitions from working aerobically (where the oxygen demand is being met) and increases the intensity until they are working anaerobically (where the oxygen demand is greater than that which the body can deliver to working muscles), leading to increasing fatigue that will eventually force the athlete to slow down and recover aerobically.

Lactate remains at a steady level as intensity increases, with a small but marked increase at around 70% when the body starts to use more glucose than fat as the main form of fuel (commonly referred to as the aerobic threshold AeT). As intensity continues to increase, there is another marked increase at approximately 85% where lactate starts to increase more rapidly. This second point

**lactate threshold** the point at which blood lactate starts to more rapidly increase, indicating that the body is starting to work anaerobically and will experience increasing rates of fatigue

of more rapid increase in lactate is known as the anaerobic threshold (AnT) or **lactate threshold (LT)**, and this is the point or heart rate zone at which lactate starts to accumulate faster than it can be removed. This means that the body is starting to be unable to meet the oxygen demand and is considered to be working anaerobically (recognising that there is oxygen present, but there is not

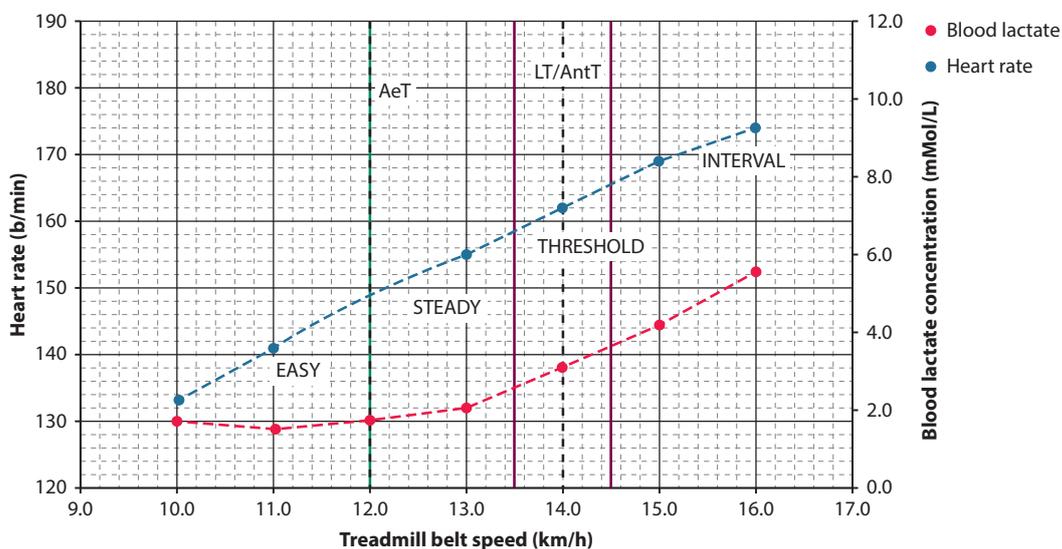
enough to fuel aerobic pathways). If the intensity continues to increase, then the degree of anaerobic work also increases, and lactate increases until the point of exhaustion.

Lactate threshold is an area in which there are many misunderstandings and contradictions in the

research and specific terminology used. Lactate threshold is sometimes referred to as anaerobic threshold, onset blood lactate accumulation or the lactate inflection point.

To accurately measure and test blood lactate during physical activity, blood analysis can show the intensity of exercise that correlates with the sharp increase in lactate, indicating the level where an athlete transitions to working increasingly anaerobically.

Athletes in different sports are then able to convert and use these measurements to suit their own sport: most athletes use heart rate, cyclists use power wattage output, and rowers use stroke cadence. Experienced athletes learn to accurately track against their perceived rate of exertion (PRE) to judge when they are working just below, at or above the point or zone of lactate threshold. In sports such as triathlon, rowing, middle distance swimming and running, an athlete aims to work consistently for an extended period just below the lactate threshold zone, and to only go above it if necessary (e.g. when nearing the finish line), as doing so will require an interval of rest and recovery afterwards. This is undesirable mid-event as the fatigue and inefficiency of this interval will decrease performance. Training programs aim to increase an athlete's lactate threshold zone, allowing them to tolerate higher levels of lactate as well as be able to clear lactate more efficiently using aerobic pathways. Therefore, a variety of training is required for athletes to build these capacities, and this training needs to be tailored to the specific requirements of that athlete, who, for example plays a particular position in a specific sport.



**Figure 6.16** Graph showing the relationship between blood lactate and increasing heart rate  
 ISBN 978-1-108-95129-6 © Hawgood et al. 2024 Cambridge University Press & Assessment  
 Photocopying is restricted under law and this material must not be transferred to another party.



**Figure 6.17** Lactate threshold testing during a maximal oxygen uptake test

RPE scales and associated language are often used to help athletes know what level of intensity they should be moving at for a set interval or period of work, and the examples that follow use this same language. Another recent development is the understanding and use of **maximum aerobic speed (MAS)**. This is a level just below lactate threshold, where the lactate levels start to rise more noticeably. An athlete performing above their MAS will not be able to sustain aerobic activity for an extended period.

### Aerobic training

Aerobic training involves periods of sustained work longer than 30 minutes at a steady, low-moderate intensity (level 3–5 RPE). Because the oxygen demand can be met while working aerobically, this intensity of training can be sustained for over 2 hours, until the body starts to be depleted of glycogen levels. There are various ways this can be measured, but a common way is to maintain the working heart rate between 70–85% of MHR (though variables can influence these measurements). A few training protocols or methods include the following.

- Continuous training: steady pace and speed is maintained for over 30 minutes.  
*5–10 km at a steady pace maintaining a consistent heart rate (level 3/4 RPE)*
- Fartlek training: continuous training where periods of slower work are interspersed with periods of faster work. ‘Fartlek’ is Swedish for ‘speed play’.

*30 seconds high speed run (level 8–9 RPE); then 2 minutes moderate run (level 3/4 RPE) for 8 repetitions*

- Aerobic interval training: periods of work and rest that take the athlete to and marginally above the lactate threshold.

*2 minutes fast run (level 7/8 RPE), then 4 minutes of recovery run (level 2/3 RPE) for 8 repetitions*

- Aerobic circuit training: A variety of moderate exercises performed in a sequence that keep the heart rate at approximately 70–85% for over 30 minutes. This also develops muscular endurance.

*5 circuits of squats, skipping, sit-ups, bench push ups, lunges: 45 seconds of work with 15 seconds of rest*

**maximum aerobic speed (MAS)** the lowest speed at which an athlete reaches their maximal oxygen uptake ( $\text{MaxVO}_2$ )

Sports that rely more heavily on aerobic training are longer endurance-type events lasting 90 minutes and up to several hours. Individual sports include middle-distance running, long-distance swimming, triathlon, road cycling and cross-country mountain bike racing. In team sports, positions such as a midfielder player in football, who cover over 10 km in 90 minutes must also have large aerobic engines. Aerobic training is also an essential component of higher intensity anaerobic training and sports. A strong aerobic base allows for more efficient lactate clearance and recovery, allowing the athlete to be ready for the next higher intensity effort in anaerobic training.

## Anaerobic training

Anaerobic training utilises anaerobic pathways that operate in the absence (or lack of) sufficient oxygen. As a result, it involves varying periods of work and rest to suit the requirements of the particular sport being performed. Therefore, anaerobic **interval training** is required to prepare the athlete for success.

**interval training** periods of high intensity work efforts interspersed with periods of rest and/or active recovery

- **Anaerobic interval training (moderate – long):** Intermittent sports that cycle through higher intensity efforts, followed by a short active recovery, require training that also continuously cycles through these defined periods of work and rest, and which keep the athlete in a constant state of fatigue (e.g. football, basketball, netball, AFL, rugby, enduro mountain bike racing, middle distance swimming, and 200–800 m running). By switching between aerobic and anaerobic

intensities, the athlete is able to build the capacity to work harder, longer and more often (level 8–10 RPE), and then recover quicker, ready to go again (level 2/3 RPE). Work and recovery efforts should replicate the requirements of the sport, be between 15 seconds and 2 minutes, and have a similar rest period to that of the actual sport. By consistently working under high levels of fatigue, the athlete develops greater lactate tolerance and improved aerobic recovery with efficient lactate clearance.

- **Anaerobic interval training (short):** This is training for maximal effort sports of short duration (level 10 RPE) that rely on phosphocreatine pathways for energy and do not require oxygen as they last for no more than 15 seconds (e.g. 100 m sprint, shot put, weightlifting and high jump). Rest periods involve slow active recovery that allow for PCr stores to be fully restored, ready for the next effort (level 1/2 RPE).

**Table 6.9** Ratios for interval training

Type of training	Sport examples	Work to rest ratio	Intensity of work effort	Minimum duration
Aerobic interval	Rowing, road cycling, middle distance running	2:1–1:1	Just above lactate threshold ( $\approx$ 80–85% MHR)	2 minutes +
Anaerobic interval (moderate–long)	Football, basketball, 200 m swim, 400 m sprint	1:2–1:4	Well above lactate threshold ( $\approx$ 85–95% MHR)	15 seconds–2 minutes
Anaerobic interval (short)	100 m sprint, shot put, weightlifting, high jump	1:5–1:25	Maximum ( $\approx$ 95% + MHR)	1–15 seconds



**Figure 6.18** AFL players in pre-season training using aerobic and anaerobic intervals

## Practical Application 6.2

### Aerobic and anaerobic activities

Participate in a range of different aerobic and anaerobic activities, taking careful note of the work to rest ratio of each. Use an RPE scale to start to personally describe how each level feels and compare this against the work heart rate at the end of each work interval. Compare also the experience of recovery and the effect it has on the next effort.

**Skills:** analysis, communication

## Differentiated training programs

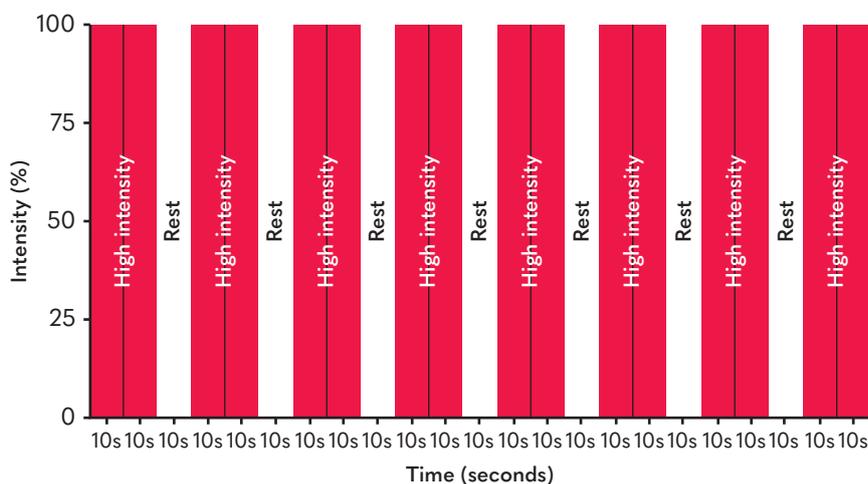
Research and sports science continue to reveal more detailed information about the specific requirements of athletes in varying positions in different sports. This important data allows for highly differentiated and individualised strength and conditioning programs to be developed to suit the needs of specific athletes. Wearable technology such as GPS-tracking vests and devices that measure the power output on bikes and rowers provide real-time feedback and data to be analysed against an athlete's aerobic and anaerobic training zones, allowing for optimum development. This information also allows for increased tracking of the athlete's current and developing fitness capacities, as well as the total workload of training and performance, which can help protect against overtraining that pushes the athlete over the fine line of excessive training loads. Differentiated training programs can also be required for athletes with disabilities or functional limitations due to injuries. An athlete with a lower limb limitation may need to use a hand cycle to develop their aerobic and anaerobic capacities.

## Contemporary training methods

The world of strength and conditioning in professional sport evolves at a rapid rate, making it hard to keep up with the latest research, training innovations, philosophies and even language. At the highest level, the Australian Institute of Sport is heavily invested in ensuring that contemporary training methods are assessed for their value in performance for all athletes. Leaders of strength and conditioning in various sports and teams should also follow rigorous scientific processes to track the implementation of new training procedures and protocols to ensure player development, safety and wellbeing. As these methods become accepted at elite levels, they filter into recreational levels of sport and health to provide benefit for all participants. Some examples of these contemporary training methods are listed below.

### High intensity interval training

Popularised through the CrossFit movement, High intensity interval training (HIIT) is now common language across all spheres of sport, fitness and health. It closely resembles anaerobic



**Figure 6.19** Tabata HIIT training protocol

interval training, with defined periods of ‘near maximal’ intense work followed by periods of lower intensity or total rest. Sometimes described as metabolic training, it takes athletes well into the ‘red zone’ of intensity for short bursts, which causes a significant spike in metabolism for a period. This has many positive benefits for aerobic and anaerobic performance and improved cardiovascular health. Many group fitness classes, online training workouts and apps utilise HIIT training, and the shorter nature of the workouts is attractive for busy people. A well-researched HIIT protocol known as Tabata was developed by Izumi Tabata in 1996. It involves 20 seconds of high intensity work with 10 seconds of rest for eight repetitions (total of four minutes work). To be effective, the athlete should be approaching fatigue and exhaustion in the seventh and eighth repetition, and should complete two to three sets in a workout. For example, if you’re doing a body-weight squat Tabata workout, the first set should be slightly uncomfortable as you complete them at a moderately fast pace, but you then hold that same ‘rep’ count for each set, which leads to the required elevation of heart rate and fatigue.

### Sprint interval training

Sprint interval training (SIT) is similar in nature to HIIT; however, rather than completing ‘near maximal’ efforts, the work efforts for SIT are brief, intermittent bursts ‘all-out’ at maximum intensity. The rest periods of active or passive recovery are also longer. Four rounds of 30 seconds maximal work with 4 minutes rest in between would count as a SIT session. Studies have shown mixed results comparing HIIT and SIT in regards to anaerobic and aerobic performance; however, they both have been shown to lead to greater results compared to moderate and steady intensity exercise. SIT also engages the neuromuscular system more than HIIT, which may lead to improved speed and power for athletes. The physical conditioning required to perform SIT requires athletes to be well conditioned in all areas of base fitness and to always ensure a proper warm up and cool down to ensure safety.

### Speed, agility and quickness training

Speed, agility and quickness training (SAQ) recognises that many movements in competitive sports involve rapid changes of speed and



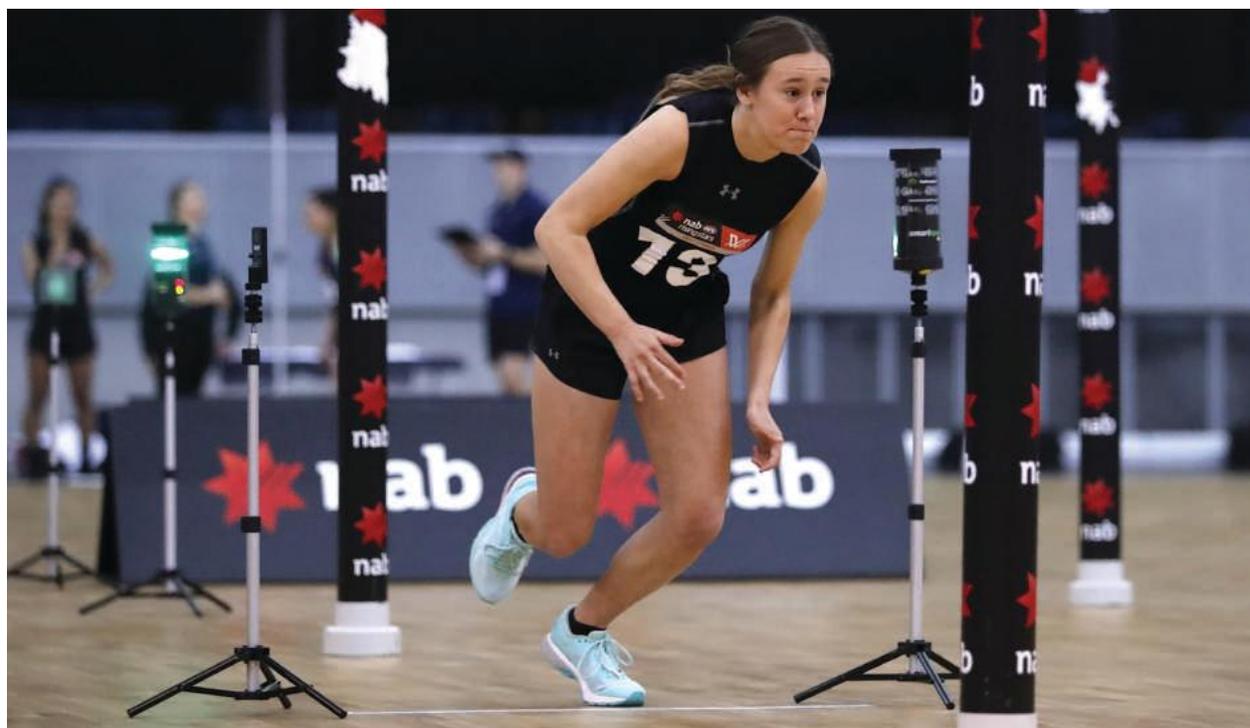
**Figure 6.20** Footballers doing sprint interval training (SIT)

direction, often in response to an external stimulus such as the movement of an opposing player, requiring a reaction and decision in response. However, there is value in SAQ for everyone as everyday moments also require the ability to respond quickly to a situation, such as ducking out of the way of a falling object or catching yourself if you trip. Many exercises simply operate in a front plane (e.g. running only involves movement straight ahead). Moving forwards, backwards, laterally and at varying paces are important components in most sports and also provide reduction in injury risk during dynamic movements. SAQ seeks to develop the following reflexive and neuromuscular abilities of the human body across multiple planes:

- Speed is the ability to move the body or parts of the body as fast as possible (e.g. sprinting after taking an intercept in football or rapid acceleration to chase a deflected ball in volleyball).
- Agility is the ability to accelerate, decelerate and change direction with accuracy and speed in response to an external stimulus. Many agility tests are predictable and known, but true agility requires a decision to be made (e.g. stepping left or right in response to an opponent’s movement).
- Quickness is the ability to react and change body position and direction as fast as possible with maximum force production (e.g. a vertical jump to rebound in basketball or adjusting tackle technique in rugby as an opposing player makes a late change of direction).

Examples of SAQ training activities include:

- ‘T’ or ‘X’ drills that involve moving in all directions as fast as possible
- zigzag drills with changes of direction in response to a cue (light or voice)
- ‘tennis ball drop and catch test’ and light reaction testing to develop reaction speed
- chase and tag drills where a player needs to react to the unpredictable movement of a tagger
- agility ladders and hurdles to develop bounding and rapid short movements.



**Figure 6.21** Agility testing to measure an athletes’ reaction time, acceleration, deceleration and ability to change direction, seen here in AFL testing where the green light flashes to signal when to run and which direction to step

### Revise and summarise 6.3

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Summarise the key features of aerobic training methods (continuous, fartlek, aerobic interval and aerobic circuit training) and identify advantages and disadvantages of each.
- 2 Summarise the key features of anaerobic training methods (medium-long anaerobic interval, short anaerobic interval, fartlek) and identify advantages and disadvantages of each.
- 3 Identify reasons why it is important to have differentiated training programs, and give examples of how athletes in the same sport may have a differentiated program.
- 4 Outline the key features of contemporary methods of training (HIIT, SIT and SAQ).



Quiz

### Think critically and apply 6.3

- 1 Critically analyse the physical performance requirements of a specific sport (individual or group, or compare positions within a team sport) and justify the best type of aerobic and/or anaerobic training to meet these requirements.
- 2 Collaborate and design a weekly in-season training session for a sport that incorporates a variety of relevant conditioning activities aimed at improving performance. Justify the inclusion and design of each selected activity.



Collaborative investigation

**Skills:** collaboration, analysis, problem-solving, research

## 6.4 Programming based on the FITT principle

### Learning objective 6.4

DESIGN a training program based on the FITT principle

The FITT principle (frequency, intensity, type of exercise and time or duration of exercise) provides the basic parameters of training program design intended to develop the desired physiological adaptations. These parameters are only a broad estimate, suitable for recreational and amateur athletes. Professional and full-time athletes may exceed these to achieve their performance goals.

There are many variables that can affect these guidelines based on individual and sporting requirements. Sports that require aerobic and anaerobic capacities will include varied blends of these training types, depending on the phase of training in the periodised annual plan. For example, early pre-season training in most team sports often has a broad focus on developing an aerobic base, whereas late pre-season shifts to include more anaerobic training to prepare for the intense demands of competition.

**Table 6.10** A FITT program

FITT principle	Aerobic training	Anaerobic training
<b>Frequency:</b> How many training sessions per week?	3–5 training sessions per week	2–4 training sessions per week
<b>Intensity:</b> How intense should the training sessions be?	70–85% max heart rate	85%+ max heart rate
<b>Time:</b> How long should each session be in duration?	20–120 minutes in the aerobic training zone	15–45 minutes in the anaerobic training zone
<b>Type:</b> Which exercises should be undertaken?	Moderate aerobic-based activities (running, swimming, riding, rowing, light/body-weight resistance training) using either continuous, fartlek, long interval or aerobic circuit protocols	High-intensity anaerobic activities (running, swimming, riding, rowing, moderate-heavy resistance training) using specific interval protocols of work to rest ratios to achieve the desired goal



Quiz

### Revise and summarise 6.4

Complete the quiz in the Interactive Textbook and answer the question below on paper or in the Interactive Textbook.

- 1 For each of the principles of FITT, provide a definition and outline the guidelines for an aerobic and anaerobic training program.

### Think critically and apply 6.4

In small groups, design a training program for a micro-cycle (once per week) for a chosen sport. Include an overview of the intended conditioning focus (aerobic or anaerobic) and a brief outline of the activities in each session. Ensure that all elements of FITT have been addressed and highlighted.

**Skills:** collaboration, creative thinking, problem-solving

## 6.5 Immediate physiological responses to aerobic training

### Learning objective 6.5

INVESTIGATE the physiological responses to aerobic training

Imagine you are to complete a 5 km parkrun at varying speeds. What does your body feel like if you:

- move at a fast walk/slow jog
- move at a steady run pace that can be held consistently
- move at a fast run pace that requires you to intersperse your run with slower recovery sections.

What are the major changes that your body makes to accommodate these adjustments in speed and intensity?

What are the primary reasons for these changes?

### Immediate physiological responses to training

At rest, our body exists in a state of homeostasis where chemical reactions are stable and balanced (similar to a car that is simply idling and not moving – it is producing heat and some parts are moving, while other parts are stationary). While moving at a stable intensity for a prolonged period (e.g. jogging for 3 km), several key physiological changes occur within the various systems of the body to restore a level of functioning balance (similar to a moving car in cruise control). If this homeostasis is not recalibrated and restored to accommodate this activity, severe physiological changes could cause significant damage.

An obvious example of this is the production of sweat, and **vasodilation** after sustained movement. If the body is not able to maintain a steady core

body temperature of 37 °C to 38 °C, then rising levels will cause the breakdown of enzymes and damage to major organs. The homeostasis of temperature is achieved by a number of changes in various body systems in response to the increased metabolic (chemical) activity.

#### vasodilation

the dilation or widening of blood vessels and capillaries near the surface of the skin to increase heat loss

During exercise, most of the changes and responses occur primarily to ensure that the muscles have the required oxygen and nutrients to sustain the increased level of activity, as well as aid the removal of metabolic waste products such as carbon dioxide. In the case of extreme sports, the body can sustain such levels for many hours, such as an ultra-ironman event that lasts for over eight hours, as long as nutritional intake is maintained. There are five immediate physiological responses to training.



**Figure 6.22** Runners in a 5 km parkrun experiencing the immediate physiological responses to steady exercise.

## Heart rate

The most obvious change that occurs during an increase in physical activity levels is an increase in **heart rate**. This can be easily detected and monitored by the participant, and can provide relatively reliable information about the intensity

**heart rate** the number of times the heart beats in one minute

**maximum heart rate** an approximate calculation of the maximum heart rate an individual can work towards, measured as  $220 - \text{age}$  (e.g. the MHR of a 25-year-old would be  $220 - 25 = 195$  bpm)

of exercise. For most healthy adults, resting heart rate should be between 60 and 72 beats per minute (bpm). This range is indicative of a healthy and efficient cardiovascular system. As athletes develop their cardiorespiratory endurance, their resting heart rate can be reduced to as low as 30 bpm.

As exercise increases, so does the working heart rate to ensure that the increased oxygen demand is being met. This will continue until the heart rate reaches a

maximum. This is known as **maximum heart rate** (MHR). A common and simple calculation is  $220 - \text{the age of the athlete}$ . Another formula considered to be more accurate is  $208 - (0.7 \times \text{age of athlete})$ . It should be noted that many factors can influence both maximum heart rates as well as target heart rate zones.

If an athlete settles into an intensity of exercise that they are able to sustain for 20 to 45 minutes, the heart rate will level off, and only change if there is an increase or decrease in exercise intensity. Athletes mostly measure the intensity of exercise as a percentage of their MHR. To achieve specific goals, they may aim to work within a set zone for a set amount of time. Table 6.11 outlines basic characteristics of these heart rate target training zones.

As soon as exercise starts, the heart rate will rise rapidly and level off as the intensity of exercise finds a steady state. Likewise, when exercise stops,

**Table 6.11** Heart rate target training zones

% of MHR	Heart rate zone descriptions
50–60%	<b>Basic aerobic training zone:</b> this zone is typical for older or untrained individuals starting an exercise program. For most young healthy adults, a brisk walk would raise their heart rate into this zone. This is also the zone that is optimal for a cool-down or recovery interval. While in this zone, the body is working aerobically using more fat as an energy source, with the oxygen needs of the muscles being easily satisfied.
60–70%	<b>Health-based aerobic training zone:</b> this is a comfortable pace that can be sustained for an extended period. It is still a predominantly aerobic pace where oxygen demand is easily supplied for most healthy people. It is suitable for people aiming to increase cardiovascular health or for people new to training, who may be looking to develop a base level of fitness or are trying to lose weight. New research is finding the significant and unique improvement athletes can experience by training in this zone, commonly known as Zone 2 Aerobic Training. This is at a level where they are still able to hold a conversation, and the body adapts in powerful ways such as increased mitochondrial density, which increases aerobic capacity.
70–85%	<b>Performance-based aerobic training zone:</b> in this zone, the body is working at a more stressful level where cardiovascular and aerobic development will be more effectively achieved. At the lower end of this zone, kilojoules are optimally burned, using both fat and glycogen stores. As the athlete pushes towards the top end of the zone, fatigue levels will increase and there is a greater reliance on glycogen stores as oxygen needs are becoming more difficult to meet. Working consistently above 80% MHR for an extended period is very challenging, but leads to the greatest aerobic development.
85% +	<b>Anaerobic training zone:</b> as athletes begin to work above 85% MHR, they will experience a greater degree of fatigue, due to localised neuromuscular fatigue (a feeling of heaviness within the muscles), as well as an increase in metabolic by-products such as lactate. Athletes generally have to intersperse this intensity of training with a rest period at a lower intensity, which is known as interval training. This is also a very effective way to develop aerobic fitness.

the heart rate decreases rapidly initially, and then more slowly as it returns to the resting heart rate level. In unfit people, this recovery time is slower, and the immediate recovery from exercise is a key indicator of cardiovascular fitness.

### Stroke volume

To increase the amount of blood circulating around the body, the heart not only beats faster but harder as well. By contracting with more force, a greater amount of blood is ejected into the aorta and around all the arteries in the body. The **stroke volume** increases in direct response to the increased amount of blood being returned through the veins. This leads to a greater amount of oxygen being made available to the working muscles. Typically, stroke volume can double before reaching a plateau.

Stroke volume increases until the athlete is working between 40% and 60% of MHR, at which point it typically plateaus. In non-athletes, it increases from about 60 mL at rest to 120 mL at maximal exercise. In elite endurance athletes, stroke volume can increase from 100 mL at rest to 200 mL at maximal exercise. This stronger contraction in athletes is made possible by an increase in the thickness of the muscular wall of the left ventricle, which is a response to sustained aerobic training. Interestingly, stroke volume is greater when in the supine (or lying) position, as venous return does not have to overcome the increased gravitational force when standing in an upright position. Swimming is an example of exercise in this position.

### Cardiac output

The combined effect of a heart beating faster and harder is known as increased **cardiac output**. At rest, the oxygen demands of the body are easily

met, and there is little difference in the relative cardiac output between an untrained and trained individual. However, as the individual starts to exercise, cardiac output rises to meet the increased demand for oxygen.

To calculate a person's cardiac output, their heart rate should be multiplied by their stroke volume.

$$\text{Heart Rate (HR)} \times \text{Stroke Volume (SV)} = \text{Cardiac Output (CO)}$$

To determine the cardiac output of a healthy adult with a resting heart rate of 60 bpm and a stroke volume of 75 millilitres per beat, the calculation would be:

$$60 \text{ bpm} \times 85 \text{ mL/beat} = 5100 \text{ mL/min}$$

Interestingly, an adult on average has approximately 5–6 L of blood circulating in their body. Therefore, close to this entire quantity of blood circulates around the body each minute.

Exercise has a profound effect upon cardiac output. Table 6.12 outlines this for a trained athlete. The sixfold increase in cardiac output demonstrates the degree to which working muscles require significant amounts of oxygen to enable them to produce energy aerobically.

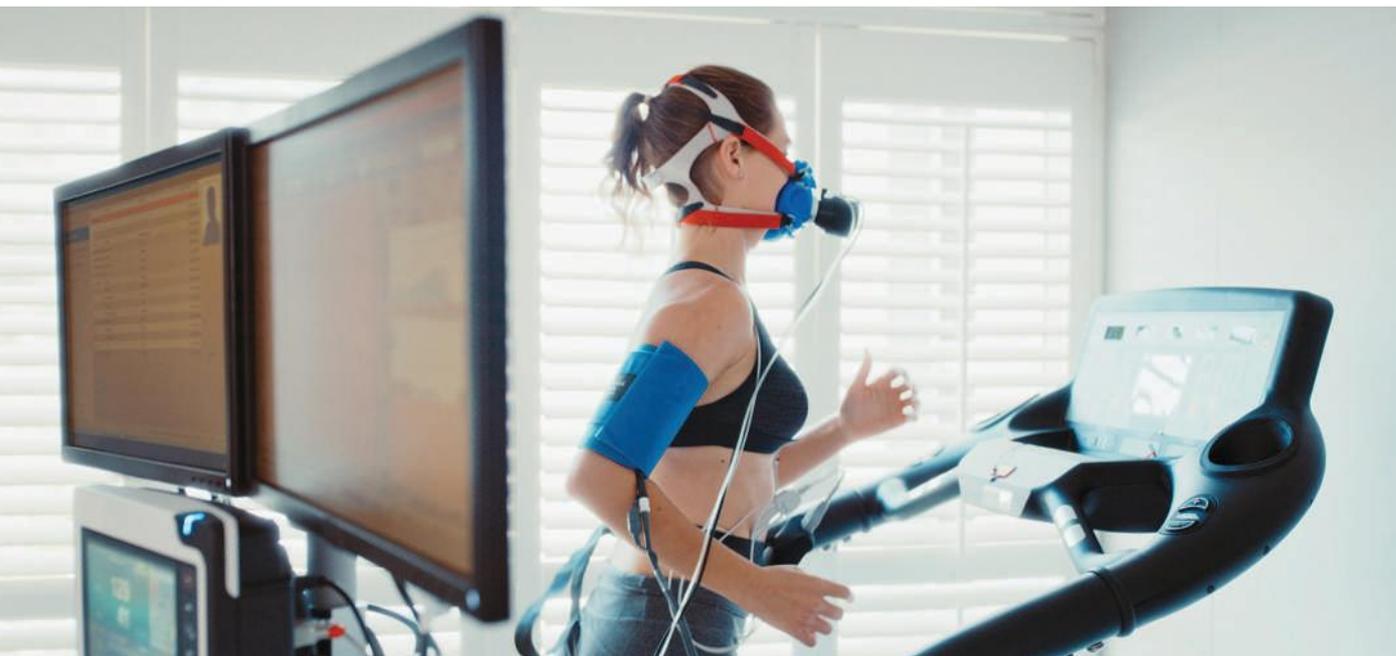
In addition to the extra oxygenated blood circulating around the body, a large proportion of the blood in the body is redirected from non-essential organs during exercise

**stroke volume** the volume of blood ejected by the left ventricle of the heart during each systemic contraction; it is measured in millilitres per beat

**cardiac output** the volume of blood ejected by the left ventricle of the heart per minute; it is generally measured in millilitres per minute

**Table 6.12** Heart rate, stroke volume and cardiac output

Intensity level	Heart rate	Stroke volume	Cardiac output
<b>Untrained athlete</b>			
At rest	72 bpm	70 mL/beat	5040 mL/min
High intensity	170 bpm	110 mL/beat	18 700 mL/min
<b>Trained athlete</b>			
At rest	50 bpm	100 mL/beat	5000 mL/min
High intensity	195 bpm	155 mL/beat	30 200 mL/min



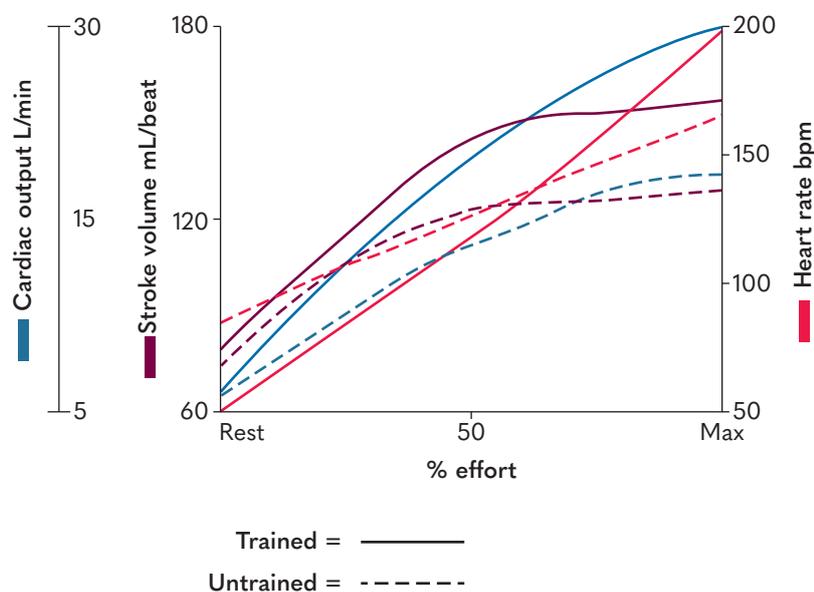
**Figure 6.23** Max  $\text{VO}_2$  testing, where oxygen intake is measured through increasing speed and incline until failure

such as the liver, kidneys and brain. At rest, muscles generally use up to 25% of the cardiac output. However, during exercise, this increases to over 80%.

Trained athletes are able to deliver the same amount of oxygen at lower heart rates, as the efficiency of their various body systems allow this. As exercise intensity steadily increases, so does the cardiac output, until its maximum output is reached (Max  $\text{VO}_2$ ). At maximum output, trained athletes are able to produce significantly greater amounts of aerobic power output, which translates

to faster speeds, an obvious advantage in sports such as triathlon.

Untrained adults will score a  $\text{VO}_2$  max of approximately 30 mL/kg/min. Trained athletes are able to achieve scores in excess of 75 mL/kg/min. Generally, males can achieve slightly greater scores due to their increased body size and muscle composition. A common test for Max  $\text{VO}_2$  is the multistage fitness test, commonly known as the 'beep' test.



**Figure 6.24** Graph comparing the differences in heart rate, stroke volume and cardiac output for trained and untrained individuals

## Ventilation rate

As exercise starts, the demand for oxygen in the working muscles also causes the rate and depth of breathing to increase to help meet this demand. This complements the increase in heart rate and subsequent blood flow, which carries the oxygen to the working muscles. The two stages of **ventilation** are **inspiration** (breathing in) and **expiration** (breathing out). Primarily, the inspiration is to draw oxygen-rich air into the lungs and the expiration is to remove the waste product of carbon dioxide. A full cycle of inspiration and expiration is considered a full breath or ventilation cycle.

Generally, an adult's resting ventilation rate and depth is approximately 12 breaths and 6 L of air per minute (**minute ventilation**). As physical activity increases, both the rate and depth of ventilation rapidly increase to meet the increased oxygen needs. Ventilation rate continues to rise until exercise steadies, and ventilation stabilises to ensure sufficient oxygen is being supplied. Likewise, when exercise stops, ventilation decreases rapidly at first and then more slowly until it returns to the resting level.

## Lactate levels

As the intensity of physical activity increases, blood lactate levels also increase, which is a clear indication of the intensity of exercise. There is much misunderstanding about the relationship between exercise fatigue and blood lactate levels. Firstly, the term lactic acid is often used interchangeably with lactate; however, this is not correct. Lactic acid is found in milk products and not the human body. Furthermore, most people believe that lactic acid is 'the enemy', and the cause of fatigue. This also is not true as lactate acts as a counteractive product against increasing hydrogen ions, muscle acidity and a loss of muscle contraction force. Lactate was covered in greater detail earlier in Section 6.1 Energy systems of the body and 6.3 Aerobic and anaerobic training.

As a quick recap, the two major processes used to resynthesise ATP involve the breaking down of glucose into pyruvate, in a process called glycolysis. If energy production occurs aerobically (in the presence of oxygen), pyruvate is processed

through a series of chemical reactions, and the body can efficiently maintain balanced pH levels and remove metabolic waste products from the working muscles. However, when glycolysis occurs anaerobically (when insufficient oxygen is available to the working muscles), pyruvate rapidly accumulates in the muscle as well as the pH-increasing protons from the rapid breakdown of ATP.

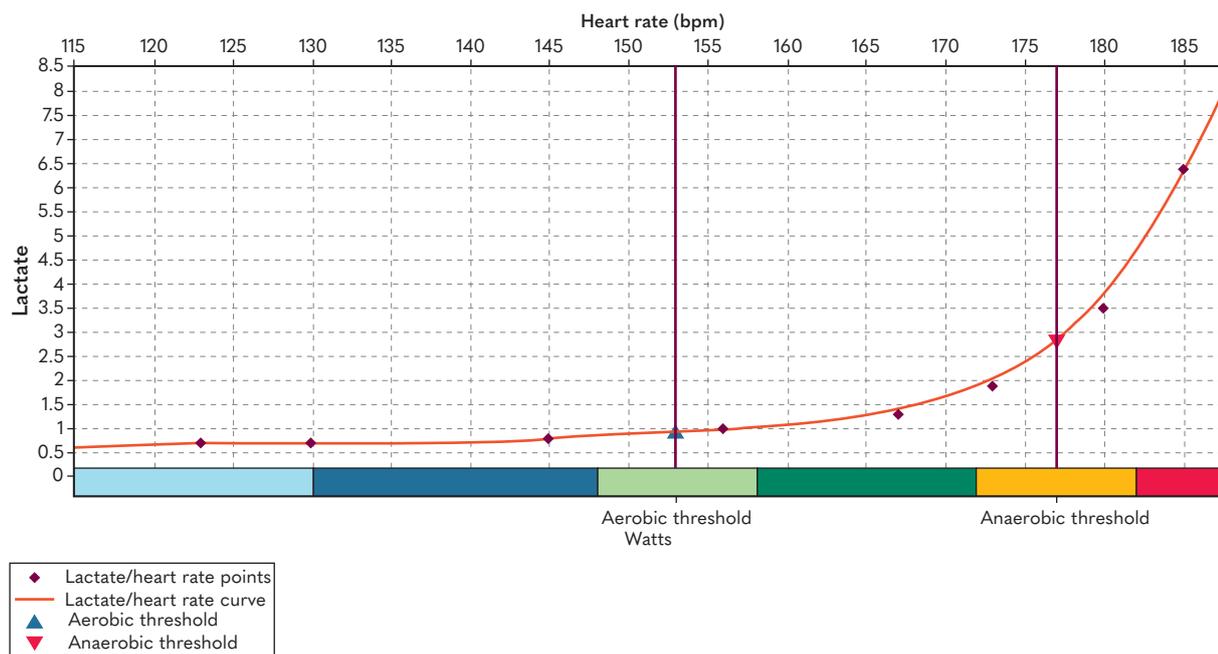
To buffer against this increasing acidosis that occurs during intense physical activity, the protons are absorbed into the pyruvate, resulting in a new substance called lactate. This lactate is then transported to the liver and other organs of the body, to be converted back into glucose to be used again for energy within the muscles.

During moderate exercise, lactate levels stay fairly consistent and low. As the intensity increases above a moderate level (known as the aerobic threshold) lactate starts to increase steadily. As the intensity increases to a higher level where the oxygen demand can no longer be met (known as the anaerobic threshold), lactate levels start to increase exponentially (known as onset blood lactate accumulation or OBLA) until a maximum effort is reached and the athlete is forced to stop or slow down.

A common misconception is that increasing lactate causes increased muscle acidosis, and is the primary cause of muscle fatigue and 'the burning sensation'. However, it is clear that increasing lactate levels are only an indication of intense training and could even be considered a beneficial by-product of anaerobic exercise. Lactate levels can be measured with a lactate analyser (which involves a finger prick to analyse a drop of the athlete's blood). When this occurs at regular testing intervals, an athlete's endurance and development can be monitored.

**ventilation** the depth and rate of breathing; ventilation rate is measured in breaths per minute and ventilation depth is measured in either millilitres per breath or litres per minute  
**inspiration** the act of drawing air into the lungs from the external environment  
**expiration** the act of releasing air from the lungs into the external environment  
**minute ventilation** the total amount of air that is breathed in one minute

## The lactate threshold and OBLA



**Figure 6.25** Graph outlining the relationship between increasing lactate levels and heart rate, specifying when the aerobic and anaerobic thresholds are crossed

### Immediate physiological responses to aerobic training

Professional and elite sport has driven an enormous amount of scientific research into the value of specific training methods, equipment and training aids in achieving the physiological adaptations desired for the performance requirements of sports. Leaders of strength and conditioning seek the most rigorous and effective methods to achieve this and will invest

large amounts of money in search of the ‘one-percenters’ – those methods that will help deliver the marginal gains that could lead to success. In order to develop these desired adaptations (which are explored more in Year 12 Health and Movement Science), training stimuli should elicit specific physiological responses that, over time, trigger the body to adapt and develop, leading to increased performance.



**Figure 6.26** Swimmer testing their lactate using a drop of blood between increasingly fast intervals

### Research skills 6.1

Investigate physiological responses to aerobic training by researching the effectiveness of a specific aerobic training method in developing a targeted physiological response. Ensure the training method is controlled, and the means of assessment is valid and reliable.

Submit a report of your investigation, based on the following requirements:

- Create a research question.
- Select a data collection method: possibilities include observation, survey or interview.
- Discuss whether there are any ethical considerations you need to consider for this data collection method.
- Discuss how you will ensure that the data you gather is valid, reliable and credible.
- Once you have gathered your information, present your findings and draw a conclusion about the effectiveness of the training method in developing the targeted physiological response.
- Identify whether your research has opened up any further questions that could be explored.

*You may wish to refer to the research skills material in the Interactive Textbook when completing this activity.*

**Skills:** collaboration, analysis, communication, creative thinking, problem-solving, research



Depth Study

### Revise and summarise 6.5

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 How does exercise immediately affect the following physiological responses to training? Include references to resting levels, sub-maximal levels and maximal levels.
  - a Heart rate
  - b Stroke volume
  - c Cardiac output
  - d Ventilation rate
  - e Lactate levels
- 2 Examine the reasons for the changing patterns of respiration and heart rate during and after sub-maximal physical activity.



Quiz

### Think critically and apply 6.5

As a group, create a simple practical learning lab that can be used to investigate and experience the immediate physiological responses to training at varying levels of intensity. Record your results and present a report of your findings using graphs to represent your data.

**Skills:** collaboration, analysis

## 6.6 Testing physical fitness

### Learning objective 6.6

DEBATE the purpose and outcomes of testing physical fitness for different population groups

All sports have a physical fitness profile that relates to successful performances. This profile is generally derived from analysing the relative contribution of the components of fitness to the unique requirements of a particular sport, and, in many scenarios, specific playing positions within a team game.

**Table 6.13** Components of fitness

Health-related components of fitness	Skill-related components of fitness
Cardiorespiratory endurance	Speed and power
Muscular strength	Agility
Muscular endurance	Balance
Flexibility	Coordination
Body composition	Reaction time

Targeted and specific testing of these physical fitness components is essential for a variety of reasons and in different contexts, and is relevant to all population groups. Professionals such as physical therapists, doctors and personal trainers regularly test the physiological capacities of people of all ages and levels of health. For those involved in active pursuits, testing is relevant for all levels of competitive athlete, from amateur through to elite. Being able to test someone's

current fitness capacities, and then use this data to inform future programs and goals, is a common process relevant to all people. In fact, many people will track their own health and performance in ways that are meaningful to them. As with all research and testing, it is essential that testing

**valid** the extent to which a test measures what it is supposed to measure

**reliable** the extent to which a test measures without error and is fair and repeatable

procedures are both **valid** and **reliable**, in order to produce credible results.

### Tracking progress towards health, fitness and performance goals

Physical fitness testing at the start of a new season or for new player signings provides reliable baseline data for the tracking of progression towards identified performance goals. By repeating these tests at key points in the training program and season, players and coaches can track and review their progress towards these goals. Many sports have developed their own set of testing procedures and equipment to increase the specificity of the test to the requirement of the sport. This increased validity as well as reliability has been driven through technological advancements and scientific research (e.g. timing gates, force plates, GPS tracking and, video technology). While students may perform the 'beep test' and the 'sit and reach test' at school, these may not be suitable for elite sports.

Given the scientific nature of most elite sports, the reliance on data is becoming increasingly important for success. Technologies such as GPS tracking and power output meters are changing our understanding of what athletes must be able to do in order to win, and therefore how they should train to reach these goals. Physical fitness testing is a key aspect of increasing the likelihood of attaining these goals.

Particularly during pre-season, athletes and teams undertake high training loads and volumes to improve their physical fitness capacities. Setting performance goals is a positive motivating factor, and using a valid and reliable test to track progress towards the goal is necessary. Younger players often use the off-season to increase resistance training to build their muscle hypertrophy and strength. Using benchmarks such as a 1 RM deadlift test can help them to track their improvements and progress towards an identified goal.

For example, the Bronco test is a 1200 m shuttle run that can provide valuable and comparable data between a player's previous and current efforts, and also can be used to compare different athletes. It tests cardiorespiratory endurance at a high intensity, which is appropriate to the game of rugby union or league.

This purpose testing is also relevant for everyday people who wish to track their own levels of physical capacity, whether it be for health-based outcomes (tracking body weight) or performance goals (5 km parkrun personal best time). While this is less comparable and valid, it is an important measure of personal progress.

### Player identification, talent scouting and transfers

Professional and elite representative sporting teams will seek to identify new recruits and signings using a range of identification measures. While there is a clear emphasis placed on an athlete's physical skills, motor coordination and tactical awareness, they are also assessed and identified based on their physical fitness capabilities.

For example, an AFL player may have excellent kicking accuracy, but poor levels of aerobic capacity, acceleration and vertical leap power. Each year, potential rookies from all development clubs are invited to the AFL Draft Combine, where team representatives are able to observe and gather data from simulated training drills that combine both skill execution and the physical fitness components required for their particular position in AFL.

Fitness tests commonly performed at the AFL Draft Combine include the vertical jump (standing and running), the AFL agility test, a 20 m sprint, a 6 × 30 m repeat sprint, the multistage fitness ('beep') test and a 3 km time trial.

This identification should also consider factors that may influence their results (e.g. their growth potential and previous injury) and consider the potential development that could be realised with the correct training program.

In addition to physical fitness testing, medical examinations are also used to consider potential



**Figure 6.27** Players being tested for vertical jump height at an AFLW combine



**Figure 6.28** Medical screenings of fundamental movement skills during football pre-season

new signings. These often assess for the ongoing effects of previous injuries, as well as look at any limitations or potential fitness issues a player may have down the track. Functional movement screenings are excellent assessments of flexibility, mobility, strength and body composition.

## Safely returning from injury

Injured athletes who are unable to maintain regular training for more than 1–2 weeks will suffer the effects of reversibility and the loss of training effect and fitness levels. While this is unavoidable to an extent, it is important to have baseline data that indicates the fitness levels an athlete had prior to injury. This then sets a benchmark for them to work towards as they rehabilitate and resume their full strength and conditioning program.

For example, a swimmer suffering from a rotator cuff tear will be unable to continue their strength and conditioning programs, leading to a loss of upper body strength. If they know their 5 RM bench press level, then they can set this as a goal for their rehabilitation and track their progress as they undergo their rehabilitation.

Non-athletes will also engage with similar testing following injury or surgery. Physiotherapists regularly perform functional testing to monitor progress as they rehabilitate and return to previous levels of capacity.

### Activity 6.3

#### Testing physical fitness

Choose a sport and identify two different population groups that play it (e.g. adults and children; elite and recreational; or those aiming for health-based or performance goals). Research and prepare a report about the physical fitness testing procedures and measurements used in this sport. Explain how the test is done, what differences there are for the population groups, and why it is relevant to the specific requirements of this sport.

**Skills:** analysis, communication, research



Quiz

### Revise and summarise 6.6

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 For each component of fitness, provide a definition and an example of a sport that requires that component. Identify a suitable test relevant to that particular sport.
- 2 Summarise the main reasons why physical fitness components need to be tested.
- 3 How can these physical fitness testing results be used by the following?
  - a Players
  - b Managers and coaches
  - c Strength and conditioning coaches



Depth Study



Collaborative investigation

### Think critically and apply 6.6

Choose a sport and a population group, and analyse the relative contributions of the components of physical fitness for successful performance by members of the group. This could be presented by ranking them in order of importance or by displaying the components on a pie graph to visually demonstrate their relative importance. Justify all judgements made.

**Skills:** collaboration, analysis, communication

## Chapter summary

- The human body relies on adenosine triphosphate (ATP) to fuel all body processes.
- There are three energy systems in the human body that help to resynthesise ATP at varying levels of intensity and duration of activity.
- The ATP-PCr and glycolytic energy systems operate anaerobically to resynthesise ATP.
- The aerobic energy system operates aerobically to resynthesise ATP.
- These three energy systems all have a distinct fuel source, duration, intensity, ATP efficiency, cause of fatigue and rate of recovery.
- The three energy systems can operate concurrently to contribute to the total resynthesis of ATP.
- Nutrition plays a vital role in helping fuel the resynthesis of ATP, through the appropriate consumption of macronutrients that provide the body with energy.
- Macronutrients also contribute important elements to the chemical processes involved in movement.
- Activities that are more aerobic or anaerobic have varying nutritional requirements.
- Recreational athletes have varying nutritional requirements compared to elite athletes due to the differing quantities of training.
- Aerobic training methods include continuous, fartlek, long interval and aerobic circuit-based training methods.
- Anaerobic training methods include short-to moderate-interval training.
- For training programs to be effective they should be highly differentiated to help the athlete achieve their specific goals and to develop the physiological adaptations that will increase the likelihood of success.
- Contemporary training methods are becoming increasingly recognised and valuable for health and performance outcomes. These include high-intensity interval training, sprint interval training, and speed, agility and quickness training.
- Aerobic and anaerobic training methods should be designed according to the FITT principles that specify the frequency, intensity, time and type of training that will help performance goals be met.
- Aerobic training causes immediate physiological responses to the heart rate, stroke volume, cardiac output, ventilation rate and lactate levels.
- Testing physical fitness using valid and reliable procedures is an increasingly important aspect of training programs to ensure performance goals are met and the wellbeing of athletes is supported.

## Multiple-choice questions

- 1 What is the most likely cause of fatigue in a runner completing a 100 m sprint?
  - A dehydration
  - B accumulation of lactic acid
  - C depletion of muscle glycogen
  - D depletion of phosphate creatine
- 2 The anaerobic glycolytic energy system:
  - A operates with oxygen
  - B provides energy for just over 2 minutes
  - C uses the breakdown of glycogen in the absence of oxygen
  - D is used in short maximal events such as shot put and high jump
- 3 An elite 10 000 m runner would predominantly use which energy system during a race?
  - A ATP-PCr energy system
  - B anaerobic glycolysis energy system
  - C aerobic energy system
  - D adenosine triphosphate
- 4 Which of the following fuels are used to produce energy most at rest?
  - A carbohydrates
  - B proteins
  - C fats
  - D ATP
- 5 Fartlek training consists of:
  - A a series of explosive exercises
  - B a series of exercise stations arranged in a specific order
  - C a steady, low intensity exercise over a long period of time
  - D a continuous steady state aerobic exercise with higher intensity periods or efforts
- 6 Short- to moderate-interval training is best used to improve which type of fitness?
  - A aerobic fitness
  - B strength and power
  - C muscular endurance
  - D anaerobic fitness
- 7 The lactate threshold is defined as:
  - A the maximal exercise intensity an individual can maintain with little or no lactate accumulation for an extended period of time
  - B the point at which blood lactate begins to accumulate in large quantities in the blood
  - C the point at which lactate starts to decrease in the blood
  - D the point at which lactate accumulation is higher than lactate removal
- 8 An individual's highest possible oxygen consumption during exercise is identified as:
  - A  $\text{VO}_2$  max
  - B lung capacity
  - C oxygen uptake
  - D lactate threshold
- 9 What testing procedure is most valid for a basketballer?
  - A sit and reach test
  - B 1.6 km time trial
  - C stork stand
  - D vertical jump and medicine ball throw
- 10 Which of the following is the best test of speed?
  - A vertical jump
  - B 1.6 km time trial
  - C Illinois agility test
  - D 40 m sprint

## Exam-style questions

- 1 Analyse the energy systems used by a triathlete throughout a race. (5 marks)
- 2 Identify a team sport and analyse the energy systems used. (4 marks)
- 3 Compare the causes of fatigue and recovery of the three energy systems. (4 marks)
- 4 Compare the dietary requirements of a power athlete and an endurance athlete. (5 marks)
- 5 Compare the dietary requirements of a recreational athlete versus an elite athlete. (4 marks)
- 6 Explain how macronutrients relate to the three energy systems. (4 marks)
- 7 Justify the training methods best suited to marathon running. (3 marks)
- 8 Justify which type of training is best suited to weightlifting. (3 marks)
- 9 Distinguish between short-, moderate- and long-interval training sessions. (6 marks)
- 10 Argue the case for high intensity interval training and sprint interval training sessions. (6 marks)
- 11 Outline the immediate physiological responses to aerobic training. (5 marks)
- 12 Outline the FITT principle and how it is used to design training programs. (4 marks)
- 13 Justify the use of physical fitness testing in training programs. (4 marks)

# Chapter 7

## Acquiring, developing and improving movement skills

### After completing this chapter, you will be able to demonstrate knowledge of:

- how the characteristics of learners influence movement skill acquisition
- the stages of movement skill acquisition that a learner will experience
- how movement skills are categorised and used through the stages of skill acquisition
- how different practice methods are used through the stages of skill acquisition
- how the elements of performance are developed and improved through the stages of skill acquisition
- how different forms of feedback are used through the stages of skill acquisition.

### Key terminology

#### Syllabus terms

augmented

#### Other important terms

acquisition

motor pattern

motor skill

proprioception/  
kinaesthetic sense



### Driving questions

- 1 What are the first movement skills an infant will learn in the first 12 months of life?
- 2 Consider the fundamental movement skills that most toddlers learn (jump, land, kick, hit, throw, roll etc). What factors help this development? Make a list of the various factors that assist a child in developing these various skills.
- 3 Think of a physical skill that you learned in the last 5 years, in which you went from being a novice to at least proficient. What did it feel like when you were first attempting to learn the skill? When did you know that you had reached a basic level of competence? What factors helped you successively progress (think of the internal and external factors)?
- 4 Think of the most physically capable, athletic and skilled person you know. What makes you say this about them, and why do you think they are at this standard of movement competency?

# Introduction

**motor skills** the coordinated and specific movement of the body to achieve a desired outcome

**acquisition** the learning or development of a physical skill and ability

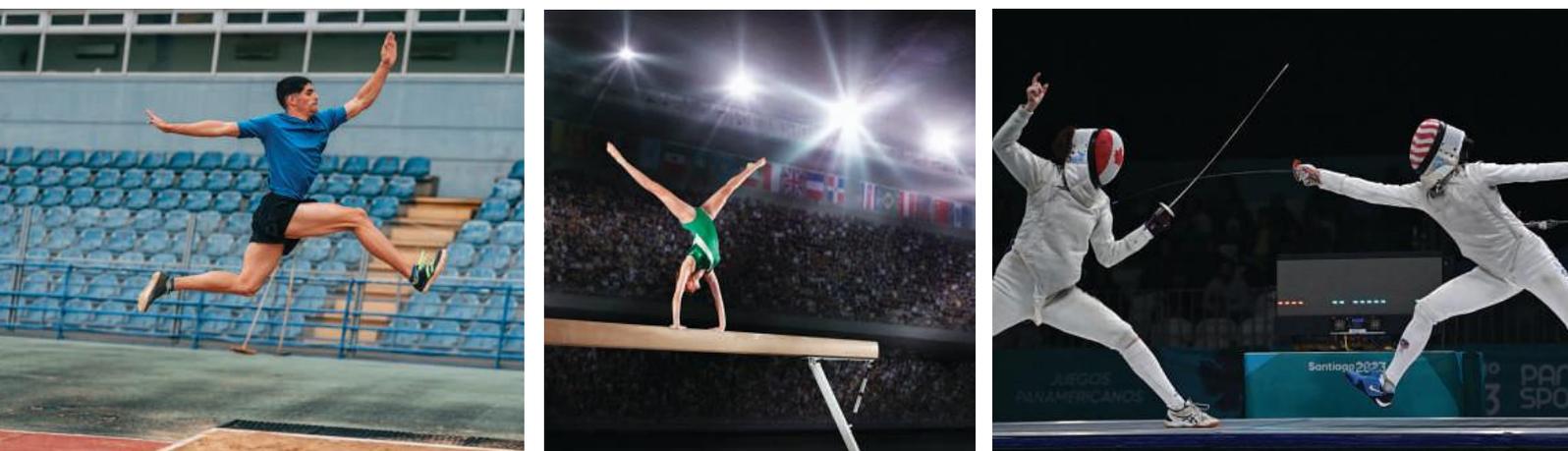
It is important to have a broad understanding of the concept of movement skills. In the general sense these are often described as fundamental movement skills or **motor skills**, and someone who has developed a wide range of these skills could be described as physically literate. There is a strong correlation between people who develop a wide range of movement skills during their growth and development, and long-term positive health outcomes. Movement skills also allow people to confidently engage in a wide range of sport, recreational and health-based physical activities throughout their life. Consider someone who has never learned to proficiently swim, ride a bike, throw or hit a ball, or to just have a basic level of balance and coordination for navigating everyday life. A helpful analogy is to consider a toolbox with a wide range of tools. Having only a hammer and a saw would be limited, but the more tools someone can acquire into their 'movement skill toolbox', the more enriched and successful they can be in how they choose to move and be physically active. The **acquisition** and development of these movement skills is important recreationally, as well as for people with the aspiration and opportunity to become elite in a particular sport.

The development of a strong base of athletic skills can provide someone with the opportunity to refine these to a level in which they can engage in elite competitions, where the specific skills can be developed to a world class standard and to suit the intricate demands of professional sport.

These fundamental movement skills can be divided into three categories:

- **Locomotor skills** are skills used to move from one place to another (walk, run, skip, jump, hop, roll, dodge etc).
- **Stabilisation skills** are skills that are used to adjust and control body movement during movement (balance, land, turn, twist, hang, brace, rotate, stretch etc).
- **Manipulative skills** are skills that require the use of equipment with control, accuracy and power (throw, catch, strike, kick, bounce, trap, collect etc).

This chapter investigates the various internal and external factors that influence the depth and breadth of movement skills that a person can learn or acquire. Contextually, this learning can happen in the family home during childhood, in the backyard or at the park with mates, during formal and informal play and games at school, and in more formal and focused coaching sessions in specific sports.



**Figure 7.1** Locomotor, stabilisation and manipulative skills

# 7.1 Characteristics of learners

## Learning objective 7.1

EXAMINE how the characteristics of learners influence movement skill acquisition

There are many contributing factors to the success of individual athletes, such as financial support, the quality of facilities and coaching programs and the talented athlete development pathways available to the athlete in their chosen sport. However, there are several inherent characteristics of the learner that also contribute to the success and degree of movement skill they can acquire. While many of these characteristics are inherited through someone's DNA make-up (nature), some can also be attributed in part to positive and supportive early learning experiences (nurture).

## Personality

Personality represents the characteristics that shape an individual's patterns of thoughts and behaviour. There are five areas of personality that can influence someone's capacity to learn movement skills. Positive traits are those that are advantageous when they are present at higher levels. Varied traits are useful at low levels in some movement contexts and useful at high levels in different movement contexts. The acronym OCEAN is used to discuss these traits. Examples include:

- **Openness (positive trait):** people with high levels of openness tend to be more creative, imaginative, adventurous and eager to learn new things, and are open to new experiences and challenges.
- **Conscientiousness (positive trait):** people with high levels of conscientiousness tend to pay greater attention to detail, prefer structure and schedule, and are more focused on preparation and successful task completion.
- **Extraversion (varied trait):** people with high levels of extraversion are often energised when around people, more excitable and emotionally expressive, like to be the centre of attention and are very sociable. People with low levels (known as introversion) tend to prefer individual and more complex tasks with higher levels of task focus and concentration, with less varied social interaction.
- **Agreeableness (varied trait):** people with high levels of agreeableness tend to be more interested in other people and are caring and empathetic. They enjoy helping others and teamwork. People with low levels are more interested in individual activities, are more competitive and are less concerned about other people.
- **Neuroticism (negative trait):** people with low levels of neuroticism tend to be more emotionally stable and relaxed, less anxious and can handle stress well.

These various personality traits can all influence skill acquisition, and a person's ability and willingness not only to have a go and learn something new, but also to persist and continue until they have reached a point of personal satisfaction.



**Figure 7.2** People with high levels of extraversion are often energised when around people.

## Heredity

Heredity refers to the characteristics that are transferred from one generation to the next via genetics and DNA.

The heredity of an athlete is a major factor in determining potential to succeed. These are the psychological characteristics (personality), physical attributes and biological characteristics passed on from one's parents. It is not uncommon for elite athletes to have parents and/or siblings who have also been highly successful in sport. Characteristics such as height, body shape (somatotype), limb length, personality, intellect, game sense and more are directly impacted upon by heredity. However, while the athlete can inherit many wonderful qualities from their parents, it is important for these qualities to be nurtured. Simply being born with natural sporting talent is no guarantee of sporting success. The environment in which the athlete grows up, the access the child has to skill development and the hard work the athlete is willing to put in are factors that are just as

important as the genetic traits one may have inherited. Consider, for example, elite athletes whose genetic make-up has provided them with an immense advantage, from the most muscular weightlifter to the tallest basketballer or the leanest diver. The advantageous traits which these athletes enjoy must be supported with targeted training programs to ensure they are maximised for success.

## Confidence

Confidence develops through prior success, positive reinforcement and encouragement. It represents the belief that a person can and will succeed. A learner who believes they can achieve something difficult is far more likely to succeed than the learner with self-doubt. The same can be said for an elite athlete. Sometimes a lack of confidence can be the barrier between ultimate success and just falling short. For this reason, confidence is critical to the acquisition of new skills. Learners must believe they can acquire the skill to a proficient level at least, even before they start. Confidence also helps with resilience and the ability to bounce back from failure and keep going with determination.



**Figure 7.3** Examples of world-class elite athletes representing the ways in which various characteristics of the learner contribute towards success (clockwise from top left: Serena Williams, Lionel Messi, Steph Curry and Simone Biles)

## Prior experience

Prior experience will influence an athlete when first learning a new skill. It involves the transfer of learning from previous experiences into new learning tasks. An athlete who has already developed similar movement skills or motor patterns may be able to transfer them into the new skill. Also, the confidence they have developed from their prior experience can accelerate their learning curve. The development of components of fitness can also make it easier to learn new skills or sports. A good example of prior experience and its influence on learning new skills is diving. Many Olympic-level divers have been gymnasts for many years. Gymnasts already possess a mastery of their movement, and can easily flip, tumble, turn and contort their bodies into the necessary positions for success in diving. There are many examples of elite athletes who have changed sports and succeeded in transferring their skill base. Prior to winning the Tour de France, a road cycling event, Cadel Evans was a world champion cross-country mountain biker. Many cricketers go on to play golf at a high level after their careers have ended. Many 100 m sprinters are also excellent long jumpers. There have been many examples of athletes playing at elite levels in both rugby

league and rugby union. Many of the AFLW players have backgrounds in sports that assist with the handballing, jumping and landing activities of AFL, such as netball and touch football. Even some Gaelic footballers from Ireland have come to Australia for successful AFL careers, despite the ball being a different shape.

## Ability

Ability represents the learner's general capacity for coordinated movement patterns. This factor is influenced by many inherited and social factors. Ability may relate to hand-eye coordination (striking), foot-eye coordination (kicking) or the general ability to move the body in complex and coordinated ways. These abilities can be developed, but having a greater ability level will improve the rate and depth of skill acquisition. For example, a learner with excellent balance, agility and foot-eye coordination will easily learn to kick a ball successfully in a variety of ways. A learner who does not possess high natural ability will need to work harder and demonstrate greater determination if they are to succeed. For example, cricketer Don Bradman not only attained the established skills of batting more easily than most, but also revolutionised the sport with new skills that his contemporaries tried to emulate.

### Revise and summarise 7.1

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Identify examples of how an athlete's personality can influence the way movement skills are acquired, developed and improved.
- 2 Identify examples of how an athlete's heredity can influence the way movement skills are acquired, developed and improved.
- 3 Identify examples of how an athlete's confidence can influence the way movement skills are acquired, developed and improved.
- 4 Identify examples of how an athlete's prior experiences can influence the way movement skills are acquired, developed and improved.
- 5 Identify examples of how an athlete's ability can influence the way movement skills are acquired, developed and improved.



Quiz

### Think critically and apply 7.1

Select four different well-known elite athletes from different types of sports. Compare and contrast the ways in which the characteristics of the learner (personality, heredity, confidence, prior experience and ability) seem to have contributed to their success.

**Skills:** analysis, communication, creative thinking, problem-solving, research

## 7.2 Stages of skill acquisition

### Learning objective 7.2

INVESTIGATE the stages of movement skill acquisition that a learner will experience

#### motor pattern

memorised configurations of nervous system activation that can produce repeated and successful movement outcomes

To better understand the stages of skill acquisition (or skill learning), an understanding of the concept of a **motor pattern** will help. A motor pattern refers to the learning and configuration of specific neural pathways that produce repeatable and successful actions from the musculoskeletal

system. Consider a tennis serve: the brain must tell which muscles to contract, in what order, how hard and for how long in order to move the bones and joints in such a way that they produce success in the highly complex skill of serving. This is also referred to as being coordinated, as individual movements are arranged in such a structured way that they produce success. As this same movement

is reproduced successfully, a motor pattern develops that requires less intensive cognitive thought and effort to repeat. Consider the skill of elite athletes: they appear to reproduce almost perfect skill every time, seemingly without much thought. Compare the feeling of learning a new complex skill with something you are well skilled in, such as walking.

As learners acquire new movement skills, they progress from being a novice, through varying levels of proficiency and may possibly reach the level of expert given the right conditions. As they progress through these stages, they are developing specific motor patterns that make skills more accurate and repeatable. These three stages are called the cognitive, the associative and the autonomous stages, and they each have defined characteristics and requirements that coaches will meet to help athletes progress through the stage. Each stage can vary in length depending on the individual learner or the nature of the task, and many learners may not progress to the next level.



**Figure 7.4** As learners acquire new movement skills, they progress from being a novice, through varying levels of proficiency and may possibly reach the level of expert given the right conditions.

### Cognitive (the learning stage)

The cognitive stage (referring to the mental processes of thinking, reasoning and remembering) is the initial stage of learning a new skill. At this point, the learner does not have a specific motor pattern or mental image of the skill being learned. However, they may have a similar movement skill they are able to transfer from prior experience (e.g. a tennis player learning badminton). It is essential that the learner first gains knowledge and understanding of the various sub-components (movements) of the skill. The process might begin with the learner watching the skill being performed by someone who is proficient, and then breaking it down into smaller components in order to teach the skill (e.g. a tennis serve has a ball toss, back swing, strike and follow through). The stimulus given to the athlete in the form of videos and demonstrations must be balanced so as not to overload the athlete with information that may cause confusion and anxiety (known as cognitive overload).

The physical practice of the skill is critical in this stage. The complexity of the skill will determine

how many steps the teaching and practice is broken into, and how long it will take to move to the next stage. A coach will use drills as a way of breaking the skill into smaller sub-components. As these drills are mastered, the athlete can start linking the entire skill together. While practising in the cognitive stage, athletes will typically make many gross errors and require external feedback from the coach or teacher to help guide them. In most cases, positive reinforcement when something is done well must be a feature of the coach's feedback. The use of negative reinforcement is of little value to the athlete. Repetition is important, but practice should be broken into smaller parts as this stage can be mentally taxing.

The two biggest factors dictating how quickly it takes an athlete to move beyond the cognitive stage are the coach and the complexity of the skill. Some athletes may take as little as a few minutes, or as long as many weeks to learn a new skill. The use of video feedback can help the athlete externally see specific areas to improve.



**Figure 7.5** A tennis player in the cognitive stage of skill acquisition, learning the basics of forehand

### Associative (the practice stage)

The second stage of skill acquisition is referred to as the associative stage. This stage is characterised by less tuition from the coach, and more practice from the athlete. During this stage, the athlete is doing fewer drills and is more focused on practising the entire movement involved in the new skill. Errors still occur, but with frequent practice these will be reduced, and the athlete will begin to gain some fluency in the execution of the skill. As the motor patterns start to develop, the learner begins to be able to detect the reason for their own errors due to developing internal sensory input and awareness of what the movement skills should start to 'feel' like.

Feedback from the coach is still very important to provide a greater understanding of how to improve. It is best that feedback be used sparingly, but in meaningful and specific terms, rather than just positive encouragement. Again, video

feedback can help the athlete to see their own mistakes. This stage is an important point in the acquisition of the new skill because, as the athlete begins to feel more proficient, their confidence also increases. The increased sense of confidence is a critical step in the psychology of the athlete, as it represents the point at which the athlete feels comfortable performing the skill. With confidence and ability, the athlete will start to move to the third stage of skill acquisition. Some athletes, however, remain at the associative stage, and never reach a level where the skill can be performed automatically. This stage can also be long in duration, as it can take a long time to go from basic and proficient to refined and skilled. Practice sessions can be longer in duration, and a variety of activities can help maintain player interest. In sports, this stage is where players should be introduced to game-based learning, which is beneficial to learning.



**Figure 7.6** A tennis player in the associative stage of skill acquisition practising their serve

### Autonomous (the tactical stage)

The third and final stage of skill acquisition is the autonomous stage. As the name suggests, in this stage the learner performs the skill automatically and their motor patterns are now highly refined. They do not need to consider and plan the execution of the skill – it can simply be performed immediately, consistently and accurately without much thinking. Sub-routines can be linked together more easily and in the correct order and combine various skills (e.g. combining individual elements together into a gymnastics floor routine and tumbling pass). Although there may be a few minor errors, these are very occasional and are generally corrected quickly without external feedback. The skill is executed efficiently, effectively and in a way that is visually attractive. When this level of execution is practised, the athlete may be in a state of physical and psychological harmony. This state is referred to as ‘flow’.

When athletes perform skills autonomously, they have great ability to attend to all the other demands of their sport. For example, when a skill is autonomous, the athlete can pay greater attention to reading the play and making the correct decisions, such as choosing which player to pass



**Figure 7.7** A tennis player in the autonomous stage of skill acquisition, using their serve in elite competition

the ball to or which weakness in the opposition to exploit. This is the stage at which the coach can assist with the tactical implementation of skills, such as selection of the correct shot to play as a batter in cricket. Another tactical decision might be the choice of various skills and movements made by a basketballer in driving a basketball towards the hoop.

### Revise and summarise 7.2

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Outline the characteristics, features and suitable coaching advice for an athlete in the cognitive stage of skill acquisition.
- 2 Outline the characteristics, features and suitable coaching advice for an athlete in the associative stage of skill acquisition.
- 3 Outline the characteristics, features and suitable coaching advice for an athlete in the autonomous stage of skill acquisition.



Quiz

### Think critically and apply 7.2

Select a new skill to learn and reflect on the experience of what it is like to learn the skill and what factors make it more or less difficult to reach the associative stage at minimum (e.g. juggling three tennis balls, making a left and right torpedo pass with a touch football or performing basketball dribbling skills). Students who are more advanced should try to teach and help others through the stages of skill acquisition as far as they can in the time provided.

**Skills:** collaboration, communication, problem-solving

## 7.3 Characteristics of motor skills

### Learning objective 7.3

ANALYSE how movement skills are categorised and used through the stages of skill acquisition

Movement skills can be characterised in a variety of ways, which has implications for the planning of coaching activities and programs.

### Closed and open motor skills

This refers to the stability and predictability of the learning environment:

- **Closed motor skills** are performed in a stable and predictable environment where the athlete is free to concentrate only on the task at hand with minimal chance of distraction or the need to make decisions – for example, passing a football between two people focusing on technique and accuracy.
- **Open motor skills** are performed in increasingly unstable and unpredictable environments where the athlete is required to execute skills under the pressure of change and the need to make decisions. These variations could be natural events such as weather (e.g. wind) or forced reactions due to the movement of the opposition requiring fast decision-making during skill execution – for example, playing small-sided games of maintaining possession with a focus on passing and moving into space.
- **Coaching implications** cognitive learners initially require closed environments, and as they progress through the associative and autonomous stages, they can be exposed to game-like situations which progressively open the environment, requiring decision-making and skill execution under the pressure of change.

### Gross and fine motor skills

- **Gross motor skills** involve large body movements and powerful muscular contractions, often moving the athlete into different body positions or shapes – for example, the run-up and general arm action of bowling in cricket.
- **Fine motor skills** involve small body movements and more precise contractions to produce detail and accuracy in motor skills. These are often performed in the final milliseconds of an action where subtle movements can produce specific outcomes. An example is the action of cricket spin bowlers, who rotate their fingers across the ball and impart spin to make the ball change direction when it lands.
- **Coaching implications** there are very few sports or activities that exclusively require fine motor skills, such as writing or playing piano. Early learning generally involves the basic motor pattern of the gross muscle action, and as these are developed, the finer muscle action can be developed and applied. This reflects the autonomous stage of learning, where tactics can be implemented through these refined actions.



**Figure 7.8** Table tennis requires the gross motor skill of hitting the ball, as well as highly precise fine motor skills to control this hitting action and impart spin to confuse the opponent.

## Discrete, serial and continuous motor skills

- **Discrete motor skills** have a distinct beginning and end point in the execution of the skill. These skills can be practised in isolated efforts, allowing for rapid feedback and reflection with a coach and/or video between efforts. They can be repeated, but the athlete returns to the start position to repeat the skill. These tasks are often a maximal single power effort (such as shot put, weightlifting or long jump) or a highly precise single action (such as a basketball free throw, football penalty or archery shot).
- **Serial motor skills** involve the execution of several discrete skills or elements together in one sequence (e.g. triple jump has the run-up, hop, step and jump) or an ongoing effort such as team sports that require multiple skills executed in combination (e.g. basketball players must run, stop, step, dribble, pass, catch and shoot).
- **Continuous motor skills** occur when there is no distinct ending to the movement cycle. The movement cycle is ongoing and repeats

without disruption for an extended period of time. Swimming, running and cycling are all continuous. If the person is racing, the finish line indicates when to stop; otherwise it will be when the person chooses to stop.

## Self-paced and externally paced motor skills

- **Self-paced motor skills** involve the athlete deciding when to commence the execution of the skill (e.g. platform diving, bowling in cricket, conversion in rugby union, the javelin throw or tennis serving).
- **Externally paced motor skills** involve the athlete executing the skill in response to external cues or actions (e.g. batting in cricket, tackling in rugby league, receiving a serve in tennis or starting a race).
- **Coaching implications** some sports and movement skills are exclusively self-paced, which simplifies the training. However, sports that require the externally paced execution of skills need to progressively and gradually introduce more complex decision-making as learners progress through the associative and autonomous stages.



**Figure 7.9** In cricket, bowling is self-paced, whereas batting is an externally paced motor skill.

## Individual, co-active and interactive motor skills

**Individual motor skills** are movements that are performed in isolation from other athletes, often with one athlete performing at a time (e.g. high jump, weightlifting, gymnastics or surfing).

- **Co-active motor skills** are skills performed at the same time as others but without direct contact or confrontation in competition (e.g. a running or swimming race and triathlon).
- **Interactive motor skills** are skills in which skill execution and competition involve the

direct contact and involvement with others in opposition (e.g. boxing, football, rugby and tennis).

- **Coaching implications** individual and co-active skills can be trained with a highly individualised focus. The actions of others should have no impact on an individuals' own skill execution. The best you can do is your personal best. However, interactive motor skills require intense levels of tactical awareness of the opposition, as well as the ability to make the right decision in response to their actions.

### Practical application 7.1

#### Motor skills

In groups, create a practical demonstration of the various characteristics of motor skills.

Afterwards, experience, participate in and practise a range of sports skills and games, and assess and reflect on the characteristics of the motor skills performed.

**Skills:** analysis, communication, creative thinking, problem-solving, research



Quiz

### Revise and summarise 7.3

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Compare the use of open and closed motor skills through the stages of skill acquisition.
- 2 Compare how gross and fine motor skills are developed through the stages of skill acquisition.
- 3 Explain the difference between discrete, serial and continuous skills.
- 4 Compare how self-paced and externally paced skills can affect someone in the cognitive stage of skill acquisition.
- 5 Outline the differences between individual, co-active and interactive motor skills and how they influence the learning environment.

### Think critically and apply 7.3

For a selected sport, analyse the characteristics of the motor skills required and present this as a sports profile. Demonstrate an understanding of how the motor skills required for the sport will influence the nature of the training, activities and program required for success in this sport.

**Skills:** analysis, communication, problem-solving

## 7.4 Practice methods for different stages of learning

### Learning objective 7.4

INVESTIGATE how different practice methods are used through the stages of skill acquisition

There are a number of ways that coaches can structure coaching programs, sessions and practice activities to best suit the stage of skill learning and acquisition.

### Massed or distributed practice

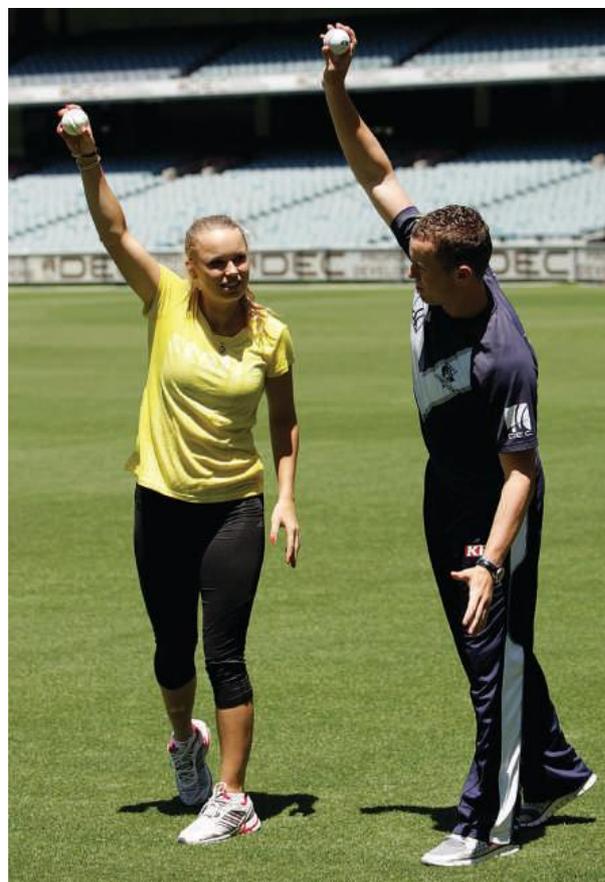
Massed practice involves long blocks of training or practice without a break or change, whereas distributed practice refers to shorter blocks of practice, with more regular breaks or transition to a different activity.

For early learners, distributed practice is advised as often they are younger and less able to focus on one task for an extended time. Cognitive learning is also very demanding, and shorter breaks allow the learner to refresh and refocus. For older and more advanced learners, longer sessions of massed practice are suitable as skill execution is more physical in nature and involves less mental fatigue. This massed practice can also create artificial pressure to perform (such as an instruction that the athlete may only finish practice after 10 successful free throws have been shot in a row). The intensity of physical demand of an activity can also determine whether massed or distributed practice is more suitable. Highly fatiguing skills such as weightlifting require more periods of work and rest, whereas low energy tasks such as rowing can be performed for longer periods without rest.

### Whole or part practice

Whole practice involves the execution of the whole skill or sport in its entirety, whereas part practice involves breaking a skill into its sub-components (or a serial sport into its discrete components) to refine these in isolation.

For early learners of complex skills, it is advisable to use part practice where possible to decrease the complexity of the skill, and then practise putting the separate parts back together using whole practice. For advanced learners, who are able to perform the skill consistently well, part practice will only be useful if a specific error has been identified as being in need of improvement, such as the foot placement of a fast bowler in cricket. Some sports are not easy to break up into sub-routines or parts (such as sailing or cycling). A tennis serve is a good example of a skill that can be broken into parts, as it can be separated into the ball toss, back swing, ball contact position and follow through. This can also be performed without a ball in order to focus on the motor pattern required.



**Figure 7.10** Some skills can be learned using part practice

## Blocked or random practice

Blocked practice involves practising the same skill under the same conditions multiple times, in order to build stronger motor patterns and refine movements (e.g. when a tennis coach hits 30 forehand shots to the same spot of the court or a player takes 20 netball shots from the same spot). This contrasts with random practice in which there is constant variation in the skill either by choice or in response to external stimuli (e.g. when a tennis coach varies between forehand and backhand shots or a basketball player takes

each shot at the hoop from a different point on the court).

For early learners, blocked practice can build faster and stronger motor patterns as learners can focus on the single action. As learning progresses, they should start to include random variations to develop decision-making skills, and the ability to transfer to different skills within the game successfully (this is suitable for serial sports). For example, a tennis coach might vary the place on the court to which they return the ball, requiring the learner to adjust their movement for the different skill.

### Practical application 7.2

#### Practice methods

In groups, create a practical demonstration of the various practice methods that can be used in various sports, and have students participate in these in order to experience each method.

**Skills:** analysis, communication, creative thinking, problem-solving, research



Quiz

### Revise and summarise 7.4

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Compare and contrast the use of massed and distributed practice.
- 2 Compare and contrast the use of whole and part practice.
- 3 Compare and contrast the use of blocked and random practice.

### Think critically and apply 7.4

Research a selected sport and identify aspects of the sport that suit the various practice methods.

**Skills:** analysis, research

## 7.5 Performance elements

### Learning objective 7.5

ANALYSE how the elements of performance are developed and improved through the stages of skill acquisition

Performance elements are critical for athletic success, particularly in sports requiring interactive motor skills and movements (where competitors are in direct contact or involvement with one another, such as rugby league). While athletes may demonstrate proficiency in skills during practice, they must also be able to read situations accurately and execute them correctly during the pressure of competition within increasingly open environments.

### Decision-making

Decision-making is a mental skill that is learned through years of practice. Knowing when to pass the ball or draw a player, or which opposition weakness to target, are examples of crucial performance elements. Presenting athletes with

simulated and real scenarios can help develop decision-making skills. Augmented 3D virtual reality (VR) video technology is now being used to provide game scenarios with a first-person view so the athlete can experience real-life scenarios and consider the decisions they should make in each. Athletes and teams also take time after training and competition to watch video replays and debrief specific decisions, and their level of success can ensure continuous improvement. Generally, these decisions happen in milliseconds and require an instant reaction to what is happening right in front of the athlete. Only the best athletes and teams are able to develop these skills and consistently make the right decisions.

### Strategic and tactical development

The athlete who can manipulate a game to their advantage is said to have strategic and tactical awareness. The knowledge and confidence to take leadership of a situation to ensure the best possible outcome for the athlete, and possibly the team, is immensely powerful in sport.



**Figure 7.11** AFL is a fast-paced invasion game requiring rapid decision-making skills and acute tactical awareness.

Often, opponents may possess similar levels of skill and ability, but it is the strategic and tactical awareness alone that can make the difference between winning and losing. Strategies are pre-planned courses of action, which are prepared ahead of the game, although they may be able to be adjusted mid-game if there are challenges or opportunities that arise during the game. Coaches often devise these strategies for the team and may often practise set formations and plans of attack for upcoming games. In football, coaches and players implement strategic player formations utilising their team's strengths or exposing the opposition's weaknesses (e.g. 4-3-3 or 4-4-2 formations). In basketball, teams may devise set plays to take advantage of a strength in their team or a weakness in the opposition (such as having shorter opponents). In tennis, a player may recognise a weakness in their opponent's backhand, and they will try to isolate that skill to draw errors. Comparatively, tactics are the

actions taken to achieve these goals and put strategies into place. Using overlapping runners in hockey, creating triangles of players in AFL to always have passing options and setting a screen in basketball are tactics that can be used to bring a strategy into reality.

### Developing performance elements

Modified and small-sided games are used to develop these decision-making skills and the ability to use tactics as part of a larger strategy. These can be set up with a specific learning focus that encourages athletes to think as well as act. The use of effective questioning is a powerful tool to develop these cognitive skills in athletes. For example, a game of four versus three possession in netball (with the team of four always being the team with the ball) encourages players to always be moving into space off the ball, and to always look for two options before choosing who to pass to.



Quiz

### Revise and summarise 7.5

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Outline the importance of decision-making in sport and describe an activity used to develop this in a selected sport.
- 2 Distinguish between strategies and tactics, and make a list of common examples of each in a selected team sport.

### Think critically and apply 7.5

Engage in a modified team invasion game, where the rules and structures are adapted to create new performance scenarios and challenges. Reflect on the decision-making required and what strategies and tactics each team employed. Use peer assessment to track the movement of a single player and highlight moments of good decision-making and tactical execution. Ask the group questions such as:

- Who was the hardest player to compete against and why?
- What were examples or times where you had to make a decision, and what made that easier or harder to do?
- What did you do to make decision-making more difficult for the other team?
- Did your team use any set strategies or tactics within the game?

**Skills:** collaboration, analysis, communication, problem-solving

## 7.6 Feedback for different stages of learning

### Learning objective 7.6

ANALYSE how different forms of feedback are used through the stages of skill acquisition

To learn anything, feedback about performance is required to understand what is going well and what can be improved. As athletes progress through the stages of skill learning and acquisition, they require different forms of feedback. Effective coaches can provide specific, actionable and understandable feedback, and ultimately help the athlete to be able to process feedback internally without the need for an external source of feedback.

### Source of feedback: task-intrinsic (internal) or augmented (external) feedback

Feedback can come from either internal or external sources:

- **Task-intrinsic feedback** is information received about performance from within the athlete's own sensory inputs, especially sight, sound and feel. Further to this, proprioceptors are a part of the somatic nervous system and are responsible for detecting the body's specific position in space as it moves, known as **proprioception** or **kinaesthetic sense**. These nerves are mostly located in joints, muscles and tendons. As the body performs a well-known action as a result of a refined motor pattern (e.g. an elite golf swing or tennis serve), the body's proprioception is providing instantaneous information to the brain about the 'feel' and quality of the movement. Athletes with autonomous levels of skill will report that a skill 'felt off'. This can sometimes allow for correction during the skill. Consider a tennis serve where the ball toss doesn't quite come

out of the hand perfectly, but the athlete can adjust their shot accordingly with success. A penalty kicker in rugby union may slip a little in the run-up and be able to account for this as they strike the ball. Often a basketballer will know before the ball reaches the target if it is likely to miss or go in based on how the shot felt. There is also an injury prevention element to proprioception and its relationship with balance. A player may detect their ankle rolling into a dangerous position upon landing and before they're even aware, they can change their body position to prevent further damage. Ankle sprains often decrease proprioceptive awareness, which leads to an increased risk of re-injury. This is why balance activities are a key part of rehabilitation.

- **Augmented feedback** is information received about performance from sources external to the athlete. This may be from other players, a coach, the crowd or the use of video feedback. In the case of photos or video, a computer can combine this information with a view of the real world.

During the cognitive stage, players rely exclusively on augmented external feedback because they have not yet developed a mental understanding of the requirements of the skill as they are yet to develop proprioceptive awareness. Effective coaching using simple verbal feedback with the use of demonstrations and clear explanations (and the use of video) can help develop this. As the athlete progresses through the associative and autonomous stages of learning, they increasingly develop the ability to use task-intrinsic feedback to assess performance.

**proprioception/ kinaesthetic sense** the perception and awareness of the body's position and movement through space

## Timing of feedback: concurrent (instant) or delayed feedback

Feedback may be instant or delayed:

- **Concurrent feedback** is information received during the execution of a skill. It is primarily associated with intrinsic feedback as the athlete detects and corrects their own errors in the moment. In some circumstances, it may come from an external source, such as a teammate communicating information and calling for a change in action during a play (e.g. a decoy runner in rugby league may see that a defensive gap has opened and call for the ball mid-play. The passer can decide to pass to them instead).
- **Delayed feedback** is information received after the execution of the skill has finished. This can vary in time from only seconds after the skill has been performed (e.g. when

watching a video replay on the big screen or hearing the audible feedback from a coach) to days after the skill, when video replays can be analysed.

During the cognitive stage, players are yet to develop intrinsic feedback, and therefore concurrent feedback is not possible. However, as soon as they start to develop the motor patterns and feel of a movement, concurrent feedback becomes of use. Athletes at this stage also rely on delayed feedback from a coach to help them understand why a skill was unsuccessful, and how they can improve. Delayed feedback using video replay can be used at all stages. For early learners, it should be viewed as soon as possible after performance of the skill, whereas elite athletes can wait longer to review their performance.



**Figure 7.12** An elite footballer receiving external augmented feedback from the coach



**Figure 7.13** Elite cyclists rely on concurrent feedback from their team via an earpiece, as well as advanced performance information through their bike computer.

## Type of feedback: knowledge of results (KR) or knowledge of performance feedback

Feedback can provide knowledge of results or of performance:

- **Knowledge of results (KR) feedback** is information about the success of an action (e.g. whether the ball went in the hoop, whether the gymnast landed the somersault on their feet, or whether the ball was caught).
- **Knowledge of performance (KP) feedback** is information about the quality of movement, regardless of result.

KR feedback is helpful to provide positive reinforcement during the cognitive stage, as success helps the athlete to establish correct motor patterns. However, as they develop, performance and results are not always congruent. Sometimes an athlete or team can perform to a high level, but not get the result they hoped for. Likewise, poor performance can sometimes still result in success (e.g. winning a football game 1–0 thanks to an own goal may indicate that there was some luck in the result). Therefore, KP becomes more important for elite autonomous learners, as they should focus on the quality of movement that will lead to an increased chance of positive results.

### Revise and summarise 7.6

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Describe the difference between task-intrinsic and augmented feedback.
- 2 Describe the difference between concurrent and delayed feedback.
- 3 Describe the difference between knowledge of results and knowledge of performance feedback.



Quiz

### Think critically and apply 7.6

Prepare a written response comparing the effectiveness of various feedback methods through the stages of skill acquisition.

**Skills:** analysis, communication

### Research skills 7.1

For a chosen sport, analyse and research the ideal learning conditions to acquire, develop and improve selected movement skills required to reach an elite level of performance.

You could consider one or more of the following questions:

- What are the ideal characteristics of the learner that correlate with elite success in this sport?
- Which practice methods are best suited to developing the specific movements required in this sport?
- How are the performance elements developed at the various stages of learning in this sport?
- What types of feedback are effective at the various stages of learning in this sport?
- Consider other questions that are relevant.

Your report should cover the following:

- what the research tells us
- how it is applied in practice
- possible future research questions to further understand skill development in this sport.

You may wish to refer to the research skills material in the Interactive Textbook when completing this activity.

**Skills:** analysis, communication, problem-solving, research



Depth Study

## Chapter summary

- The development of motor skills is not only essential for everyday living, but also the basis for competitive pursuits that can be personally meaningful on a recreational level right through to an elite level.
- Motor skills can be categorised as either locomotor, stabilisation or manipulative skills.
- The rate and degree at which motor skills are learned will be influenced by characteristics such as personality, heredity, confidence, prior experience and ability.
- Athletes progress through three stages of skill acquisition at different rates and degrees, depending on the quality of the learning environment and their desire and opportunity to invest the time needed to progress until they reach their potential in that skill or sport.
- The cognitive or learning stage is when athletes develop the fundamental movements and a basic mental understanding of the skill.
- The associative or practice stage is when the skill is refined and improved to a proficient level and can be used in competitive situations.
- The autonomous stage is when the skill can be performed without conscious thought in a precise and consistent way under pressure.
- Motor skills can be characterised in various ways that influence the nature of the training program and the way movement skills are developed. Categories include: closed or open; gross or fine; discrete, serial or continuous; self-paced or externally paced; and individual, coactive or interactive.
- Practice methods can also be adapted to suit the stage of skill acquisition (practice can either be massed or distributed, whole or part and blocked or random).
- Performance elements of decision-making, strategic and tactical skills are all cognitive processes that enable success in the competitive environment, particularly in interactive skill-based sports.
- Effective feedback is essential to allow the athlete to progress through the stages of skill acquisition.
- Feedback may come from task-intrinsic (internal) or augmented (external) sources. It may be delivered concurrently or be delayed and it may provide knowledge about the results or performance.

## Multiple-choice questions

- 1 An individual is required to perform a discrete, open and externally paced skill. Which of the following would meet this description?
  - A putting in golf
  - B swimming 400 m
  - C throwing a javelin
  - D returning a badminton serve
- 2 Which set of motor skills is used in a basketball free throw?
  - A closed and fine
  - B closed and gross
  - C open and fine
  - D open and gross
- 3 Which group of physical skills is best acquired using massed practice?
  - A skills learned in an open environment using random practice
  - B skills that require extensive external feedback
  - C skills that require a high degree of coordination
  - D skills that have a distinctive beginning and end

- 4 Which of the following would be suitable for enhancing the performance of an autonomous athlete?
- A self-paced and distributed practice
  - B closed skills and delayed feedback
  - C distributed practice and delayed feedback
  - D concurrent feedback and tactical development
- 5 What is the nature of the skill required by a gymnast?
- A open, self-paced
  - B open, externally paced
  - C closed, externally paced
  - D closed, self-paced
- 6 An AFL coach asks a player to kick at goal 20 times from different spots. At the end of the session, the coach tells the player how many of the kicks scored goals or behinds. The coach is providing:
- A delayed feedback and knowledge of performance
  - B task-intrinsic and delayed feedback
  - C delayed feedback and knowledge of results
  - D augmented feedback and knowledge of performance
- 7 A beginner athlete in the cognitive stage will be most successful with:
- A task-intrinsic and concurrent feedback
  - B random practice and augmented feedback
  - C massed practice and delayed feedback
  - D distributed practice and augmented feedback

## Exam-style questions

- 1 Describe how the characteristics of the learner affect skill acquisition and development. (5 marks)
- 2 Describe how a coach can best support an athlete through the stages of skill acquisition. (6 marks)
- 3 Analyse the process and importance of developing the performance elements. (6 marks)
- 4 Compare the learning environment that would best suit a cognitive learner with that which would best suit an elite athlete. (8 marks)
- 5 Discuss the influence of feedback on the acquisition of skills. (6 marks)

# Chapter 8

## Relationship between psychology, movement and performance

### After completing this chapter, you will be able to demonstrate knowledge of:

- the relationship between psychology, movement and performance, including:
  - personal identity
  - motivation and participation
  - self-regulation.
- the motivational effect of communities of exercise.

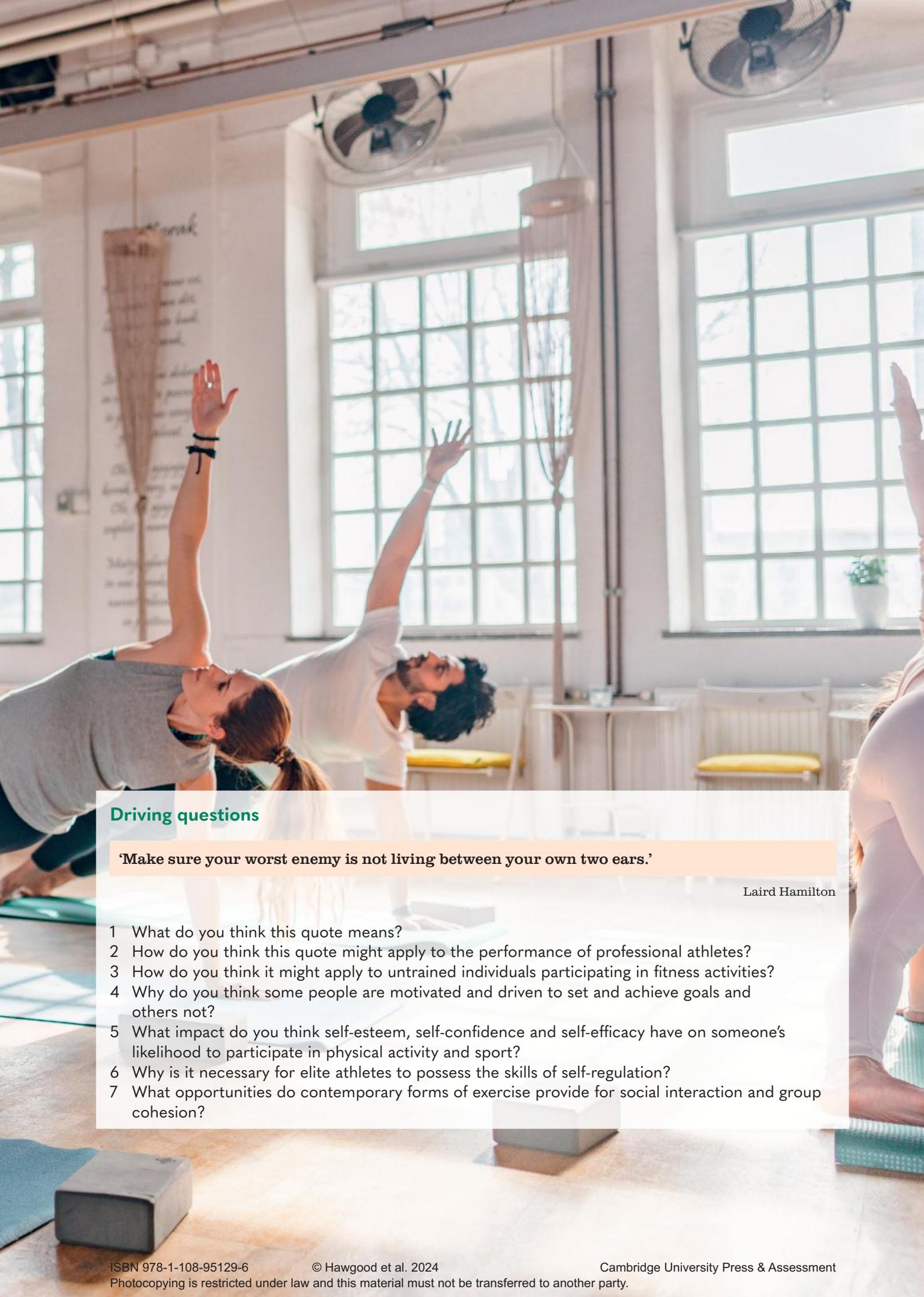
### Key terminology

#### Syllabus terms

community	health
community health	physical activity
contemporary	physical fitness
fitness	strategies

#### Other important terms

belonging	psychology
extrinsic motivation	self-esteem
fixed goals	self-regulation
group cohesion	self-talk
group dynamics	visualisation
intrinsic motivation	



## Driving questions

**'Make sure your worst enemy is not living between your own two ears.'**

Laird Hamilton

- 1 What do you think this quote means?
- 2 How do you think this quote might apply to the performance of professional athletes?
- 3 How do you think it might apply to untrained individuals participating in fitness activities?
- 4 Why do you think some people are motivated and driven to set and achieve goals and others not?
- 5 What impact do you think self-esteem, self-confidence and self-efficacy have on someone's likelihood to participate in physical activity and sport?
- 6 Why is it necessary for elite athletes to possess the skills of self-regulation?
- 7 What opportunities do contemporary forms of exercise provide for social interaction and group cohesion?

# Introduction

‘Champions aren’t made in gyms. Champions are made from something they have deep inside of them; a desire, a dream, a vision.’

Muhammad Ali

Successful performance in sport at any level is determined by a number of factors. These factors are not just limited to physical training and abilities but also include mental preparation and characteristics. Most athletes when preparing for competition will spend significant time and energy developing the required fitness components and refining their technique and skills to ensure the best possible outcome. However, good physical preparation does not always mean good performance. Throughout history there are many examples of elite athletes who possessed all the skill, technique and physical characteristics to win, and were world champions in their field, but when it came to the moment to perform, they were not able to do so at their optimum level. In many cases a lack of mental preparation let them down.

**psychology** the study of the human mind and the way that it functions, including the impact that it has on behaviour

Similarly, there are many untrained individuals who have suffered long-term health issues because they have not had the confidence, determination and self-regulation skills to change negative behaviours and replace them with positive ones.

Having an understanding of the way the mind influences our behaviours and affects our ability

to perform provides benefits at all levels of participation.

**Psychology** is the study of the human mind, its processes and functions and the way it impacts on behaviour. Psychology can help us understand the motivations behind our actions, including those relating to movement and performance. The use of psychological strategies can assist in optimising performance, improving participation and modifying behaviours.

Throughout this chapter we will be exploring the relationship between psychology and movement and the impact the mind has on performance and participation.



**Figure 8.1** Jana Novotna weeps after losing the 1993 Wimbledon women’s tennis final from an almost unassailable position.



Depth Study

## Activity 8.1

### ‘Choking’

- 1 Can you find some examples of elite athletes who ‘choked’?
- 2 What factors do you think led to their loss?
- 3 How do you think mental preparation may have changed the outcome of the situation?
- 4 For the athlete and the situation you identified above, what do you think their motivation was behind competing?
- 5 Can you find an athlete who has performed consistently well in their field?
- 6 What mental characteristic do they possess that you think would have given them an advantage?
- 7 Share your examples with the class and discuss similarities and differences between the situations.

**Skills:** communication, research

## 8.1 Personal identity

### Learning objective 8.1

ANALYSE the effect of personal identity on participation and performance

### Activity 8.2

#### Personal identity

##### Think/Ink/Pair/Share

Can you explain what personal identity is?

- 1 Write your own definition for the term 'personal identity'.
- 2 Compare your definition with another person from the class. As a pair, create a definition together.
- 3 Share your definitions with the rest of the class.
- 4 Discuss: What factors influence personal identity?
- 5 How might personal identity influence the likelihood of someone participating in sport?
- 6 How might personal identity influence someone's performance in sport?

**Skills:** collaboration, communication

Personal identity is the unique set of characteristics, qualities and attributes that distinguish one individual from another. Personal identity can play a key role in the decisions that we make and how we respond in various situations.

Personal identity encompasses all aspects of who we are and is shaped by our:

- values and beliefs
- culture and religion
- likes and dislikes
- personal characteristics including self-esteem, drive and determination.

Identity is not static, but rather can be influenced by the context in which we find ourselves and our experiences. It can evolve over time. Personal identity can have a significant impact on our participation in sport and also how we perform in sport.

### Values and beliefs

Our values and beliefs play a large role in determining how we spend our time and what we prioritise within our lives. An individual who values their physical health is more likely to be motivated to make time to participate in sport as they desire the health benefits of participation. An individual who values time with friends and peers

is more likely to involve themselves in a team sport if their friends are also participating. On the other hand, someone who does not value their physical health or time with friends and peers as much will prioritise other things such as work or leisure time over sport.

In terms of performance, a person who values winning may be more likely to train hard and put in the extra effort to achieve their desired outcome, making their training their priority and increasing their chance of success. Values can also influence the way that an individual conducts themselves within sport. A person who values integrity may speak up in a questionable situation even if doing so may cost them a point or a match.

### Likes and dislikes

Our likes and dislikes have an obvious impact on the types of activities that we involve ourselves in and whether or not we will continue to participate in them. For example, individuals who enjoy physical activity are more likely to choose to participate in sport.

Personal preference further influences the type of sport a person chooses to participate in. Someone who does not like physical activity may still enjoy

the social aspect of team sports, and enjoy the experience primarily for the time spent with friends and teammates.

## Culture and religion

An individual's cultural identity and religion can influence the type of sport that they participate in and to what extent. For example, certain sports may be more popular in some cultures than others due to traditions or the geographical environment in which they are played. In some cultures and religions, violent sports such as boxing may not be encouraged and participation in such sports may be viewed with disapproval. Religious commitments may limit the opportunities for involvement. For example, if an individual regularly attends a religious service on Sundays,

**self-talk** the internal dialogue you have with yourself

they may not have the time to participate in a sporting activity that has games on Sundays, which then limits their opportunities for participation in certain sports.

Religious festivals such as Ramadan may have a significant impact on performance due to the nutritional challenges faced in fuelling the body.

Religious beliefs can also dictate dress codes and modesty requirements, which may impact upon sports participation. For example, Muslim women who observe hijab may need to find sports that accommodate their religious dress requirements.

Religious practices such as prayer and meditation can create a sense of peace and help manage nerves, thereby having a positive impact on performance.

## Personal characteristics

Personal characteristics are closely linked to the way in which we respond in various situations and the decisions that we make in daily life. They play a key role in the likelihood of initial participation in sport and whether or not the participation will continue. Personality traits such

**self-esteem** how you view yourself and how much you like yourself

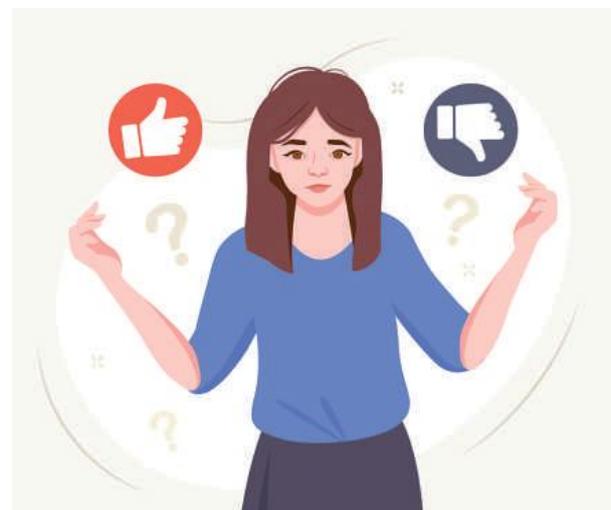
as drive, determination and high **self-esteem** may result in an individual being more likely to try new things, such as new sports, and being more likely to train for improvement.

## Drive and determination

An individual with a high level of drive and determination will be willing not only to participate in new activities but also to persevere and put effort into training and practising to improve. They are more likely to set goals that are challenging but also realistic. For example, a person with drive and determination is more likely to try a new sport such as AFL. They may not have the skills to play but are confident that if they listen to the coach and train, they will improve.

## Self-esteem

As self-esteem is a value that you attribute to yourself, it is often tied in with **self-talk**, which is the way that you talk to yourself in your head. A person with low self-esteem will often practise negative self-talk; they will say critical and self-deprecating things to themselves as part of their inner dialogue and they will be likely to experience anxiety. They are also more likely to be more self-conscious and to consider themselves unlikable and unworthy. This perception of themselves, while based more on emotions than on reality, can have a significant impact on their participation and performance in sport. An individual who is experiencing low self-esteem is less likely to try new things and less likely to engage in team sports and group physical activity. For example, a person with low self-esteem may be hesitant to join a team sport such as cricket as they may not think that



**Figure 8.2** Self-talk is the inner dialogue that goes on in your mind and it can have a significant impact on the way you behave.

they will be of value to the team or that anyone wants them on the team, and may expect that they will fail.

People with low self-esteem may also experience higher levels of anxiety and not feel comfortable in social situations. This, in turn, can impact on a person's willingness to try new things or put themselves in unknown situations.

A person with high self-esteem, on the other hand, will generally practise positive self-talk and have a greater degree of confidence around others in social settings. A person with high self-esteem has a positive perception of themselves and is happy with the way that they are.

A person's level of self-esteem can impact performance in either a positive or a negative way. A person with low self-esteem has a low value and opinion of themselves and is likely to doubt their ability to succeed. In terms of performance, this may result in the person removing themselves from a situation or competition when things get challenging. For example, they may pull out of a race or make no attempt in the first place. In a team setting they may struggle to form connections, which will affect how well they work with the rest of the team. They may not consider themselves a worthy member of the team and may not trust in their abilities. A person with low



**Figure 8.3** Personal identity has a direct impact on participation in sport and physical activity.

self-esteem is likely to seek the approval of others and generally does not respond well to criticism or negative feedback. This, in turn, may affect performance in the long run as they are more likely to focus on the negative elements of feedback that reinforce their poor self-views, rather than focus on any constructive elements. This limits their ability to improve.

A person with high self-esteem, on the other hand, is likely to engage in activities even if they don't think they will be successful. They are likely to perform more consistently as they are not as impacted by external stressors. They are more likely to take feedback on board and focus on future goals rather than on negative elements.

### Activity 8.3

#### Self-talk

Develop a cartoon storyboard or skit that illustrates negative self-talk regarding a sport or physical activity. Create a second storyboard or skit that shows the same situation but with the self-talk reframed to be positive.

**Skills:** creative thinking

### Practical application 8.1

Self-esteem can have a significant impact on performance.

- 1 For a simple skill such as a basketball free throw, each student should rate the degree of confidence they have in successfully performing the skill.
- 2 Have multiple people perform the skill five times under each of the following conditions:
  - a normal conditions
  - b repeating continually out loud or in your head 'I cannot do it; I'm going to miss' or other negative comments
  - c while others repeat negative comments

*continued*

- d while repeating affirming and positive comments such as 'I can do it'
  - e while others repeat affirming and positive comments.
- 3 Record the results for each attempt. Record any feelings or noticeable physiological responses for each type of condition.
  - 4 As a group, discuss the following:
    - a Was there any difference in the performance between conditions?
    - b To what degree do you think that performance is impacted by self-esteem? Consider the rating given by students before completing the skill.
    - c What strategies, if any, did participants use to try to block out the negative comments?
  - 5 Discuss the importance of personal characteristics such as self-esteem on performance.
  - 6 Write a positive self-talk mantra that someone with low self-esteem could repeat to improve their self-esteem.

**Skills:** collaboration, analysis, problem-solving



Quiz

### Revise and summarise 8.1

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 How does personal identity influence participation in sport?
- 2 How does personal identity influence performance in sport?



Collaborative investigation

### Think critically and apply 8.1

Athletes need to be able to maintain high levels of confidence and self-esteem, even in light of setbacks and criticism from fans and the media. Mistakes that are made by players are often replayed and picked apart by the media, fans and non-supporters alike; everyone has an opinion.

So, what impact does this have on athletes' performance?

- 1 Analyse the sport section of a newspaper, noting the nature of the articles.
- 2 What is the focus of the articles?
- 3 What impact do you think it would have on an individual or a team to have their competition performance criticised and picked apart by hundreds or thousands of people nationally and internationally in a public forum?
- 4 'It is not the critic who counts, nor the man who points out how the strong man stumbles or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood, who strives valiantly, who errs and comes up short again and again because there is no effort without error and shortcomings, who knows the great devotion, who spends himself in a worthy cause, who at best knows in the end the high achievement of triumph and who at worst, if he fails while daring greatly, knows his place shall never be with those timid and cold souls who know neither victory or defeat.'

*US President Theodore Roosevelt in his iconic 'The Man in The Arena' speech in 1910.*

Analyse the above quote and summarise the main message with reference to athletes, performance, critics and resilience.

**Skills:** analysis

## 8.2 Motivation and participation

### Learning objective 8.2

ANALYSE how motivation supports participation

Motivation plays a key role in participation; it provides drive and focus and can be a key factor in whether or not an individual is successful in achieving their goals. Individuals can be motivated to participate in sport and physical activity in a number of different ways, including positive, negative, intrinsic and extrinsic motivation.

### Positive and negative motivation

Positive and negative motivation refer to motivation that occurs based on a potential outcome.

In positive motivation, an individual is motivated to participate in an activity because of a potential desirable outcome.

This could include:

- health gains such as weight loss
- learning a new skill
- mastering an old skill
- striving to achieve a personal best
- winning a competition and/or prize
- pleasing someone else
- making a social connection
- fostering a sense of belonging
- achieving stress relief
- achieving a fitness goal.

These outcomes are all things that the participant hopes to achieve through participation.

With negative motivation, however, the incentive for participation comes from an individual wishing to avoid a particular outcome.

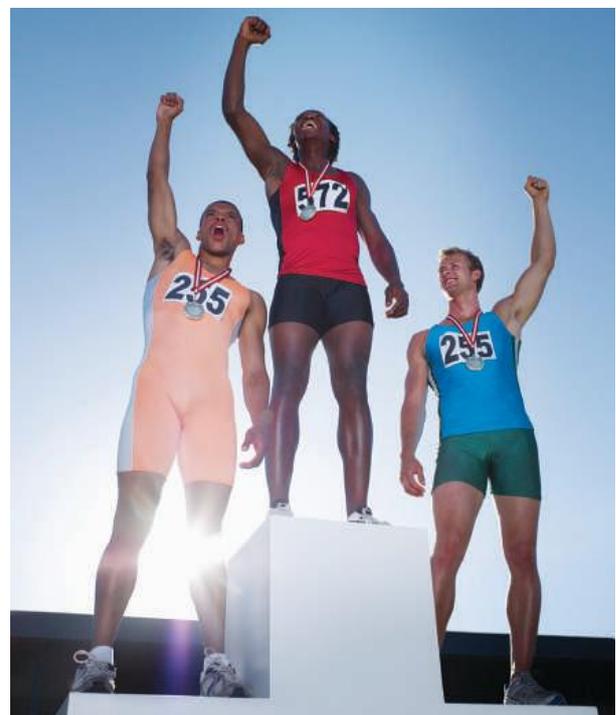
This could include:

- avoiding nagging from friends and family to be active
- training to avoid humiliation
- body image fears

- not wanting to ‘waste’ a gym membership that they have already paid for
- fear of weight gain or negative health outcomes
- fear of not living up to expectations.

These forms of motivation can affect participation at all levels. Generally, positive motivation is a more desired form of motivation, but there are times when negative motivation is a necessary and powerful tool in encouraging participation.

For example, a sedentary individual who has been told by their doctor that they are at risk of developing cardiovascular disease may begin an exercise program to avoid this negative outcome. This is a positive development, even if the motivation to begin with was negative.



**Figure 8.4** Extrinsic motivation can include rewards, medals and monetary prizes, while intrinsic motivation includes achieving a personal best (PB), personal enjoyment and personal satisfaction.

### Intrinsic and extrinsic motivation

Intrinsic and extrinsic motivation are concerned with the source of the motivation and can be

**intrinsic motivation** a motivational factor that is derived from an individual's own thoughts and/or feelings

**extrinsic motivation** any motivational factor that is derived from an external source

positive or negative. **Intrinsic motivation** refers to motivation that is internal and comes from the individual themselves. This form of motivation is highly effective as it is not dependent on external factors and is self-produced. Intrinsic motivation can include things such as achieving personal goals, pure enjoyment, personal satisfaction and the desire to learn a new skill.

**Extrinsic motivation** comprises factors external to the individual. They can be positive or negative and can provide powerful motivation. They play a role particularly in competitive sport as athletes receive prize money, awards, sponsorships and publicity. On a lower level, extrinsic motivators can include factors such as admiration from another person such as a coach or trainer, positive reinforcement from social media posts relating to the activity, a reward such as a sweet treat, the achievement of leader board status on a competitive app, the attainment badges on a

fitness app or the achievement a new level such as a belt in karate.

### Outcomes

It is widely accepted that motivation that is based on intrinsic and positive factors is likely to be more successful at consistently motivating an individual. If motivation is based on extrinsic rewards or avoidance then there is likely to be an increased chance of anxiety, lower levels of interest and effort, and a lower ability to cope with failure. For example, if a child is participating in a sport merely to please their parent, they are less likely to put in any additional practice, they may feel anxious about games as they do not want to disappoint and may feel like they have let their parent down if they don't achieve well or don't enjoy playing.

Motivation that is based on intrinsic factors, even if there are extrinsic rewards involved, generally produces more positive outcomes. There is often greater drive to further develop skills, more positive reactions to setbacks and greater enjoyment taken in the activity. For example, someone who joins a dance club because they love dancing is more likely to practise steps at home and to take on board the advice of the instructor, and is less likely to be discouraged if there is a step they cannot do straight away.

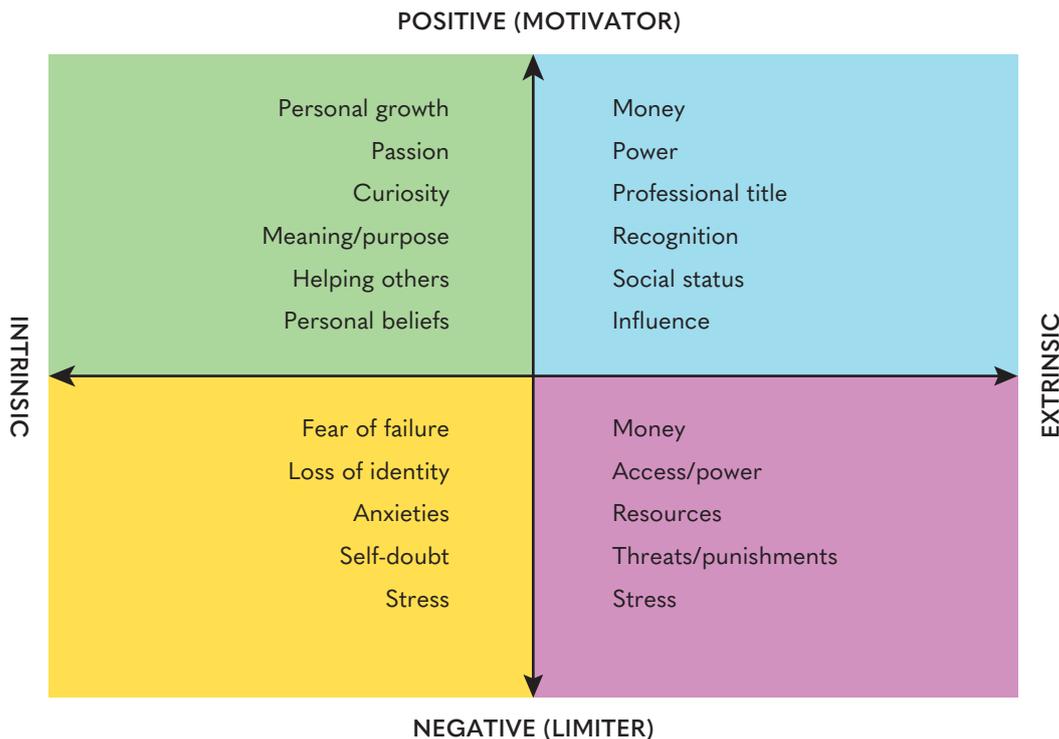


Figure 8.5 Types of motivation

**Activity 8.4****Motivation**

- 1 Develop a range of scenarios that highlight a variety of motivational types. Develop one that displays:
  - a intrinsic negative motivation
  - b extrinsic positive motivation
  - c extrinsic negative motivation
  - d intrinsic positive motivation.
- 2 Which of the above types of motivation do you think is the most effective in supporting participation in sport and exercise? Justify your answer.

**Skills:** creative thinking

**Revise and summarise 8.2**

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Outline the different sources and types of motivation, providing an example of each.
- 2 Discuss the most effective type of motivation for supporting participation.



Quiz

**Think critically and apply 8.2**

- 1 Research two famous sportspeople (either past or current) and investigate their motivation behind training and performance.
- 2 Compare and contrast their motivation, and classify it as positive or negative and internal or external.
- 3 To what extent do you think their motivation has led to their successful performance in sport?



Collaborative investigation

**Skills:** research, analysis



**Figure 8.6** Someone who joins a dance club because they love dancing is more likely to listen to the instructor and practise at home, and less likely to be discouraged if there is a step they cannot do straight away.

## 8.3 Self-regulation

### Learning objective 8.3

ANALYSE why self-regulation is essential for performance in sport and behaviour change in relation to exercise

An Olympic diver is standing on the platform about to perform a medal contending dive. He calms his mind and slows his breath, concentrating on the technical skills he needs to execute while trying to ignore the nerves and excitement he is feeling. A young man at the gym pushes through the burning he feels in his quadriceps to complete the last five repetitions of a set of gruelling squats. An overweight woman turns off the TV, puts on

**self-regulation** the process of consciously managing your thoughts, reactions and behaviours and adapting them to be consistent with your goals or ideals

her joggers, grabs her EarPods, and begins the first session of ‘Couch to 5k’.

**Self-regulation** is the process of consciously managing your thoughts, reactions and behaviours and adapting them to be consistent with your goals or ideals. Examples can range from a sedentary adult overcoming their

urge to stay on the couch and going out for a walk instead, to an elite athlete who displays consistent mental fortitude and drive to achieve their goals. Some level of self-regulation is necessary for functioning and performing in sport at all levels.

Barry J. Zimmerman, Distinguished Professor of Educational Psychology at the City University of New York, defined self-regulation as:

‘self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals’.

The process of developing self-regulation begins when a person is a baby and continues well into adulthood. In many cases, self-regulation is practised without much thought, but sometimes it needs to be consciously worked on and developed. All functioning adults have some level of self-regulation, with some people possessing more than others. Self-regulation is essential for many aspects of functioning within society and it is particularly important for performance in sport and exercise behaviour change.



**Figure 8.7** Using self-regulation to complete the last five repetitions of a set of gruelling squats

Self-regulation includes:

- being able to control impulses
- being able to manage emotions like anger, disappointment and frustration
- being able to maintain focus and attention
- behaving appropriately in a variety of contexts
- completing necessary tasks even when you don't really want to
- being able to manage feelings of excitement and anxiety.



**Figure 8.8** A distinct lack of self-regulation is evident as a brawl erupts during the Argentina and Netherlands quarter final at the 2022 World Cup.

### Activity 8.5

#### Self-regulation

In groups, create a short skit that demonstrates someone with self-regulation and someone without self-regulation in the following contexts:

- participating in a sporting match
- starting an exercise program
- losing in a gold medal race.

**Skills:** collaboration, communication, creative thinking

### Self-regulation and sports performance

There are many self-regulatory skills that must be developed for effective sports performance. They include skills such as maintaining concentration and focus, regulating emotions, managing anxiety and arousal levels, and practising positive self-talk.

The refinement of self-regulation skills is often something that an athlete achieves through working with a sport psychologist.

#### Concentration and attention skills

Being able to maintain focus and concentration, even in the midst of numerous distractions and high levels of fatigue, is a self-regulatory skill essential for performance in sport. For many athletes, the physical execution of routine skills is something that occurs with minimal concentration and thought,

as their movements become autonomous through years of training and refinement. However, in order to execute these skills within a game context they need to respond to the cues of the game. They need to be able to select the cues that are important and relevant and ignore the others, while also maintaining concentration when distractions are present. For example, a footballer executing a shot at goal must respond to the movement of the other players and the placement of the goalkeeper in order for their shot to be successful.

In a more stable environment, focus is likely to involve blocking out distractions such as spectators and other players, calming nerves and dispelling fears in order to execute skills flawlessly. For example, the focus of a hockey player about to take a penalty shot or a basketball player taking a free throw will be concentrated and attentive.

## Emotional regulation

Athletes at all levels must be able to regulate emotions and manage negative impulses to effectively perform. There are many emotions that may be experienced during competition as the result of factors, such as perceived unfair decisions, mistakes and failures; criticism from teammates, coaches and spectators; the pressure of the situation; and ‘trash talking’ from the opposition. Emotions may include anger, frustration, indifference, disappointment, defeat and excitement. These emotions can either help or hinder performance. For example, a player who is frustrated because they perceive the referee to have made a bad call can use that emotion to

increase their drive, determination and energy levels. However, if the player instead gives in to this negative emotion and yells at the referee, they may be sent off the field.

Athletes must learn how to modify emotions to:

- reduce the intensity of the emotion
- respond appropriately to the emotion within the context of the situation
- change the emotional response.

Players can employ strategies such as visualisation, breathwork, self-talk and relaxation to help with emotional regulation.

### Activity 8.6

#### Emotions

Emotions can profoundly affect sports performance.

Consider the myriad emotions a midfielder on a football field may feel within a passage of play that may only last for a minute or two.

- The passage of play may start with the player feeling confident and signalling to receive a throw-in from the sideline. (‘This is it. This is our chance!’)
- They receive the ball, control it and turn, starting towards the goal. (‘I’m going to step this player and make a run down the wing!’)
- However, they misjudge their timing and lose the ball to an opposition player. (‘Oh man, that sucked.’)
- They look up to see their unmarked teammate glaring at them. (‘They think I should have passed ... I probably should have passed ...’)
- They then chase down the ball and win it back. (‘Yes! Got it back!’)
- They turn to make another run (‘Okay, don’t stuff it up this time!’) only to be ankle-tapped just short of a shot on goal by the opposition.
- This foul is not seen by the referee. (‘Come on! How did you not see that! Are you blind?’)
- They chase after the ball, which dribbles to the goalkeeper who picks it up. (‘That guy is dirty! I should have scored then! That should have been a card!’)

A wide range of emotions have been experienced in just a short passage of play. These emotions can either help or hinder play.

- 1 For the passage of play above, identify the different emotions that may be experienced.
- 2 If the player gives into each of those emotions, what might the outcome be?
- 3 What negative impulses may have to be overcome?
- 4 In groups, create a list of strategies a player could use to manage those emotions and then use them in a positive way.

**Skills:** collaboration, analysis

### Managing anxiety and achieving optimum arousal levels

Different sports require different levels of arousal for optimum performance. Difficult or intellectually demanding tasks may require a lower level of arousal (to facilitate concentration), whereas tasks demanding stamina or persistence may be performed better with higher levels of arousal (to increase motivation).

For example, a golfer executing a putt requires a lower level of arousal as they need to achieve a high level of concentration and utilise fine motor skills. In contrast, a boxer about to undertake the second round of a match requires a high level of arousal as they require power, endurance and motivation. Being able to regulate emotional and physical responses to achieve the appropriate level of arousal is essential for performance in sport. When an athlete who is about to compete is experiencing arousal levels that are either too high or too low, they are less likely to be able to reach their full potential. They must be able to assess and adjust their arousal levels both leading up to an event and during the event. Self-regulatory skills such as concentration, focus, self-talk, relaxation and emotional regulation can be employed at this point to either increase or decrease arousal.

Anxiety levels also can significantly impact on performance. Some athletes have a predisposition to anxiety and this can be closely linked to

self-esteem and self-confidence. Being able to control nerves and manage anxiety is necessary for optimal performance.

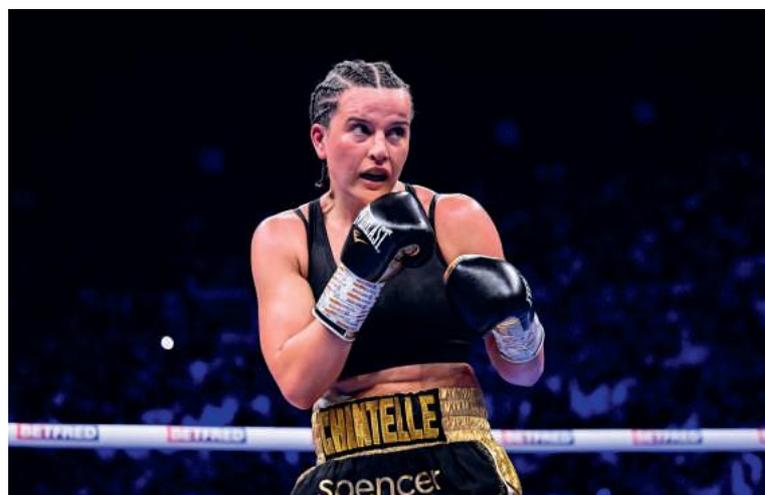
### Mental rehearsal/visualisation/imagery

Mental rehearsal can be an effective tool for managing anxiety, doubt and fear, and for increasing confidence. It can assist the athlete to control negative thoughts and remain centred and focused, providing the edge required for victory.

Two major types of **imagery** used are **mental rehearsal** and **visualisation**.

Mental rehearsal involves the athlete practising the skill in their mind. If properly performed, it allows the athlete to experience the skill before it has actually occurred and can stimulate movement patterns even though there is no actual movement taking place. It is most useful for self-paced skills that are under the total control of the athlete. Such sports include golf, archery, long jump, shot put, diving and gymnastics vault. These opportunities also exist within dynamic sports such as a free throw in basketball or a conversion kick in rugby league.

**imagery** the internal and visual creation or recollection of images and scenarios  
**mental rehearsal** practising a skill in the mind  
**visualisation** creating and focusing on a range of positive mental images and experiences to achieve specific psychological benefits



**Figure 8.9** A golfer executing a putt requires a lower level of arousal than a boxer about to undertake the second round of a match.

The use of visualisation or imagery can also assist in performance by allowing the athlete to imagine the skill being performed flawlessly, thereby visualising success. It can also assist in achieving the required level of arousal by either stimulating or calming. For example, a sprinter who is feeling anxious and stressed about the race may like to imagine a quiet and calm place such as a forest or an empty beach, using the tranquillity of the images they create in their mind to reduce heart rate, focus attention and calm nerves.

However, if the athlete were seeking to increase confidence and arousal levels, a more stimulating visualisation would achieve this –

for example, imagining themselves winning the race by a mile, performing a slam dunk or delivering a knockout punch might give the athlete the lift they need, increasing arousal levels and boosting confidence, ready for more intense competition.

A unique feature of visualisation is that it can be used while actually performing or training to increase the intensity of effort. An athlete running on a treadmill could imagine that they are running in front of their home spectators in an Olympic Games final. By creating a scenario and role-playing it to ensure incredible success, the athlete can push their body to greater heights as they ignore feelings of pain and fatigue.

### Activity 8.7

#### Visualisation

Use the QR code to watch Video 8.1, and then answer the following questions:

- 1 Outline the benefits of visualisation.
- 2 Record the key steps involved in visualisation from the video.
- 3 For a sport of your choice, write down your visualisation goal and then engage in visualising both negative and positive outcomes.
- 4 Research different athletes who use visualisation and how it helps them prepare.



Video 8.1 Visualisation

**Skills:** creative thinking, research

### Self-talk for sports performance

Being able to practise positive self-talk can help to relieve nerves and boost confidence. It can be an effective method for increasing arousal levels and

managing emotions. In many sporting competitions you will see players talking to themselves, reassuring themselves after a mistake or giving themselves a pep talk to ‘fire up’ and increase arousal levels.

### Activity 8.8

#### Preparing for competition

Use the QR code to watch Video 8.2, and then answer the following questions:

- 1 Outline the different mental strategies that are used by athletes to mentally prepare for competition.
- 2 In what ways are self-confidence and self-efficacy reflected in the athletes and the way they prepare for competition?
- 3 What different types of motivation can be seen throughout?



Video 8.2 Ten different ways that athletes prepare for competition

**Skills:** analysis, research

## Self-regulation for exercise behaviour change

Behaviour change is the process of modifying an individual's behaviours with the aim of ending any unhelpful habits and replacing them with positive ones. In relation to health and fitness, exercise behaviour change has become increasingly important as rates of cardiovascular disease, diabetes and obesity continue to rise. Many adults and children within Australia do not meet the recommended physical activity levels and would benefit from developing healthy habits relating to exercise.

Exercise behaviour change is not a quick and easy process. If an individual starts at too high an intensity, this may not be sustainable and could cause them to feel overwhelmed and lead to them giving up on exercise. In order to create long-lasting impact, the changes need to be achieved incrementally over a longer period of time. Another key component of effective exercise behaviour change is the strengthening of self-regulation skills. While there are many different tools that can be utilised to assist in behaviour change, change that is entirely reliant on external factors will be ineffective and short term. Self-regulation skills include goal setting, overriding negative impulses, emotional regulation, practising positive self-talk and self-monitoring.

## Goal setting

One important element of self-regulation for behaviour change is goal setting. Goals enhance motivation, self-efficacy and the ability to self-evaluate. They encourage persistence over time and motivate individuals to put in effort to achieve tasks.

Goals can either be **fixed** or open. The suitability of the type of goal being set may be determined by the individual and their personal characteristics.

**fixed goals** set a clear, explicit goal and generally follow the SMART characteristics

## Fixed goals

Fixed goals generally follow the SMART characteristics: Specific, Measurable, Attainable, Relevant and Time-bound.

**Specific:** the goal should be explicit and clearly defined. Goals such as 'get fitter' or 'exercise more' are not specific. Specific goals improve performance because they identify the effort required for success and enhance self-efficacy by providing a well-defined standard against which to measure progress.

An example of a specific goal is the goal of walking for 15 minutes every day for a week. Another specific goal might be to complete the 'Couch to 5k' running for beginners program in 9 weeks.



**Figure 8.10** For many people, exercise behaviour change is not an easy thing to achieve.

**Measurable:** the goal should be able to be clearly measured. This can be more easily achieved if the goal is quantifiable, whether by distance, time, frequency or energy expenditure. For example, walking for 15 minutes every day for a week can be easily measured through time and frequency. The use of a fitness tracker or fitness app allows athletes to clearly identify if an energy expenditure or distance goal has been achieved. This once again assists in enhancing self-regulation by providing clear measures of success and progress.

**Attainable:** it is essential that goals are achievable. If goals are unrealistic then this may lead to a sense of failure and frustration. It can also contribute to the development of negative feelings towards exercise as well as injury and illness. However, while it is important that goals are achievable, it is also important that goals have an element of difficulty. If they are either too easy or too hard then motivation will be decreased.

Goals should push limits but not be so far out of reach that they cannot be achieved. For example, a sedentary person who sets the goal of running 10 km non-stop within a month would be setting an unattainable goal.

**Relevant:** the goal should be in line with something that you want to achieve. Is the long-term goal to complete the City2Surf fun run? If

so, then setting a short-term goal of swimming every day is not really going to assist in attainment of the long-term goal. This can be addressed by ensuring that the goals are self-set. Self-set goals also serve to enhance motivation, self-regulation and commitment.

**Time-bound:** the goal should have a time frame for attainment. The time frame may be long-term (months to years) or short-term (days to weeks). This provides a clear boundary for when the goal needs to be achieved and assists in providing motivation. Often a goal may have several time components. For example, your long-term goal may be to complete the City2Surf fun run, but your short-term goal is to run around the block without stopping three times in a week.

### Open goals

In contrast to fixed goals, open goals, sometimes referred to as ‘process’ goals and ‘dream’ goals’, are more fluid and are non-specific. They are more exploratory in nature and generally involve a ‘see what you can do’ attitude. For example, rather than saying ‘I will walk for 15 minutes every day for a week’, the goal may be ‘I’m going to see how far I can walk in a week’. These goals can assist in motivation as, being more exploratory in nature, they reduce the possibility of failure. They may be more beneficial for someone who experiences low self-esteem and low self-confidence.



**Figure 8.11** Your long-term goal may be to complete the City2Surf fun run.

## Activity 8.9

### Goals

Read the following article and answer the following questions.

- 1 Outline the benefits of both SMART and open goals.
- 2 Outline the drawbacks of both SMART and open goals.
- 3 What applications do each of the types of goals have?
- 4 Describe a situation where an open goal may be effective. Justify your answer.
- 5 Describe a situation where a SMART goal may be effective. Justify your answer.

**Skills:** analysis

## NEWS REPORT

### Want to exercise more? Try setting an open goal for your New Year's resolution

Christian Swann

*The Conversation*, 1 January 2021

It's that time of year when many of us are setting goals for the year ahead. The most common New Year's resolution – set by 59% of us – is to exercise more.

But our research suggests the way we typically set goals in exercise often doesn't work. So, what should we do instead?

Our research interviewing elite athletes suggests one possibility is to set open goals instead.

#### Specific goals can actually put us off

Generally we're advised to set specific, or SMART, goals (where SMART stands for specific, measurable, achievable, realistic and timebound). Aiming to walk 10,000 steps per day is a common example.

This advice is typically based on goal-setting theory from the 1990s. However, that theory has now evolved, with research now suggesting specific goals in some cases can actually put us off.

One problem is specific goals are all-or-nothing: you either achieve the goal or you fail.



**Figure 8.12** Aiming to walk 10,000 steps per day is an example of a SMART goal.

That's why you might feel you've failed after 'only' recording 9,000 steps when your goal was 10,000. In reality, 9,000 steps might actually be an achievement (especially on a busy day) – but because you didn't reach your specific target, it can feel disappointing.

When you stop making progress towards your goal, or start to feel like you're failing, it's easy to give up – just like many of us do with New Year's resolutions.

Used incorrectly, specific goals even cause unethical behaviour (like using

*continued*

*continued*

devices to artificially increase our step counts and benefit from lower insurance premiums!).

One alternative is to set what's known as an open goal.

### **What are open goals?**

Open goals are non-specific and exploratory, often phrased as aiming to 'see how well I can do'. For example, professional golfers in one study described performing at their best when aiming to 'see how many under par I can get'.

When colleagues and I interviewed elite athletes about exceptional performances, a Mount Everest climber described how:

*I was just thinking, 'Oh I'll just see how it goes and take it as it comes.' I climbed higher and higher and the climb had got more and more engrossing and difficult and all-encompassing really [...] until I*

*discovered that I'd climbed like 40 metres without consciously knowing what I was doing.*

Open goals don't just work for elite athletes – they work well in exercise too. One study found insufficiently active people performed better (in this study that meant they walked further) when pursuing open goals than they did with SMART goals.

The fitness industry is already starting to use open goals. For example, the Les Mills fitness brand now recommends open goals ('to see how active you can be'), and the Apple Watch now incorporates open goals as a workout option.

### **Psychological benefits of open goals**

Open goals aren't just good for performance – they're also much more psychologically beneficial than SMART goals.



**Figure 8.13** Open goals are more psychologically beneficial than SMART goals.

Indeed, the elite athletes who first reported open goals described how they were an important part of experiencing flow – the enjoyable, rewarding state when everything just seems to click into place and we perform well without even needing to think about it.

Follow-up studies found open goals – compared to SMART goals – make walking more enjoyable, make people more confident and make them feel they performed better. That boosts motivation and suggests open goals can help people stick with exercise routines longer.

One participant said open goals ‘took away the trauma of failing’.

#### Why do open goals work differently to SMART goals?

There’s another important difference between open and SMART goals. When you set a SMART goal, you’re identifying something in the future you want to achieve (‘I want to be able to walk 10000 steps every day’).

So pursuing SMART goals is about reducing the gap between where you are now and where you want to get to – you’re always lagging behind where you want to be. That can make it feel like your progress is slow, and slow progress doesn’t feel good.

When you set an open goal, your focus is on your starting point. If your goal is to ‘see how many steps I can reach today’, then as your step count rises, it will feel like you’re making progress. You may start to think, ‘Oh, I’m already on 2000 steps ... Now it’s 3000 steps ... Let’s see how many I can get to’.

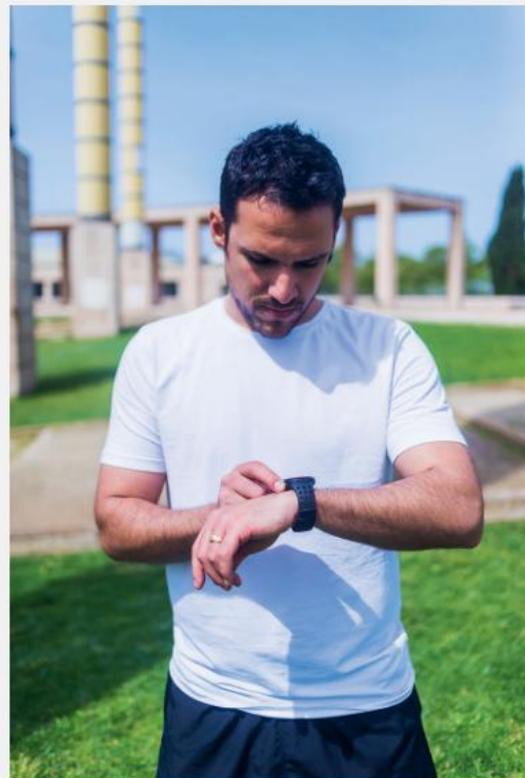
Rather than comparing against where you should be, you’re constantly building on your starting point.

That makes the process much more positive – and the more positive we feel during exercise, the more we’ll want to do it again and again.

To set your own open goals, think first about what you want to improve (for example ‘being more active’). Then identify what you want to measure, such as your daily average step count.

Phrase your goal in an open-ended, exploratory way: ‘I want to see how high I can get my average daily step count by the end of the year.’

And then get started! With an open goal, you’re more likely to see progress, enjoy the experience, and stick with it until you’re ready to set – and achieve – more specific goals.



**Figure 8.14** With a SMART goal, you may feel like you are lagging behind where you want to be.

## Emotional regulation

Emotional regulation is skill that is taught from a very early age. It involves responding to our emotions in an appropriate way.

If someone is not able to regulate their emotions then they are more likely to behave in a reactive manner and may be less likely to push through emotions to meet their goals. For example, an individual who has taken up netball as a way to increase activity may respond badly to the umpire by lashing out and talking back when they disagree with decisions. These frustrations and lack of emotional regulation may then lead to them giving up and quitting. Similarly, an individual feeling annoyed and frustrated with work may indulge those feelings and watch Netflix rather than taking the dog for a walk.

Regulating emotions in relation to behaviour change involves not giving in to negative impulses, such as reaching for an extra piece of chocolate when trying to reduce sugar intake, or resisting the urge to skip a game because you just can't be bothered.

## Self-talk for behaviour change

Positive self-talk can enhance motivation and encourage action, and can be the driving force behind positive behaviour change. If someone has consistently engaged in negative self-talk then it can be challenging to reframe. The shift to positive self-talk may take time and will need to be a conscious effort.



Quiz

### Revise and summarise 8.3

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 What is self-regulation?
- 2 Explain why self-regulation is necessary for sports performance.
- 3 Explain the importance of self-regulation for long-lasting exercise behaviour change.



Depth Study

### Think critically and apply 8.3

- 1 Prepare a series of interview questions for an athlete who competes at a high level of competition. Your questions should focus on:
  - a how they use self-talk before and during a competition
  - b the strategies they use to control negative emotions such as anger, disappointment and frustration
  - c any strategies they employ to achieve the appropriate level of arousal
  - d any pre-competition rituals or specific ways they prepare for competition
  - e their source of drive and motivation.
- 2 Contact an athlete and ask them to either complete written responses to your questions or participate in a verbal interview. Record the responses and share them with the class.
- 3 Were there any surprising responses?
- 4 Alternatively, conduct this exercise as a class.

**Skills:** communication



Collaborative investigation

## 8.4 Communities of exercise

### Learning objective 8.4

INVESTIGATE the motivational effect of communities of exercise

A triathlete in the final stages of a race is in a world of hurt. Burning muscles, sore feet, an aching chest and an overwhelming desire to give in to the pain and stop. But as they round the corner for the last leg, they hear the crowd cheering and can see members of their triathlon club ready and waiting at the finish line. It helps them push through the pain, quicken their step and power on to the finish line.

A 23-year-old man, tired from work, pushes through his desire to just go and sit on the couch and instead gets on his bike to go for a ride. He records his ride on his tracking app and, after he has finished, posts online, receiving some encouraging replies from his friends and earning a badge for five consecutive days of rides.

A 43-year-old working mother, time-poor and struggling to prioritise exercise, swaps her heels for her sneakers and her workwear for her tights and goes to join her friends for a Pilates class at the local community hall, knowing she will feel better after a stretch, sweat and chat.

A sense of community and support is a key element of motivation for both trained and untrained individuals. It can provide the inspiration to push boundaries and creates a sense of accountability, **belonging** and connectedness.

### Contemporary forms of exercise

Exercise for the purpose of increasing strength, endurance and speed has been traced back to 600 BCE in ancient Greece. In those times, exercise was mainly undertaken by the military, because for most people, general life and daily tasks provided sufficient physical activity. It was not until the mid-twentieth century that exercise as a means for health gains became widely accepted and encouraged. The shift in the way that we work stemmed from the Industrial Revolution, and this period saw a stark increase in the number of factory and office jobs. This led to a decrease in the need for manual labour and therefore a decrease in the ways people were physically active. Since then, the way we exercise has continued to evolve and change, with most people needing to make time specifically to exercise. The fitness industry has become extensive, growing in response to consumer demand. The diverse range of exercise options available reflect the many and varied preferences people have for exercise. It can be expected that this industry will continue to grow as consumers' needs and preferences change and as technology and innovations advance.

Contemporary exercise takes many forms and includes activities such as group fitness; gyms, fitness centres and health clubs; personal training; fitness apps, fitness trackers and online workouts; and sport and recreation.

**belonging** a sense of feeling as though you are a part of a group

### Activity 8.10

#### Exercise equipment

- 1 Select a common piece of exercise equipment like the treadmill. Create a 2-minute piece of digital media that outlines how that piece of equipment has been developed over time to become its contemporary form.
- 2 Propose any future developments or modifications that you think could make this piece of exercise equipment better.

**Skills:** collaboration, communication, creative thinking

Collaborative  
investigation

## Activity 8.11

### Exercise options

Investigate the various options for exercise available around your local area. What options are available for children, teenagers, women, men, the elderly, people with a disability and other groups?

**Skills:** research

### Group fitness

Group fitness refers to a diverse range of fitness activities, usually led by an instructor and participated in as a group. This form of exercise has remained popular over the last few decades and provides multiple benefits. As well as providing the physical benefits of exercise, it also provides social benefits. Exercising in a group context allows for social interaction and fosters a sense of community and belonging as individuals become part of a group. The group setting also increases motivation through the encouragement of the instructor and other class members, and by providing a sense of accountability. As most group fitness sessions are run by a trained instructor, they can also assist in the development of correct technique as the instructor is able to provide active feedback to the participants.

Some examples of group fitness activities and classes include:

- yoga
- Pilates

- Zumba
- bootcamp
- running clubs
- high intensity interval training (HIIT)
- CrossFit
- spin
- aerobics
- boxing
- strength classes
- group personal training (PT)
- aqua aerobics
- seniors' classes such as chair yoga
- women-only classes
- aerial yoga
- circus fitness
- pound/drum-based fitness
- dance fitness.

Given the large variety of group fitness options available, it is a form of exercise that provides something for everyone.



**Figure 8.15** The variety of group exercise activities available means that there is something to meet everyone's needs.

### Gyms, fitness centres and health clubs

The number of gyms, fitness centres and health clubs has almost doubled in the last decade. Gyms provide the space and a variety of equipment for individuals to exercise and train. Equipment may include machine and handheld weights, exercise balls and aerobic exercise machines such as stationary bikes, treadmills, cross-trainers and rowing machines. Gyms also often provide group fitness classes.

Gyms have also evolved based on consumer demands, with an increase in women-only gyms, men-only gyms, 24-hour accessible gyms, CrossFit gyms and gyms that focus on time-effective workouts.

Gyms provide motivation in a few ways. In many cases, an individual has made a financial commitment and wants to feel that they are making the most of their purchase. They

can improve motivation through the social environment that a gym provides. Many gyms will also call members or send reminder emails if members have not visited in a few weeks.

### Personal training

A personal trainer works one-on-one with an individual to design and implement a training program that targets their individual health and fitness goals. Some trainers may also provide the opportunity to train with a partner or as a group. In general, the sessions can cost between \$35 and \$100. The frequency of the sessions is up to the individual and the trainer. The accountability and encouragement that a personal trainer provides can be an effective tool in increasing motivation levels and participation among untrained individuals. It can also be a vital tool in pushing a trained athlete to achieve their goals.



**Figure 8.16** Gyms provide the space and equipment for exercise in a purpose-built environment.



Depth Study



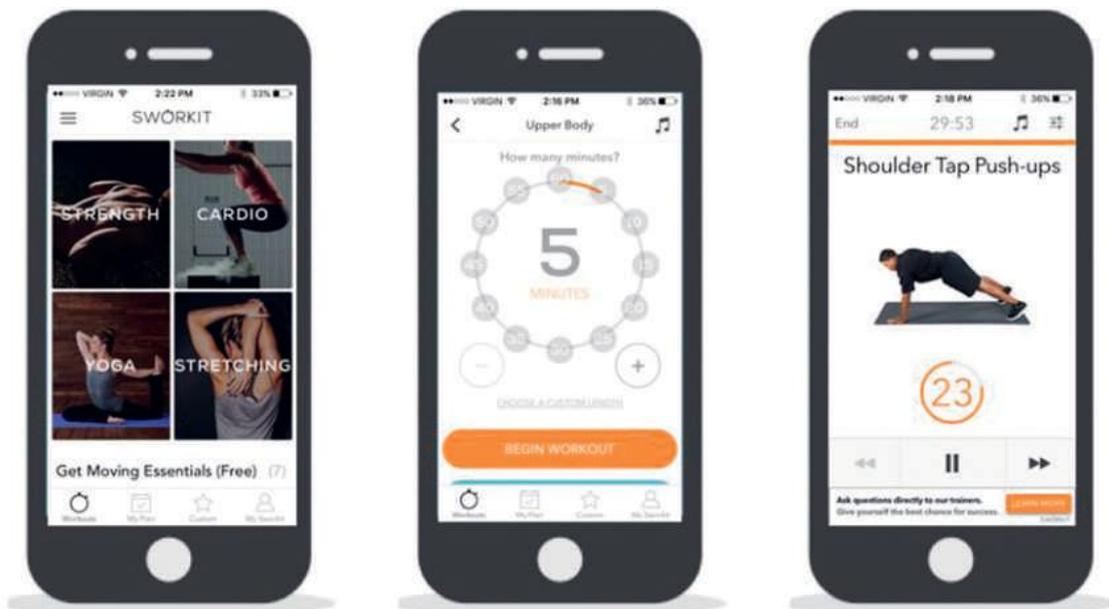
Collaborative investigation

## Fitness apps, trackers and online workouts

Fitness apps, trackers and online workouts had been gradually increasing in popularity in recent years, but their usage exploded during the COVID-19 pandemic as gyms and group fitness activities were closed and people were largely confined to their houses.

Fitness apps are designed to guide the user through a variety of health and fitness activities from beginner levels to advanced. They take on a variety of different forms:

- **Fitness-tracking apps** allow your device to track your physical activity levels by recording data such as distance travelled, steps taken and pace maintained. The apps often allow users to include fitness goals and reminders to encourage and motivate them to be active. Further motivation is gained from the ability to earn rewards like digital badges for achieving milestones and fitness goals. Apps include Fitbit, Apple Fitness and MOVES.
- **Workout apps** provide structured workouts or a database of suggested activities to guide the user through an exercise session. They range from basic 7-minute workouts for beginners through to more advanced, intensive power-building workouts. Some examples of apps include Centr by Chris Hemsworth, Sworkit and SWEAT.
- **Social fitness apps** allow users to connect across devices and share fitness data from their own fitness apps. They also allow users to create challenges based on steps, distance, kilojoules or other wellness-based elements such as sleep. Apps include InKin, Pump Up and Nike Run Club.
- **Competitive fitness apps** allow for competition between users. Apps such as Strava and Zwift use competition as motivation for users, providing training guidance as well as rewards for achieving personal bests and goals. They utilise elements such as leader boards to encourage competition and allow participants to comment on workouts when posted online.
- **Altruistic fitness apps** aim to motivate through tracking your run, with each mile earning money from the corporate sponsorship pool. These apps are focused less on the run data and more on earning for a charity – for example, Charity Miles.
- **Gamified fitness apps** focus on video game elements to motivate the user. Some use your activity levels to create worlds (e.g. Treeceps), some power up little creatures (e.g. Hops – Journey of the Tree Spirit) and some motivate through the creation of a virtual situation (e.g. Zombie Run).



**Figure 8.17** Apps such as Sworkit guide the user through a range of different exercises.

## Case study 8.1

### Strava – fitness for all

- 1 Research the Strava app.
- 2 Describe the main elements of the app.
- 3 What features of the app have made it so appealing and so successful?
- 4 Analyse the effectiveness of the app in motivating people to participate in and improve performance.
- 5 How does Strava address the needs of an untrained athlete?
- 6 How does Strava address the needs of an elite or professional athlete?
- 7 What are the requirements to receive pro-athlete status on Strava?
- 8 To what degree does Strava promote a sense of community and provide social interaction?

A good article to read to support the answering of these questions can be found at the Latana website (<https://cambridge.edu.au/redirect/10298>).

**Skills:** analysis, research

The sheer variety of apps and online workouts available means that almost everyone can find an app to suit their personal needs. Many apps also have content that is accessible via the web on a desktop or laptop computer, increasing the accessibility and usability of the programs. The cost of apps varies from free to weekly subscriptions or annual passes. Many fitness apps are also taking a more holistic approach to health and fitness, including meal plans, sleep advice and more, to assist individuals in making positive choices.

### Sport and recreation

Individual and team sports and recreation are still major forms of exercise within Australia. Sports such as football, netball, AFL, cricket and basketball all remain popular sports for children and adults to participate in. Swimming, walking and cycling are also common recreation exercises.

Sport in Australia continues to evolve and grow as sporting bodies support the needs of the Australian community. Women's AFL and rugby codes in particular have seen huge development over the past 15 years, with the professionalisation of women's national sporting competitions.

## Practical application 8.2

### On your own:

- 1 Download one of the free exercise apps.
- 2 Participate in one of the workouts and write and post a review.
- 3 Rate your chosen app on usability, motivation and entertainment value.

As a class:

- 4 Download the Strava app. Using your school grounds or local playing fields, create some Strava art or write an abbreviation of the name of your school (see <https://cambridge.edu.au/redirect/10299>).

Group challenge:

- 5 Within your class, set a distance goal for walking, running or riding. Either in groups or as a class, set a challenge to see who can meet the goal the quickest.

**Skills:** collaboration, analysis, creative thinking

## Encouraging group dynamics, group cohesion, social interaction and a sense of belonging

Contemporary forms of exercise allow for social interaction in numerous ways that were not

**group cohesion**  
the bond that the group shares and that keeps the group together

**group dynamics**  
the attitudes, processes and behavioural patterns that occur between group members

previously possible. They allow not only for interaction with members of the immediate local community through fitness groups, gyms and sporting clubs, but also connection with others across the globe through the use of apps and online platforms. These interactions can also foster a sense of belonging, develop **group cohesion** and establish positive **group dynamics**.

Group dynamics refers to the attitudes, processes and behavioural patterns that occur between group members. They are impacted by how people respond to each other in group settings and the relationships that exist among group members. Some forms of contemporary exercise can be effective in developing positive group dynamics, while others may be more limited.

Group cohesion is the bond that the group shares. It is what keeps the group together. In a highly cohesive group, members will feel a strong connection to the other members and feel a sense of common purpose or goal.



Depth Study



Collaborative investigation

### Activity 8.12

#### Motivation

- 1 As a class, develop a questionnaire that you could distribute to a local fitness club. Your questions should be focused on the motivations, benefits and social elements of the activity.
- 2 Distribute the questionnaire to a variety of clubs and/or fitness groups in your local area.
- 3 Review your results and compare the motivations behind the different groups. Compile these in a one-page infographic using Canva or another online platform.
- 4 In groups, propose ways that health and fitness clubs could increase the motivation of their members and attract new clients.

**Skills:** communication, problem-solving

The degree of connection and group cohesion experienced in communities of exercise may vary depending on a number of factors. While online platforms may provide a broader audience to connect with, the connections can take longer to develop and may not develop beyond surface-level. For example, connecting with other people through an app such as Strava (where you can post publicly or privately, ‘follow’ other people and comment on their activities) can provide many positive connections. Individuals can feel encouraged and motivated, and belong to groups within the app. The connection, however, may be somewhat limited, as while there is connection within the group, this is generally limited to the activities. Connection and interaction on these platforms can be enhanced through the use of elements such as community pages. Online forums, where members can post photos and articles, allow members to provide and gain further inspiration and encouragement.

One of the benefits of this sort of social interaction is that the degree of connection is up to the individual. Users can immerse themselves in the online world with people of similar interests and views, or stay relatively uninvolved while still feeling part of a community. The level of engagement is up to them.

Gyms, health centres and fitness clubs create communities of exercise by providing a space for individuals to exercise together in a social setting. Individuals can engage with others who share similar interests and goals. For many, the social interactions they receive and the sense of belonging fostered at a gym can be a key motivator for attending and participating. Knowing this, many gyms actively seek to increase interaction and actively try to ensure that people feel like they belong. By running additional social events like holiday-themed parties or offsite workouts, gyms can provide a different setting for people to relate

to each other, encouraging cohesion. Challenges are another way that gyms aim to provide additional opportunities for social interaction and can contribute to group cohesion. As previously mentioned, challenges are commonly included in fitness apps, with gamification being a frequently used method to increase motivation and encourage participation. Challenges and competitions can encourage a sense of fun and belonging as members feel a part of something. Fitness clubs and gyms may run challenges such as weight-loss challenges, rowing challenges and squat challenges. Many also give ‘Member of the Week’ and other awards to increase motivation and engagement.

Social media also provides an opportunity to connect with various communities of exercise that can assist in motivation and encourage performance. There are hundreds of local, national and international groups that all share a common interest and seek to provide support and encouragement to members. For example,

a quick search for ‘running’ in the groups on Facebook will reveal myriad different groups: groups for those who are serious runners and want to improve times and get tips; groups that just provide motivation; groups for beginners; groups for women; groups for girls; groups for men; groups for trail running; groups for ultra-running; local community running groups; marathon running groups; groups focused on the science behind running and more. These online communities provide social interaction and can sometimes be the connection that gets people active and involved in other ways.

Contemporary fitness such as group personal training and group fitness classes can also foster group dynamics as members work together to achieve fitness goals. Bootcamp or group personal training often encourages the same members to attend for the duration of the course. This consistency creates a sense of familiarity as members get to know each other and their instructors. The physically demanding nature of



**Figure 8.18** Sporting clubs provide opportunities for involvement at all levels.

the tasks can also provide a sense of cohesion as they endure physical challenges together.

There are thousands of sporting and recreation clubs within Australia providing opportunities for people to be involved at all levels and in all capacities, from players, coaches and umpires to participation in club management, registrations, canteens and social events. These clubs are an

integral part of Australia's sporting identity, and an important form of community, whether the sports are team-based or individual. Many clubs are run by volunteers who are passionate about their sport. They promote a sense of belonging through a common interest and membership, and provide many opportunities for social interaction through competition, training and social events.

### Activity 8.13

#### Sports participation

For two sports of your choice, one team-based and one with individual competition:

- 1 Explore the options available for participation at all different levels.
- 2 Research how many clubs for this sport exist in your local area.
- 3 Select one of the clubs and, describe its ethos and culture.
- 4 Examine the ways in which this club fosters community and social interaction. Do you see any additional activities in the club calendar?
- 5 For the team sport or activity, analyse how a new team could develop a positive dynamic and foster group cohesion.

For this activity, you may find it helpful to research the Australian Government's Sporting Schools initiative (see <https://cambridge.edu.au/redirect/10300>).

**Skills:** research

Many contemporary forms of exercise facilitate the development of group cohesion and group dynamics. From team-based sports and activities such as football, netball, AFL, rugby league, cheerleading, water polo and hockey to group social recreation such as walking, hiking and caving, these activities all involve individuals coming together to work towards a common goal.

Group dynamics are developed over time and often go through a five-step process:

- 1 Forming – the group is established.
- 2 Storming – members get to know each other. Conflict may arise as different personalities clash and members of the group establish roles.
- 3 Norming – members have accepted a common goal and are learning how to work together towards it.
- 4 Performing – the group is working effectively together.
- 5 Adjourning – If the group was established to meet a goal and the goal has been met then the group disbands.

The speed at which groups may go through these steps will vary. This can be due to the nature of the goal or task, with simpler goals and tasks often involving quicker progression. Some groups may never progress through all stages and may get stuck in the storming stage if differences cannot be resolved.

Team sports rely on individuals working together with other members of the group to achieve their common goals. Often these goals may revolve around competition, but can also include group-based goals relating to their performance as a team in particular areas. For example, a football team may have the goal of decreasing the number of missed passes or refining corner kicks. If groups work through these stages and are performing well together then cohesion is established.

## Case study 8.2

## Cycling

Communities of exercise can be integral in encouraging participation and improving performance at all levels.

## Lucas Hoffman

Lucas Hoffman, a cyclist from the remote SA town of Whyalla, developed his passion for cycling through his local community cycling club. This connection assisted in him fostering his natural talent and developing his skills. He trained with the local club and began racing when he could. During the pandemic when all races were cancelled and he could not train with the club, he turned to an online cycling community – Zwift. This online community provided support and encouragement, intensive training programs and competitions. One of these competitions was a worldwide competition to gain a place on a sponsored team to compete at the European Championships. This is an opportunity that he is unlikely to have had otherwise.



Depth  
Study

## NEWS REPORT

### Rising Whyalla cyclist Lucas Hoffman sprinting for European contract

Tristan Tobin

*Whyalla News*, 17 November 2022

Whyalla cyclist Lucas Hoffman has his sights set on the professional cycling tour in Europe after being plucked from obscurity to compete for a spot in one of the world's leading teams.

Twenty-five year old Hoffman is currently vying against four other people for a 2023 spot on the Alpecin-Deceuninck team after being identified as a potential champion through the virtual cycling exercise app Zwift. He beat out more than 100 000 people around the world for the opportunity.

Zwift Academy Road Finals are currently being held in Syncrosfera, a health and performance center in Denia, Spain. Before departing, Mr Hoffman said it would be a surreal experience to train alongside his potential future teammates.

'We're training with some of the best athletes in the world, so that will be a massive experience for me. You're

training with guys you watch on tv,' he said.

The experience and support he had received from the local community have been critical in developing him as a cyclist, Mr Hoffman said. He started at the Whyalla Velodrome, which was about 100 metres from his childhood home, when he was 15.

'It's a really great community. They have helped me so much. I really hope one day I can pay it back,' Mr Hoffman said.

Training as a junior under Keith Gibbons, Mr Hoffman said his early experiences at the Whyalla club were important to helping him find a love of cycling. It was a love he worked hard to nurture during the pandemic.

Unable to race competitively over the last two years, and looking to continue his training, Mr Hoffman turned to Zwift.

*continued*

Case study 8.2 *continued*

The app, which allowed him to connect his bicycle to virtual races all over the world, had led to him competing in the Zwift Academy, a series of virtual challenges in which the best athletes are selected to compete for a real world professional cycling contract.

The fourth year apprentice electrician was now eyeing a very different career.

'I'd love to race professionally over in Europe. I want to race in the Tour de France', Mr Hoffman said.

Getting noticed as a road cyclist in Australia was a huge challenge, and

his success in virtual competition had made things easier, Mr Hoffman said.

'It's pretty amazing. It's going to open up so many doors, even if I'm not successful in winning the contract', he said.

When asked why he thought Whyalla had a good track record for producing champion cyclists, Mr Hoffman said it was a combination of a tight club community mixed with country grit.

'I think it's the community feeling around the club. Everyone helps each other out', he said.

### Andy Shuttleworth

Another example of how online communities and contemporary forms of exercise can foster social interaction and a sense of belonging and cohesion, is the experience of injured war veteran Andy Shuttleworth. After a life-changing injury that resulted in him being sedentary for 20 years, he received a double knee replacement through a charity organisation. The organisation also encouraged him to engage in a more active lifestyle by taking up cycling on a recumbent trike. After developing his fitness and becoming a regular adapted cyclist, he developed a taste for racing and was keen to do more. Unfortunately, many cycling bodies and clubs didn't recognise recumbent trikes and so his options were limited. However, Andy found an online exercise community in the world of Zwift. Like Lucas, he was able to compete in races that he would otherwise not have been able to access. For Andy, however, the focus was on the social aspect of the rides and races. The online community allowed him to interact with other members who were also veterans riding adapted bikes and to develop friendships that transferred into the real world.



**Figure 8.19** Andy Shuttleworth with his recumbent trike

**Case study 8.2** *continued*

In an interview in 2022, Andy talked about using Zwift.

‘The social interaction is vital ... so we use Discord to chat even when racing’. Andy also enjoys Herd rides ‘because they are a lovely bunch and ideal for adaptive riders’ ...

‘Discord means that we aren’t only interacting with riders around us, but anyone on the ride or others just dropping in for a chat’, notes Andy when describing the social inclusion advantages of virtual cycling to the adaptive population. ...

Andy rides with others from a worldwide WIS [wounded, injured or sick] community while raising awareness and spreading the word about adaptive riding. Andy acknowledges the positive power and tremendous reach of Zwift when he says, ‘We have made friendships in the virtual world that translate to the real world’.

Christopher Schwenker, ‘Through Virtual Cycling Military Veteran and Recumbent Rider Andy Shuttleworth Heals and Helps’, *The Zommunique*, 11 January 2022



**Figure 8.20** The online world of Zwift has allowed Andy to interact with others from all over the world, creating a sense of belonging and increasing his performance and participation.

- 1 Analyse the importance of community in motivating Lucas and Andy to participate and perform.
- 2 What limitations have each of them experienced? How were these overcome? In what ways was community involved?
- 3 How do you see communities of exercise motivating Lucas and Andy in their stories?
- 4 What benefits have each of them received from the communities they are a part of?

**Skills:** analysis

## Case study 8.3

### Active farmers

Use the QR code to watch Video 8.3, and then answer the following questions:

- 1 Describe the purpose of Active Farmers. Assess the effectiveness of Active Farmers in influencing levels of exercise and physical activity in rural and remote communities.
- 2 How is a group like Active Farmers promoting group dynamics, group cohesion, social interaction and a sense of belonging?
- 3 Discuss the importance of having groups like Active Farmers that are targeted specifically at the needs of the group.
- 4 Research another city-based exercise group that addresses specific fitness needs and preferences.



Video 8.3  
Active Farmers



Video 8.3 Active farmers

**Skills:** analysis, research



Quiz

## Revise and summarise 8.4

Complete the quiz in the Interactive Textbook and answer the questions below on paper or in the Interactive Textbook.

- 1 Identify the various forms of contemporary exercise.
- 2 Explain how contemporary forms of exercise encourage group dynamics and group cohesion.
- 3 Outline the various ways that social interaction can be cultivated through contemporary forms of exercise.
- 4 Analyse how contemporary forms of exercise assist individuals in developing a sense of belonging.

## Think critically and apply 8.4

Debate the following statement:

'Contemporary forms of exercise such as fitness apps and gyms encourage comparison and self-promotion rather than positive social interaction and group cohesion.'

**Skills:** communication

## Chapter summary

- Personal identity is the unique set of characteristics, qualities and attributes that distinguish one individual from another.
- Personal identity can have a significant impact on our participation in sport and also how we perform in sport.
- Our values and beliefs play a large role in determining how we spend our time and what we prioritise within our lives, including making time to participate in sport.
- Individuals who enjoy physical activity are more likely to choose to participate in sport, but someone who does not like physical activity may still enjoy the social aspect of team sports.
- An individual's cultural identity and religion can impact on the type of sport that they participate in and to what extent.
- Personality traits such as drive, determination and high self-esteem may result in an individual being more likely to try new things, like new sports and to train for improvement.
- Motivation plays a key role in participation; it provides drive and focus and can be a key factor in whether or not an individual is successful in achieving their goals.
- Motivation can be intrinsic or extrinsic, and positive or negative.
- It is widely accepted that motivation that is based on intrinsic and positive factors is likely to be more successful at consistently motivating an individual.
- Self-regulation is the process of consciously managing your thoughts, reactions and behaviours, and adapting them to be consistent with your goals or ideals.
- There are many self-regulatory skills that must be developed for effective sports performance.
- The refinement of self-regulation skills is often something that an athlete achieves through working with a sport psychologist.
- Being able to maintain focus and concentration, even in the midst of numerous distractions and high levels of fatigue, is a self-regulatory skill essential for performance in sport.
- Athletes at all levels must be able to regulate emotions and manage negative impulses to effectively perform.
- Different sports require different levels of arousal for optimum performance.
- Mental rehearsal can be an effective tool for managing anxiety, doubt and fear, and increasing confidence.
- The use of visualisation or imagery can also assist in performance.
- Self-talk can be an effective method for increasing arousal levels and managing emotions.
- Behaviour change is the process of modifying an individual's behaviours with the aim of ending any unhelpful habits and replacing them with positive ones.
- An important element of self-regulation for behaviour change is goal setting. Goals can either be fixed (e.g. SMART) or open.
- Other self-regulatory skills that may be beneficial for effective behaviour change are emotional regulation and practising positive self-talk.
- A sense of community and support is a key element of motivation for both trained and untrained individuals.
- It was not until the mid-twentieth century that exercise as a means for health gains became widely accepted and encouraged.
- Contemporary exercise takes many forms and includes activities such as group fitness; gyms, fitness centres and health clubs; personal training; fitness apps, fitness trackers and online workouts; and sport and recreation.
- Contemporary forms of exercise allow for social interaction in numerous ways.
- These interactions can also foster a sense of belonging, develop group cohesion and establish positive group dynamics.

## Multiple-choice questions

- 1 An individual who trains very hard in the hope of qualifying for the Commonwealth Games team is displaying motivation that is:  
A positive and intrinsic  
B positive and extrinsic  
C unrealistic and extrinsic  
D intrinsic and negative
- 2 The process of consciously managing your thoughts, reactions and behaviours is referred to as:  
A self-motivation  
B self-talk  
C self-esteem  
D self-regulation
- 3 In relation to fixed goals, the acronym SMART stands for:  
A Special, Mindful, Active, Real, Target  
B Specific, Measurable, Attainable, Relevant, Time-bound  
C Serious, Measured, Aimed, Resolved, Timed  
D Sensible, Mature, Achievable, Regulated, Thoughtful
- 4 Communities of exercise can be beneficial to participation in sport as they:  
A provide a sense of belonging and connectedness  
B provide motivation  
C create accountability  
D all of the above
- 5 The attitudes, processes and behavioural patterns that occur between group members are referred to as:  
A group dynamics  
B group cohesion  
C group characteristics  
D group identity

## Exam-style questions

- 1 Define belonging. (1 mark)
- 2 Identify the different types of motivation. (2 marks)
- 3 Outline the various communities of exercise. (3 marks)
- 4 Outline what group cohesion refers to. (3 marks)
- 5 Describe four contemporary forms of exercise. (4 marks)
- 6 'Believe you can, and you're halfway there', is a quote by President Theodore Roosevelt. Explain how this quote captures the importance of self-confidence and/or mental preparation for good performance in sport. (5 marks)
- 7 For two different forms of contemporary exercise, analyse how they encourage social interaction and group dynamics. (6 marks)
- 8 Evaluate the various types of motivation for their effectiveness in supporting participation. (8 marks)
- 9 Justify why self-regulation is essential for good performance in sport. (8 marks)
- 10 Analyse the impact that high and low levels of self-esteem and self-efficacy can have on an individual's performance in sport and physical activity. (8 marks)

# Depth studies and collaborative investigation



## Chapter

Chapter 9: Depth studies

Chapter 10: Collaborative investigation

Additional support for the depth studies and collaborative investigation, including a dedicated section on research skills, is available in the Interactive Textbook.

# Chapter 9

## Depth studies



As part of your Year 11 Health and Movement Science course, you are required to undertake at least two depth studies.

A depth study gives you the opportunity to engage more deeply with an aspect of the course. It consists of an investigation or activity – or a series of investigations/activities – that extends on one or more of the concepts in the course. You may do one depth study for each of the two course components – Health for Individuals and Communities, and The Body and Mind in Motion – or you may do depth studies that look at elements from each component.

You may complete a depth study individually or as part of a group.

Possible depth study ideas include (but are not limited to):

- Completing a profile of a sport or an individual athlete.
- Completing a case study of a health-related organisation or group.
- Designing and completing an experiment, or series of experiments, to test a claim.
- Performing a literature review for a specific focus area, with analysis of the evidence and data.
- Investigating and reporting on a particular health issue that affects Australians.
- As a group, undertaking a large scale case study which can be broken into parts such that each student can work independently on their part.

The final presentation for a depth study will summarise the work you have completed, presented in a format that is appropriate. Possible presentation formats include:

- essay
- report
- poster
- presentation
- speech
- video
- podcast.



**Figure 9.1** You might decide one of your depth studies will be a profile of a particular sport.

Refer to the Interactive Textbook for more information about completing your depth studies, including an exploration of some different types of depth study, and formats for your final presentation. There is also a dedicated section on research skills.

## Depth study topics

Your teacher may guide the class through specific depth studies, or you may work on a topic of your own choice. The only requirement is that it builds on material and concepts you have looked at in the course.

### Textbook suggestions

Throughout this textbook, you will see that a number of the activities and case studies are flagged with an icon:



This icon indicates that the authors think the activity or case study has potential to be explored further in a depth study.

### Sample depth study

Here is a sample depth study: a case study that draws on both components of the course, and which requires a range of investigations.

**Note that this is only an example. As you saw on the previous page, depth studies can cover a wide range of methods.**

Nico is a 16-year-old student at a local high school, who loves football but has only ever played socially with friends, and during PE and break times at school. Academically, Nico generally enjoys school and has good grades across all subjects, particularly those that involve analysis and problem solving.

Nico comes from a low-income, single-parent household, with two younger siblings. They live in a high-density area in a major capital city.

Nico has had some chronic physical pain from growth related issues as well as a formal diagnosis of depression. Nico is carrying some extra weight and feels their fitness is less than desirable.

Nico struggles with feeling positive about future prospects but is able to form strong relationships with peers and teachers.

Nico's Dad has been talking with them about their current health and wellbeing,

and Nico has expressed interest in improving all aspects of their health.

You and your colleagues, who work in a multi-disciplinary health improvement facility, have been employed to work with Nico on developing a plan to help improve their health. Your brief is to include low-cost positive health improving actions, which are research based and focussed on improving all dimensions of Nico's health.

This scenario-based depth study requires you to work through Nico's problem, determine the factors that affect it, and then develop potential solutions. It invites deep exploration and a variety of recommendations. For a depth study such as this one, your teacher might invite you to consider it as a group, and then distil it into smaller sub-components to be investigated individually, using the syllabus as a guide.

Steps you could take are:

- developing a definition of health to present to Nico and Nico's Dad
- researching the causes and protective factors for one or more of Nico's health issues, including looking at epidemiological data and identifying the key trends that apply to Nico
- summarising the influence of the various determinants of health on Nico, and identifying how they may provide opportunities to support Nico
- researching one or more of the major health issues affecting Nico, and making recommendations for improving their health
- researching football training, including aerobic and anaerobic requirements, and designing a 7-day program for Nico that incorporates the FITT principle
- designing a skill-based training program for Nico.

At each step of the depth study, you will develop the question you need to answer (including assessment criteria).

# Chapter 10

## Collaborative investigation

In addition to the depth studies, you are required to undertake a collaborative investigation.

Like the depth studies, the collaborative investigation gives you the opportunity to engage more deeply with an aspect of the course. However, in this case it must be undertaken as a group. There will be both an individual assessment and a group assessment.

As part of your Year 11 Health and Movement Science course, you are required to take part in a collaborative investigation. This involves working together in a group to investigate a research question, giving you the opportunity to engage more deeply with an aspect of the course.

## Collaborative investigation research questions

The collaborative investigation should research a question that is of interest to your group.

The question must focus on an area covered in one of the course components, and it must not significantly overlap with an investigation or research you are undertaking in another Year 11 or Year 12 course. It must also not overlap with one of the depth studies you are undertaking.

Throughout this textbook, you will see that a number of the activities and case studies are flagged with an icon:



This icon indicates that the authors think the activity or case study has potential to be explored further in a collaborative investigation.

Other potential topics for a collaborative investigation include (but are not limited to):

- To what extent can strength training be used to improve performance for an endurance-based athlete?
- How do cultural expectations influence the attitudes and physical activity choices of young people?
- Analyse how government agencies have engaged with local First Nations communities in the development and implementation of health promoting programs?
- Analyse the effectiveness of the various aspects of the National Road Safety Strategy (2011-2020) in reducing road related harm.
- To what extent do psychological and nutrition strategies contribute to success in various elite sports?

The collaborative investigation lets you manage your own learning, and develop skills also applicable to the depth studies. However a key aspect of the collaborative investigation is that it relies strongly on social and communication skills, as group members need to rely on each other in order to ensure the investigation is successful.

- For a selected health issue affecting young people, analyse the effectiveness of current educational programs and make recommendations for future developments.
- Analyse the factors that have the most influence in determining the likelihood that an athlete will go onto an elite level of representation.
- For a selected sport, analyse how various training methods are used to develop the body systems required for success.

NESA has provided further suggestions and guidelines on their website, <https://curriculum.nsw.edu.au/learning-areas/pdhpe/health-and-movement-science-11-12-2023/teaching-and-learning>.



**Figure 10.1** For your collaborative investigation, you could look at a health issue affecting young people, such as vaping, and analyse the effectiveness of current educational programs.

# Elements of the collaborative investigation

The collaborative investigation consists of four elements: design, documentation, presentation and a reference list.

## Design

Your proposal.

## Documentation

A portfolio of work, completed either individually or as a group. It should include:

- your design proposal, including the research methods you plan to use
- the process by which you developed the research question
- a record of discussions you had within your group, and also with teachers and other persons involved in the research
- a record of the major decisions your group made as part of the investigation

- reflections on, and evaluation of, the collaborative investigation, by group members and others such as your peers and teacher
- drafted responses to the question you were researching
- statements by group members of the learnings from the collaborative investigation.

## Presentation

You may present your findings in a written, oral or multimodal format. The presentation should summarise the findings of the research, and provide evidence to support them, with all sources acknowledged.

## Reference list

You are required to provide a reference list of the sources you used within the investigation. The format must be consistent, and you should use an appropriate reference style, such as Harvard or APA, including for referencing of websites.

# Process of completion

NESA has provided a five-phase process for completing your collaborative investigation. This is included in the document ‘Teaching advice (Collaborative Investigation): Health and Movement Science 11–12’, available at <https://curriculum.nsw.edu.au/learning-areas/pdhpe/health-and-movement-science-11-12-2023/teaching-and-learning>.

A summary of this process is:

- Phase 1: form collaborative investigation groups, decide on an area to investigate, conduct initial research and formulate a research question.
- Phase 2: conduct further research and propose a hypothesis of the outcome you expect, based on your research to date.
- Phase 3: develop your method for collecting data, including ethical considerations and risk management.
- Phase 4: collect, present and analyse your data, which may be quantitative, qualitative, or a combination of the two.
- Phase 5: draw conclusions from your data analysis, evaluate the investigation as a whole and complete your presentation.

NESA recommends checking in with your teacher throughout the process, and particularly at the end of each phase.

Refer to the Interactive Textbook for more information about the elements and process of your collaborative investigation, including checklists and other tools. There is also a dedicated section on research skills.

# Glossary

**acquisition** the learning or development of a physical skill or ability

**activist** a person who campaigns to bring about political or social change

**adenosine triphosphate** the most basic source of energy in the human body – a compound consisting of an adenosine molecule and three phosphate groups

**advocacy** an action aimed at gaining support for a particular cause

**aerobic** metabolic processes that occur in the presence of oxygen

**agonist** the primary muscle that is working during a muscular contraction (may be shortening or lengthening under tension)

**anaemia** a condition in which the red blood cells, iron or haemoglobin levels are at low levels, affecting oxygen carrying capacity

**anaerobic** metabolic processes that occur in the absence of oxygen

**anatomical position** a standard point of reference used when describing terms and positions of human anatomy and physiology: standing upright, arms by sides, palms facing forward and legs parallel

**anatomy** the study of the structures of the body and their relationships

**antagonist** the opposing muscle to the agonist muscle, which is relaxed allowing the joint to freely move

**appendicular** the part of the skeleton that comprises the shoulder and pelvic girdle, arms and legs

## **Australian Bureau of Statistics (ABS)**

Australia's national statistical agency that gathers and analyses statistics in a broad range of areas including economic, social, population and environmental statistics

## **Australian Institute of Health and Welfare (AIHW)**

Australia's national independent agency on health and welfare data. AIHW provides information and statistics to inform and support policies and decision-making within health and welfare

**autonomy** independence and freedom to be able to make one's own decisions

**axial** the part of the skeleton that comprises the head, vertebrae and rib cage

**belonging** a sense of feeling as though you are a part of a group

**burden of disease** the impact of living with injury and illness, and premature death; often measured in terms of how many years of healthy life were lost

**carbohydrate loading** consuming an increased quantity of carbohydrates in the final days before an endurance event to maximise glycogen stores

**cardiac output** the volume of blood ejected by the left ventricle of the heart per minute; it is generally measured in millilitres per minute

**circulatory system** organs and tissues that pump blood and its contents around the body, including the heart, arteries, veins and capillaries

**concentric** the phase of an isotonic contraction where the muscle is contracting or shortening while under tension

**connectedness** the number and quality of social connections or relationships with family, friends and acquaintances

**COVID-19 COronaVIrus Disease 2019.** An infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which was first identified in Wuhan, China, in December 2019. It spread globally, and on 11 March 2020 the World Health Organization declared the outbreak to be a pandemic.

**digestive system** organs and tissues that help extract nutrients from the food and fluids consumed, as well as the removal of waste products; it includes organs such as the mouth, stomach and intestines

**dynamic health** the concept that an individual's level of health is not fixed but rather is constantly changing

**eccentric** the phase of an isotonic contraction in which the muscle is lengthening while under tension

**endocrine system** organs known as glands that produce hormones (or chemical markers), which are released into the blood to travel around the body to act as communication messengers as required

**enzymes** proteins that help speed up metabolism and chemical reactions

**expiration** the act of releasing air from the lungs into the external environment

**extrinsic motivation** any motivational factor that is derived from an external source

**fixed goals** set a clear, explicit goal and generally follow the SMART characteristics

**food security** being able to obtain sufficient, safe and nutritious food

**generation** members of a society who were born at approximately the same time; a generation tends to be approximately 15–20 years

**glycaemic index** a rating system for the effect that foods will have on blood sugar levels, with pure sugar (glucose) being 100

**glycogen sparing** using fats as an energy source for as long as possible during exercise to preserve glycogen for higher intensity and longer duration events

**group cohesion** the bond that the group shares and that keeps the group together

**group dynamics** the attitudes, processes and behavioural patterns that occur between group members

**haemoglobin** a protein within red blood cells that binds to and carries oxygen around the body

**health promotion** the process of enabling people to increase control over, and improve, their health

**heart rate** the number of times the heart beats in one minute

**HIV/AIDS** human immunodeficiency virus/acquired immunodeficiency syndrome. HIV attacks the body's immune system and if not treated can then lead to AIDS. There is no effective cure for AIDS

**homeostasis** the stable equilibrium and balance between human body systems

**imagery** the internal and visual creation or recollection of images and scenarios

**inspiration** the act of drawing air into the lungs from the external environment

**interdependent** where two or more body systems rely on one another to fulfil their own function

**intersectoral** actions that involve multiple sectors of society, including government and non-government agencies

**interval training** periods of high-intensity work effort interspersed with periods of rest and/or active recovery

**intrinsic motivation** a motivational factor that is derived from an individual's own thoughts and/or feelings

**isometric contraction** muscle contraction without a change in the length of a muscle; refers to a stationary contraction

**isotonic contractions** the shortening and lengthening of a muscle through joint action while under a constant load

**kinematics** the study of objects in motion and how technique adjustments can increase the efficiency of motion to achieve a greater outcome

**kinetics** the study of the body that creates force and how this relates to the object being acted upon

**lactate** a naturally occurring by-product of cellular respiration, which is associated with the fatigue related to high-intensity exercise

**lactate threshold** the point at which blood lactate starts to more rapidly increase, indicating that the body is starting to work anaerobically and will experience increasing rates of fatigue

**maximum aerobic speed (MAS)** the lowest speed at which an athlete can run where they have reached their maximal oxygen uptake ( $\text{VO}_2 \text{ max}$ )

**maximum heart rate** an approximate calculation of the maximum heart rate an individual can work towards, measured as  $220 - \text{age}$  (e.g. the MHR of a 25-year-old would be  $220 - 25 = 195 \text{ bpm}$ )

**mental rehearsal** practising a skill in the mind

**Millennium Development Goals (MDGs)** goals developed by the United Nations to combat poverty, hunger, disease, illiteracy, environmental degradation and discrimination. Committed to by leaders around the world in the year 2000, they have since been superseded by the Sustainable Development Goals.

**minute ventilation** the total amount of air that is breathed in one minute

**motor pattern** memorised configurations of nervous system activation that can produce repeated and successful movement outcomes

**motor skills** the coordinated and specific movements of the body to achieve a desired outcome

**multidimensional health** health consisting of more than one dimension, incorporating the physical, mental, spiritual, emotional and social dimensions

**multimorbidity** the presence of more than one disease or medical condition in a person

**muscle insertion** the muscle bone attachment that moves; contraction is in the direction away from this point

**muscle origin** the muscle bone attachment that does not move; contraction is in the direction towards this point

**muscular system** a body system consisting of skeletal, smooth and cardiac muscle, the muscular system produces movement of the body, maintains posture and helps circulate various fluids throughout the body

**nervous system** organs and tissues that help to coordinate sensory information, cognitive processes and various responses around the body such as movement; it includes the brain, spinal cord and nerve cells

**Ottawa Charter** a WHO framework for health promotion that can be applied to all health-promoting agencies

**physiological adaptations** metabolic or physiological changes within cells and tissue in response to training stimuli

**physiology** the study of the functioning of human body systems

**profile drag** the shape and surface area of the object as it moves through fluid

**proprioception/kinaesthetic sense** the perception and awareness of the body's position and movement through space

**psychology** the study of the human mind and the way that it functions, including the impact that it has on behaviour

**relative health** the concept that an individual's level of health is determined in reference to others or to their own level of health at another time

**reliable** the extent to which a test measures without error and is fair and repeatable

**reorienting health services** directing the focus of the health sector towards health promotion, prevention and supporting the wellbeing of the whole person to complement traditional roles of diagnosis, treatment and rehabilitation; reorientation can also involve coordinating other sectors to work for health

**resilience** the ability to 'bounce back', recover and respond positively to challenging, stressful and traumatic situations

**respiratory system** organs and tissues that allow for the action of breathing, such as lungs, diaphragm, alveoli and the nasal cavity

**self-concept** the belief a person has in their own strengths, abilities, personality and status; a sense of the kind of person you are

**self-efficacy** the belief you have in your ability to achieve your goals and produce desired outcomes and your motivations to do so

**self-esteem** how you view yourself and how much you like yourself

**self-identity** recognition, awareness and acceptance of the qualities and characteristics that make an individual feel unique

**self-regulation** the process of consciously managing your thoughts, reactions and behaviours and adapting them to be consistent with your goals or ideals

**self-talk** the internal dialogue you have with yourself

**self-worth** a person's inner belief in their own value and place in the world, and their belief that they are worthy of esteem and respect from others

**skeletal system** organs and tissues that form the body's internal framework, consisting of bones, teeth and connective tissue (e.g. cartilage and ligaments)

**social media** websites and applications that focus on community, the sharing of ideas and interests and the creation of networks

**stabiliser** a muscle that helps maintain balance and stability during movement without directly contributing to it

**stroke volume** the volume of blood ejected by the left ventricle of the heart during each systemic contraction; it is measured in millilitres per beat

**supportive environments** the places people live, work and play that protect them from threats to health and that increase their ability to make health-promoting choices

**United Nations (UN)** an international organisation consisting of 193 member states that seeks to promote peace, justice, respect, human rights, tolerance and solidarity by working together to find shared solutions to common problems

**valid** the extent to which a test measures what it is supposed to measure

**vasodilation** the dilation or widening of blood vessels and capillaries near the surface of the skin to increase heat loss

**ventilation** the depth and rate of breathing; ventilation rate is measured in breaths per minute and ventilation depth is measured in either millilitres per breath or litres per minute

**visualisation** creating and focusing on a range of positive mental images and experiences to achieve specific psychological benefits

**VO<sub>2</sub> max** the maximum amount of oxygen a person's body can absorb during exercise; measured in millilitres of oxygen absorbed into the muscles per kilogram per minute

**World Health Organization (WHO)** an agency of the United Nations that seeks to achieve high levels of health for all

**Y2K** In the last years of the twentieth century, there were fears of widespread computer failures as the calendar ticked over to 2000, due to many programs representing the year by two digits, meaning they might interpret '2000' as '1900'. In the end, there were very few problems, probably because of the pre-emptive work done by computer programmers

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