

# 2

# Determinants of health and illness

## KEY TERMS

Alma Ata declaration  
Burden of disease  
Communicable diseases  
Determinants of health  
Health care gap  
Infant mortality  
Inverse care law  
Life expectancy  
Non-communicable diseases  
Sociocultural factors  
Socioeconomic factors

## LEARNING OBJECTIVES

After completing this chapter, you should be able to:

- 1 Discuss the major factors contributing to health and illness.
- 2 Briefly explore disparities in worldwide disease burden and mortality.
- 3 Identify various biomedical and behavioural factors that influence a person's health.
- 4 Briefly describe how socioeconomic and sociocultural factors influence a person's health.
- 5 Discuss the environmental factors contributing to the health of a community and of an individual.
- 6 Briefly describe the challenges and gains associated with the health care gap experienced by Aboriginal and Torres Strait Islander peoples.

## WHAT YOU SHOULD KNOW BEFORE YOU START THIS CHAPTER

Can you differentiate between mortality and morbidity?

Can you differentiate between incidence and prevalence?

## INTRODUCTION

The World Health Organization (WHO) defines health as ‘... *a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*’. The WHO also believes that the attainment of maximal health is a fundamental human right. This chapter will focus on the multitude of aspects that can determine health status and the development of illness for an individual, community or population. This will be achieved in the process of exploring the **burden of**

**disease**, which is the measure of how life is shortened by illness, injury, disability and premature death in a population. This chapter is not meant to be a deep exploration of the pathophysiological causes of all of the conditions mentioned, as this is done in the body of the text in the appropriate chapters; rather, its role is to highlight the complex and prolific influences of various factors that can affect health and illness, which may not otherwise be appreciated by a purely biomedical examination of the diseases and conditions explored in the text.

# DETERMINANTS OF HEALTH AND ILLNESS

## LEARNING OBJECTIVE 1

Discuss the major factors contributing to health and illness.

## HEALTH AND ILLNESS

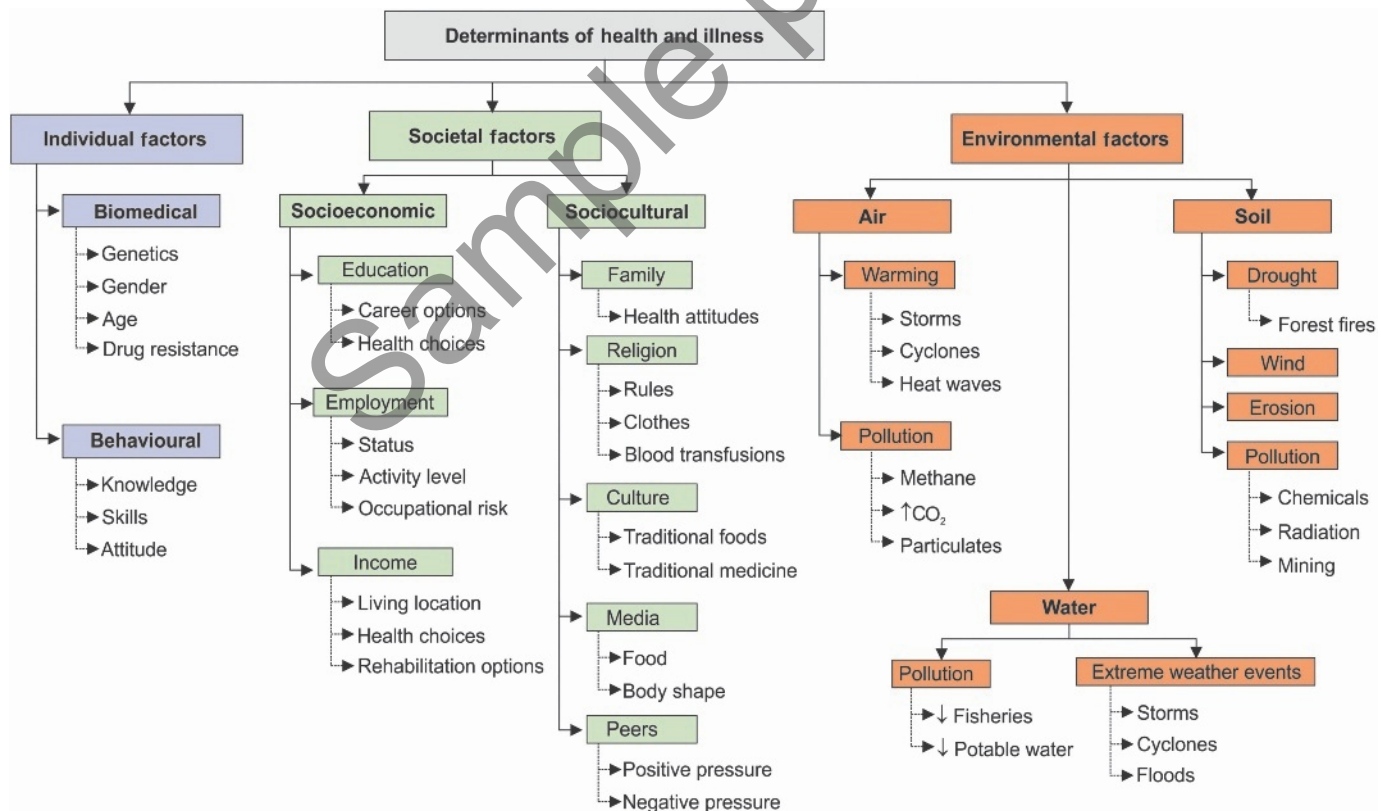
When planning illness prevention and disease management programs, organisations responsible for health promotion consider the **determinants of health**. These are factors that influence the likelihood of staying healthy or becoming ill. Although there are numerous factors that influence health, they may be distilled into three primary determinants:

- 1 *individual factors*—such as biomedical conditions or the behavioural choices made by the individual
- 2 *societal factors*—such as socioeconomic or sociocultural influences
- 3 *environmental factors*—which can contribute to the health and wellness of a person, community or population.

Figure 2.1 illustrates the complexity of various factors that can influence individual and population health. This diagram is by no means complete; however, it attempts to identify major contributors to health and illness. The diagram's construction also closely represents the structure and contents of the chapter.

In 1978, an international body co-sponsored by the WHO formulated a document called the **Alma Ata declaration**. Its fundamental goal was to achieve world health by the year 2000, and, although the goal was not achieved, the action marked the first steps towards identifying the need for world governments, local communities and health care workers to understand the importance of primary health care in the prevention of disease and the promotion of health and wellness.

While many diseases are preventable through the management of risk factors, the provision of basic nutrient and hygiene requirements or the use of vaccinations, other diseases are non-preventable, such as Parkinson's disease, type 1 diabetes or aortic aneurysm. *Preventable diseases* are often divided into communicable and non-communicable diseases. Although some **communicable diseases** will be discussed briefly in this chapter, see Chapter 8 for more in-depth discussion on various communicable or infectious diseases. **Non-communicable diseases**



**Figure 2.1**

Determinants of health and illness

↓ = decrease; ↑ = increase; CO<sub>2</sub> = carbon dioxide.

account for approximately 70% of all deaths, which equates to approximately 40 million people globally per year. Measurement of **life expectancy** and mortality rates can provide an insight into the health of a nation, and comparisons over time can measure the efficacy of programs or initiatives to improve the health of a population.

## DISEASE BURDEN AND MORTALITY

### LEARNING OBJECTIVE 2

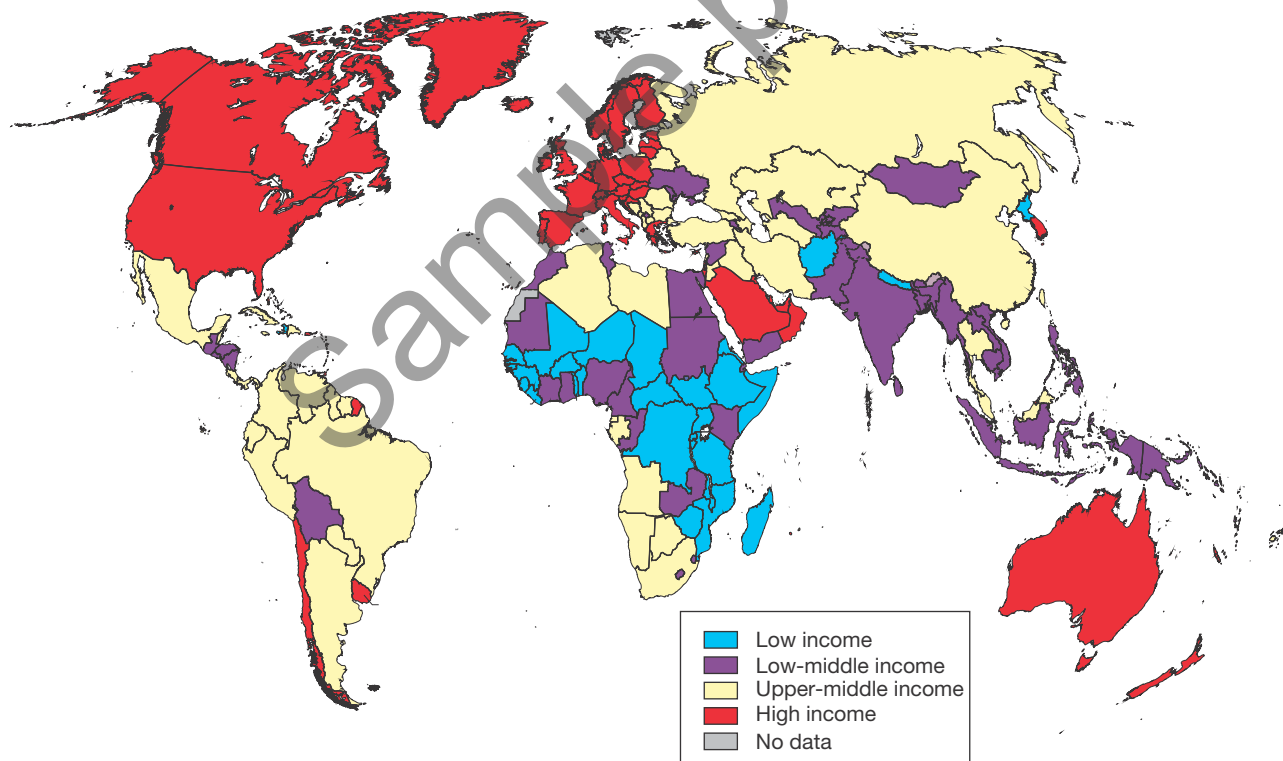
Briefly explore disparities in worldwide disease burden and mortality.

A former Secretary-General of the United Nations, Kofi Annan, once said: ‘The biggest enemy of health in the developing world is poverty.’ It is estimated that more than 1.2 billion people live on less than US\$2 per day. The World Bank has recently grouped all countries by income, and developed a classification based on gross national income (GNI) per capita, sorting each country into one of four classifications: low, low-middle, upper-middle and high. Figure 2.2 illustrates countries’ economies by GNI per capita. When reporting health statistics, many agencies now convey

certain data by this metric. Although GNI per capita does not exactly encapsulate a country’s level of development, it has been found to correlate well with important measures, such as quality of life, **infant mortality** and life expectancy.

The insight of Kofi Annan’s words is readily demonstrated when contrasting the life expectancy and infant mortality rates to a country’s income. The more impoverished countries with the lowest incomes experience significantly lower life expectancy and significantly higher infant mortality statistics compared to high-income countries (see Figures 2.3A and 2.3B). Unfortunately, these statistics support the existence of the **inverse care law**, which is the concept whereby those in the most need of medical care are the least likely to receive it.

Other distinguishing features between high-income and low-income economies are the *leading causes of death*. The WHO reports that low-income economies tend to experience more than 50% of their leading causes of death as communicable disease, nutritional deficiencies and child and maternal health issues. However, high-income countries tend to experience non-communicable disease for almost all of their leading causes of death. Figure 2.4 represents a comparison of the top 10 leading causes of death between high-income economies and low-income economies.

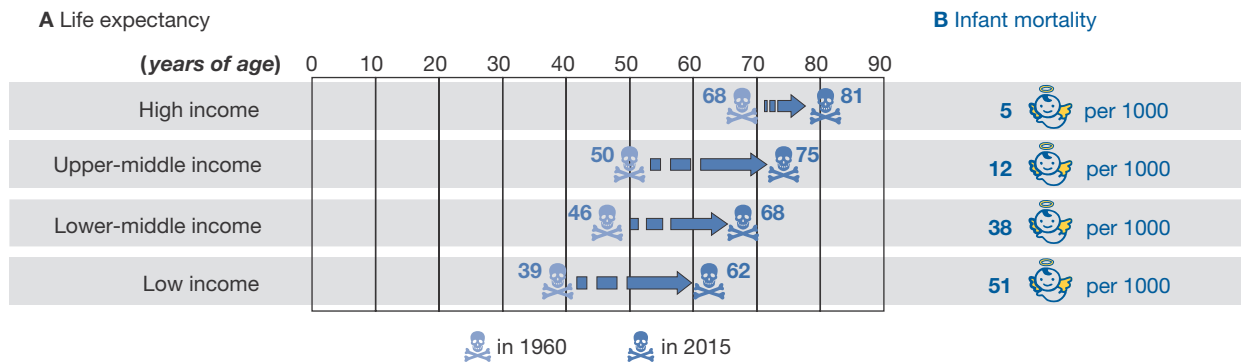


**Figure 2.2**

Distribution of countries by gross national income

Classification according to World Bank estimates of gross national income per capita US\$—Atlas method.

Source: World Bank—modified from <<http://databank.worldbank.org/data/download/site-content/wdi/maps/2017/world-by-income-wdi-2017.pdf>>.



**Figure 2.3**

Life expectancy and infant mortality rate (per 1000) by GNI economy

(A) Life expectancy data comparing countries' economies by gross national income per capita, 1960–2015. (B) Infant mortality per 1000 population comparing countries' economies by gross national income per capita, 2015.

GNI = gross national income.

Source: Data extracted from the World Bank, using the UN Inter-agency Group for Child Mortality Estimation. Retrieved from <<https://data.worldbank.org/indicator>>.

## INDIVIDUAL FACTORS INFLUENCING HEALTH

### LEARNING OBJECTIVE 3

Identify various biomedical and behavioural factors that influence a person's health.

### BIOMEDICAL

Factors such as genetics and gender may influence the health and wellness of an individual. It is sometimes difficult to separate these two concepts.

#### GENETICS

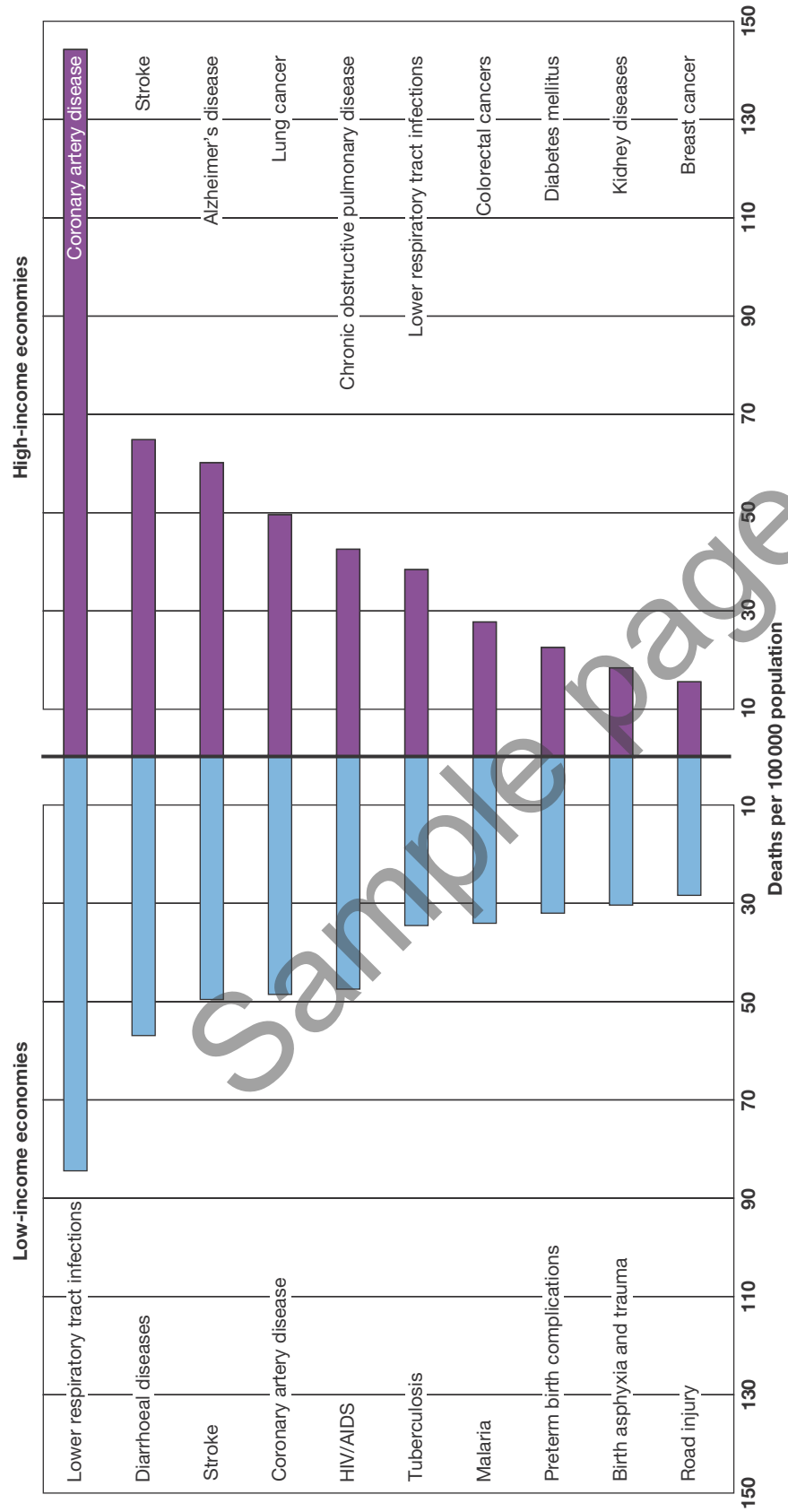
A person's gender is determined by their genetics and the presence or absence of a Y chromosome. The substitution of the Y chromosome instead of a second X chromosome in males may contribute to the likelihood of expressing an X-linked inheritable condition, such as haemophilia. However, elements of a person's gender may have nothing to do with the sex chromosomes, and everything to do with the health opportunities provided, withheld or forced upon a person based on gender alone. This may be expressed through inequalities in nutrition, education or access to health care opportunities for girls, through to extreme gender bias procedures, including female genital mutilation, and selective abortion or female infanticide practised in some regions of the world. As previously discussed, a person's chromosomal makeup may influence the expression of an inheritable condition (see Chapter 4). Genetic polymorphisms (chromosomal variations in a certain population that cannot be maintained by only recurrent mutation) have long

been identified as explaining the varied metabolism of many drug-metabolising enzymes. Subsequently, individuals may experience different values from a therapeutic drug. Early research also suggests that these variances may contribute to certain individuals' increased propensity to develop liver disease. This genetic tendency is seen in myriad other health conditions, such as atopy (an individual's tendency to be hyper-allergic). Atopy is commonly expressed as asthma, anaphylaxis and autoimmune disease. Figure 2.5 illustrates the sex chromosomes, showing a distinct difference in size and, therefore, potential genetic information related to gender.

#### GENDER

Irrespective of genetics, gender still plays a considerable role in the determinants of health. Gender may influence access to health care, or even the conditions experienced. In the most simplistic terms, males develop conditions affecting sexual health structures and male genitalia, such as the testicles and the prostate, and females develop conditions affecting sexual health structures and female anatomy, such as breasts, the uterus and the ovaries. Nonetheless, gender may play an even more significant role in a person's health and wellness when considering access to health care, religious or cultural practices performed on gender-specific anatomy, and governmental policy or regulation withholding, directing or dictating access or intervention.

Male and female circumcision have vastly different outcomes between the genders; however, some cultures and religions may hold strong beliefs about this practice. Attempts to legislate access to reproductive health resources, such as fertility prevention measures or pregnancy termination interventions, may deprive a woman of the right to decide what happens with her own body. Poor maternal health programs and support also result in increased infant and maternal mortality.



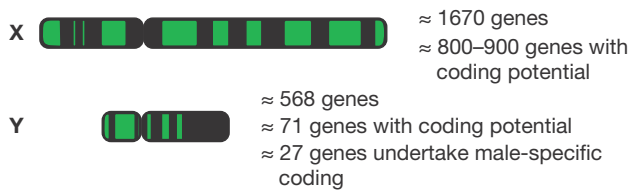
**Figure 2.4**

Leading causes of death in the lowest- and highest-income economies

The top 10 causes of death by economy income group for 2015.

AIDS = acquired immune deficiency syndrome; HIV = human immunodeficiency virus.

Source: Data extracted from the World Health Organization (2017d).



**Figure 2.5**

**Sex chromosomes**

The X chromosome is significantly longer and contains far more genes than the Y chromosome. Although modern medicine does not appreciate the entire implication of this, it is thought that this size differential may account for the significant variance in immunity, response to vaccinations and autoimmunity experienced by women compared to men.

Therefore, the failure to provide and maintain resources to assist pregnant women will also result in poorer health outcomes for infants. Conversely, money well spent in supporting good maternal health will result in significant, long-term savings to an economy’s finite health budget.

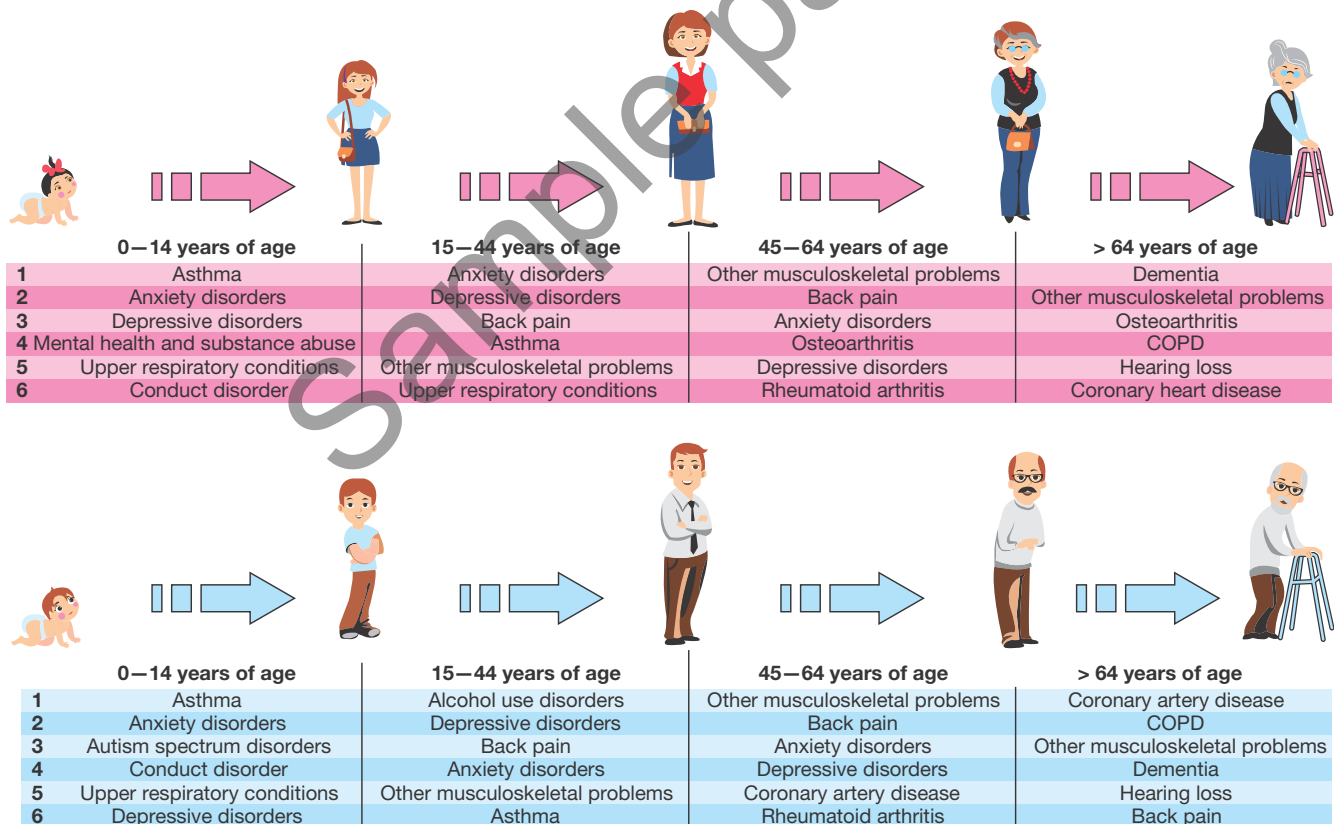
In some regions of the world, girls are excluded from the nutrients and resources necessary to facilitate conditions and opportunities to maximise their health potential. Also, for some individuals, gender identity and sexual orientation may influence the person’s ability to access suitable health care for their needs.

**AGE AND LIFESPAN CONSIDERATIONS**

An individual’s degree of health or illness may vary across their lifespan with changes unrelated to normal biological senescence. Interestingly, there is also an accompanying influence of gender on a person’s potential burden of disease across the lifespan. Figure 2.6 illustrates the top six Australian burdens of disease across the lifespan for age and gender, as determined by the Australian Institute of Health and Welfare (AIHW).

Newborn health is not only of critical importance for population growth and the long-term endurance and resilience of a country, but also to ensure that there are younger people around to care for the ageing population. Infant mortality is a good indicator of a country’s health care status, and, as seen in Figure 2.3 in the previous section, it directly correlates to an economy’s financial status.

Substantial child and maternal health programs should include the obvious components, such as the provision of adequate



**Figure 2.6**

Top six burdens of disease in Australia across the lifespan, comparing gender

COPD = chronic obstructive pulmonary disease.

Source: Extracted from AIHW (2016b).

nutrition, perinatal health supports, vaccination programs, adolescent health promotion services and reproductive health education and support. Health care decision-makers are realising that it is also important to consider the less obvious requirements, such as intra-family violence prevention education and resources, and even health care worker education programs to ensure sufficient numbers of appropriately educated individuals.

As the world ages, and health improves and life expectancy extends, many upper-middle- and high-income economies face an ever-increasing obesity epidemic associated with significantly diminishing population health, resulting from myriad obesity-related disease processes. Therefore, with increased life

expectancy not associated with sufficiently wise individual health choices, the health care budget is more burdened from chronically ill people living longer. Consequently, resource provision is taxed, and decisions about the best use of the health care dollar results in equity dilemmas when determining ‘who’ must miss out on ‘what’.

As a person ages, changes associated with senescent body systems can affect every organ system, and may exacerbate disease or even influence the selection or effects of pharmacological interventions chosen for the individual (see Figure 2.7).

As identified earlier, the senescent immune system undergoes changes; however, old age is not the only life stage with the

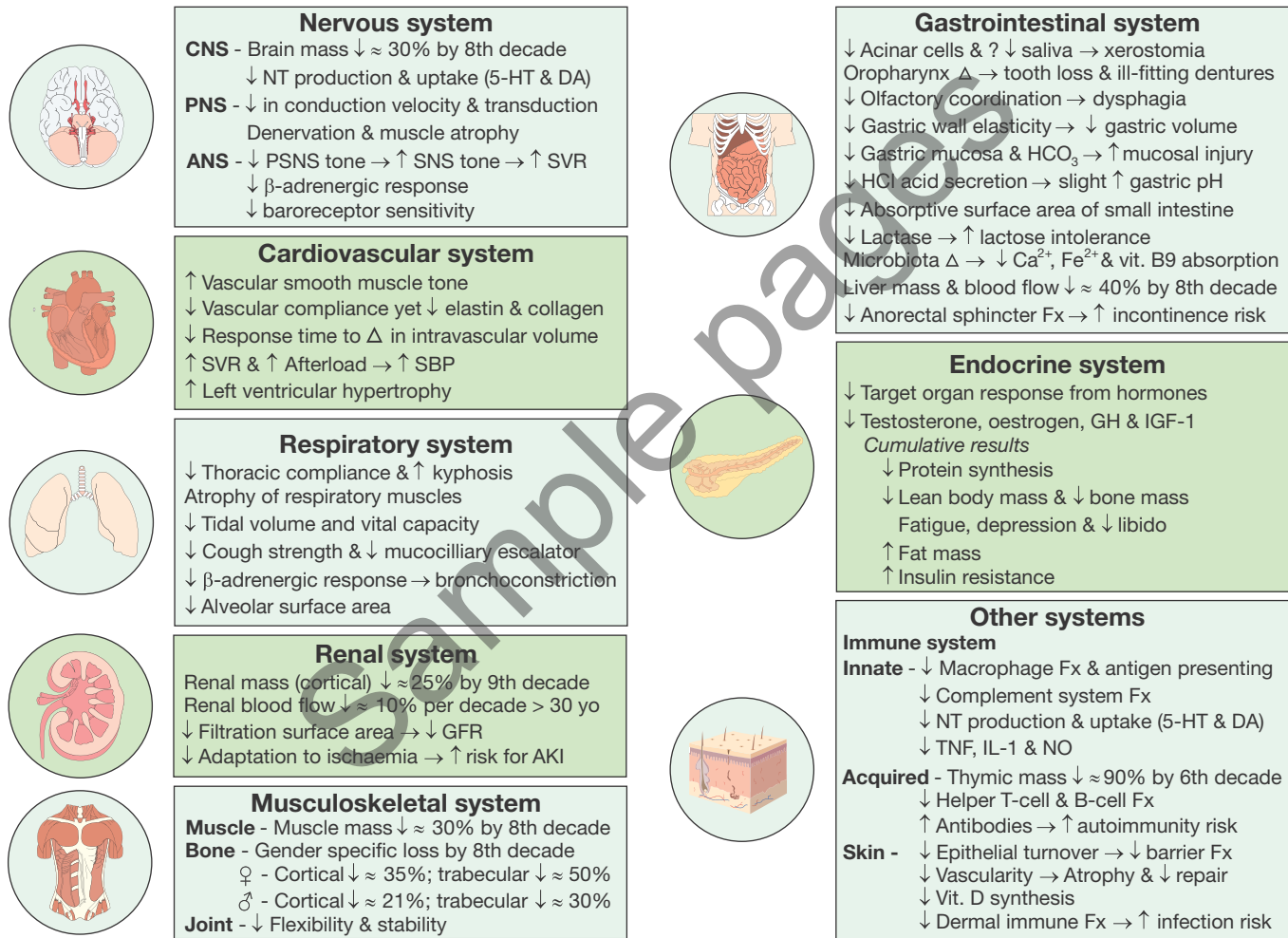
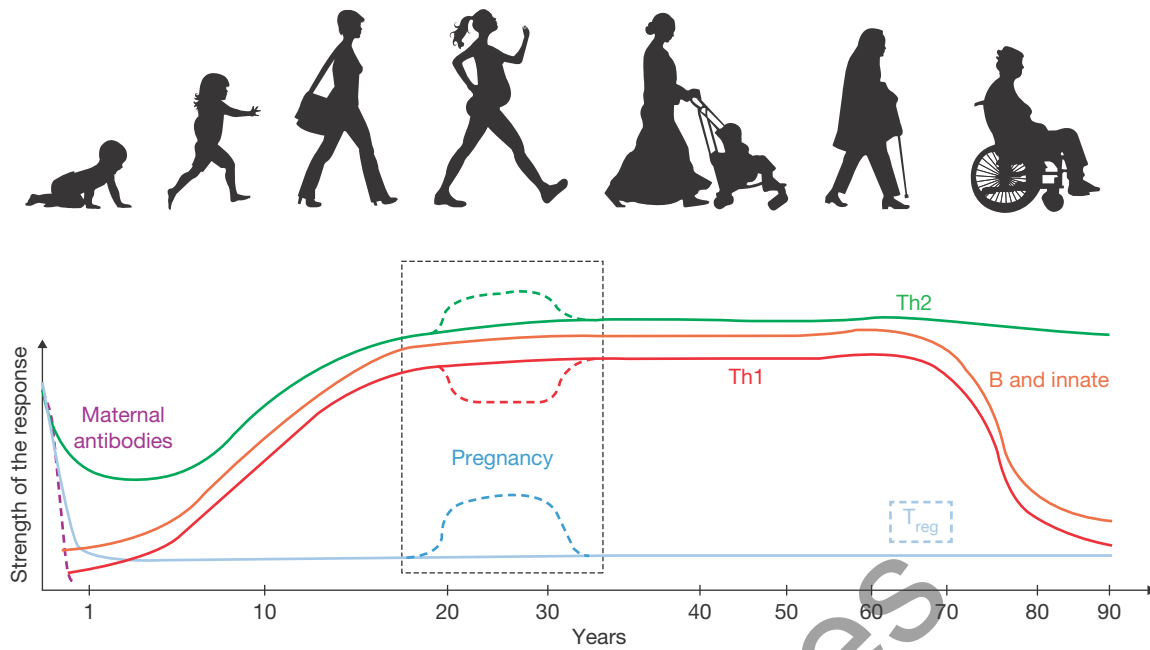


Figure 2.7

Selected biological effects of ageing that may exacerbate disease conditions and reduce effectiveness of pharmacological interventions

≈ = approximately; ↓ = decreased; ↑ = increased; Δ = change; ♀ = female; ♂ = male; 5-HT = serotonin; AKI = acute kidney injury; ANS = autonomic nervous system; Ca<sup>2+</sup> = calcium ions; CNS = central nervous system; DA = dopamine; Fx = function; Fe<sup>2+</sup> = iron ions; GFR = glomerular filtration rate; GH = growth hormone; HCl = hydrochloric acid; HCO<sub>3</sub> = bicarbonate ions; IGF-1 = insulin-like growth factor; IL-1 = interleukin 1; NO = nitric oxide; NT = neurotransmitter; PNS = peripheral nervous system; PSNS = parasympathetic nervous system; SBP = systolic blood pressure; SNS = sympathetic nervous system; SVR = systemic vascular resistance; TNF = tumour necrosis factor; yo = years of age.



**Figure 2.8**

Changes in a woman's immune system across the lifespan

As expected, the graph represents a reduced immune capacity at the two extremes of lifespan. However, it also demonstrates a dip for the Th1 line, representing a reduction in a woman's capacity to resist viral and intracellular pathogen challenges during pregnancy. The 'bumps' in the Th2 and  $T_{reg}$  lines represent changes that contribute to enhanced immunological responses. These responses include improved reactions to extracellular parasites (Th2) and increased immunological tolerance to self and foreign antigens, manifesting as reduced autoimmune reactions during pregnancy ( $T_{reg}$ ).

B = B cell; Th1 = T helper cells Type 1; Th2 = T helper cells Type 2;  $T_{reg}$  = regulatory T cells.

Source: Extracted and modified from Simon et al. (2015), Figure 1, Part A and Part C. © 2015 The Authors. Published by the Royal Society under the terms of the Creative Commons Attribution License <http://creativecommons.org/licenses/by/4.0/>.

capacity to alter immune responses. A woman also experiences life-stage immune system alterations because of pregnancy. Changes to a pregnant woman's cell-mediated immunity can result in an increased susceptibility to viral and other intracellular pathogens, yet she may experience remission in the effects of autoimmune disease (see Figure 2.8).

## DRUG RESISTANCE

A serious and developing global threat is the emergence of drug-resistant infections. Several infections that may have been managed easily a few decades ago are becoming increasingly difficult to treat, as the drug-resistant microorganisms responsible are developing and sharing mechanisms to defeat these drugs' effectiveness. Some individuals infected with multidrug-resistant organisms must rely entirely on their immune responses to fight the infection. However, individuals who are most at risk of developing such infections are often those most immunocompromised, and possess the minimal capacity to triumph over virulent, drug-resistant pathogens. Individuals with chronic disease and the youngest and oldest community members are most at risk. Health care professionals

are also at greater risk, as they work in environments teeming with microbial exposure. Compounding this challenge are drug companies who display little interest in developing new antimicrobial substances.

It should also be understood that bacteria are not the only factor presenting drug-resistant challenges. Individuals with HIV, epilepsy or mental health conditions, such as schizophrenia and depression, can possess pharmacogenomic reasons for drug resistance, such as variations in drug transporters or the enzymes necessary for conjugation or other drug-metabolising processes.

## BEHAVIOURAL

Other individual factors contributing to a person's health include those that can be considered behavioural in nature. Behaviours can be particularly influenced by knowledge, skills and attitudes. For example, if people possess knowledge regarding the importance of good nutrition and adequate exercise, they may develop steps to incorporate these into their lifestyles. If a person possesses skills that enable them to manage stress, keeps themselves and their family safe with accident prevention and



first-aid knowledge, knows how to parent appropriately, and understands basic measures to reduce their exposure to violence, they may be less likely to experience physical, emotional or psychological injury or illness.

However, knowledge and skills are not the only determining factors in relation to behaviour. Attitude can play an important part. For example, individuals may know that if they eat too much and don't exercise enough, they will become obese. Many individuals know that if they smoke cigarettes they are more likely to develop emphysema or any number of cancers; however, they still choose to undertake this risky behaviour. Although it is known that education level and financial status inversely correlate with levels of chronic disease and poor health choices, at least in Australia, many informed and affluent people still make poor health choices, evidenced by 63% of the population being overweight or obese in Australia in 2014–15.

Other attitudes that diminish the capacity to develop maximal well-being are decisions to reject important primary health initiatives, such as vaccination or screening measures for common, preventable diseases. In many preventable conditions, early diagnosis can result in reduced morbidity and mortality. Individuals may have a distrust of Western medicine and drugs, or unfounded beliefs in the putative dangers associated with vaccination. These people rely on herd immunity to keep them safe from vaccine-preventable diseases. However, as the numbers of unvaccinated people in a population increase, herd immunity will not keep them safe from diseases with high penetration.

## SOCIOCULTURAL AND SOCIOECONOMIC DETERMINANTS OF HEALTH

### LEARNING OBJECTIVE 4

Briefly describe how socioeconomic and sociocultural factors influence a person's health.

Some **socioeconomic factors** contributing to a person's health status include their level of education, the type of employment they find and their level of income. **Sociocultural factors** may include family, religion, culture, the media or peers. As many of these factors interrelate, it is often hard to discuss one without acknowledging the influence of another. As a result, the construct of this section will be more fluid, with less delineation between concepts.

## SOCIOECONOMIC

### EMPLOYMENT

As can be seen by the morbidity and mortality statistics in Figure 2.3 earlier in the chapter, there is a clear and observable difference in the health of individuals in high-income economies and those in lower-income economies. However, it would be interesting to explore whether there is a similar effect occurring within the same country. For example, Australia was identified as a high-income country by the WHO and the World Bank with

respect to gross national income, but are there still marked and observable differences in the health of individuals within that same affluent country?

Given that in Australia the wealthiest 20% have 70 times more wealth than the bottom 20%, it would be reasonable to conclude that such disparity in resources must also afford at least some health advantage. In numerous literature reviews published on various countries and regions, the overwhelming majority describe a positive correlation with health and wealth. Yet the mechanism by which this fact exists is not necessarily as clear. Therefore, a more focused analysis of possible influences is required.

The type of occupation a person chooses may not only determine the individual's societal status, but also influence income, opportunity and risk. In Australia in 2015–16, 25% of all serious workplace health and safety claims came from manual labourers, despite their constituting only 10% of the workforce population. Manual labourers were closely followed by technicians and tradesmen (18%) and community and personal service workers (16%). The occupation to claim the least number of serious injuries was managers (4%). Musculoskeletal trauma, such as sprains and strains, accounted for 58% of all occupational injuries. Lacerations and amputations accounted for 18%, and fractures for 10%. Fortunately, burns and head injuries represented only 2% and 1%, respectively. Other health effects that should be considered include the development of more long-term issues, such as osteoarthritis from repetitive strain for factory workers, or obesity risk and insulin resistance from individuals employed in sedentary occupations.

### EDUCATION

Education level may influence health choices through access to health education campaigns or knowledge of primary health services and the resources available. In some countries, disparity in health care access can be directly associated with education. If insurance must be provided through employment or be paid for directly out of pocket, rather than being paid for by governmental funds raised through taxes, those who are the least educated are more likely to be uninsured as they may be less likely to be employed, and even more unlikely to have sufficient funds to maintain adequate health insurance payments. In countries with universal health care, these disparities are less obvious.

### INCOME

In countries without universal health care, income will most likely be a significant limiting factor for access to appropriate health care. Greater wealth may permit earlier intervention or greater choice of doctor and access to allied health services, such as physiotherapy, speech pathology or occupational therapy. With increasing wealth, the standard of living increases, and access to basic health needs, such as functioning sanitation and food security, is met. Although there are individual circumstances, on the whole, as income trends away from lower brackets, exposure to physical and environmental risks also reduces.

## SOCIOCULTURAL

### FAMILY

The health attitudes of a family may have a significant influence on an individual, although it may be difficult to differentiate between this and the role genetics has played. For example, if the offspring of two obese parents are also obese, how much of the influence was genetics, and how much of the influence was food volume and selection or attitudes to healthy lifestyle choices? Nutrition is a pivotal factor in health and wellness, and a significant influence on a child's eating habits, which are formed in early life. When introducing a child to foods, providing a range of nutritious foods and limiting exposure to junk foods is only a small component of the task. Parents who understand the importance of promoting a healthy relationship with foods through not using it as a means of punishment, conveying simple messages about 'all-the-time foods' and 'sometimes foods', and involving children in the meal preparation, planning and the tasting process may begin to assist their child to embrace an open and interested relationship with classically unpopular foods.

However, few of these points are important when the capacity to provide any food is compromised by poverty and access to even the most basic nutrients is limited. Although

many people rightly reflect on the challenges of poverty and malnutrition faced by those in low-income countries, it is also important to acknowledge that there are individuals and families in every country who experience issues of food security, such as inadequate or inappropriate supply. In Australia, there are individuals and families who, because of circumstance, are unable to access nutritious food. The child living in a family that is unable to provide sufficient nutrition for growth or building immunological resilience due to unemployment, geographical isolation, mental health issues or knowledge deficits may experience life-long challenges because of their early experiences.









Nonetheless, nutrition is not the only family influence on a person's health. Family, domestic or sexual violence experiences may harm a person physically or emotionally in the acute phase, and also long-term. Enduring a family life of persistent disadvantage makes succeeding and rising from the potentially cyclical trap very difficult. The AIHW reports that 3.9% of Australians live below the poverty line; however, in its own report, it states that this metric is influenced by how it is considered, calculated and measured, and suggests that the relative value is more likely to be closer to 10–13%. Figure 2.9 represents statistical information about those in Australia enduring deep and persistent disadvantage.

**Figure 2.9**

Proportion of people in Australia  $\geq 15$  years experiencing deep and persistent disadvantage

*Deep and persistent disadvantage is measured by the Productivity Commission using seven dimensions that frame social exclusion through aspects of hardship and poverty.*

*Source: Based on Australian Institute of Health and Welfare material—AIHW (2017c), Table 1.6.1, p. 43.*

Group	Facing deep and persistent disadvantage (%)
 Living in public housing	23.6
 Dependent on income support	15.3
 Unemployed	11.5
 Lone parents	11.3
 With a long-term health condition or disability	11.2
 Highest educational attainment year 11 or below	9.3
 Indigenous Australians	10.8
 All Australians	4.4

## RELIGION

The effect of religion on health may manifest as regulation, preventing a person from partaking in alcohol, or influencing when and what they eat. For example, certain religions may restrict food types or may require a follower to fast or feast for a period of time. Some religions may determine the clothing that the follower wears. If a religion requires a follower to cover themselves so they have limited exposure to sunlight, vitamin D metabolism will be affected. Some religions may prevent a follower from receiving all of the medical options available to them. For example, if a person with anaemia or suffering a severe haemorrhage following surgery belongs to a religion that prohibits the administration of a blood transfusion, a positive outcome may be compromised. It is important for health care professionals to learn, understand and honour a person's religious wishes without judgment. However, religious beliefs should not prevent the health care professional from finding acceptable alternatives that may help the individual honour their religion while improving their morbidity or mortality risks.

## CULTURE

Much like religion, culture may influence a person's health through food choice, reliance on traditional medicines, or embracing concepts such as tribal healing. For many cultures, food plays a central role in almost every aspect of society, from welcoming gestures and building relationships, to feasting and fasting. The composition of a culture's diet is also known to strongly influence or prevent disease. The effects of following a Western diet that is high in fat will have drastically different outcomes to following a Mediterranean or a Japanese diet. Reliance on traditional healing practices may be beneficial for proven interventions, or may be detrimental for people in the community if the belief contributes to ill health itself, or if it impedes a person's willingness to seek assistance from Western medicine.

## MEDIA AND PEERS

Positive and negative health influences can be derived from the media and peer pressure. More recently, consumers of social media are less inclined to rely on critically reviewed and factually prepared reports, and instead rely more on random thoughts espoused by unknown individuals through anonymous social networks. As this trend increases, it becomes less likely that all of the health information a person is exposed to will be accurate, evidence-based, or even from an appropriately qualified person. Unfortunately, there is much erroneous or outright misinformation available to naïve and young individuals on social media networks, and following advice from some false 'experts' may ultimately cause negative effects to a person's health and well-being.

Conversely, peer pressure and the use of social media can also have positive influences, such as inspiring and motivating perceptions away from risk-taking behaviours and towards constructive beliefs about exercise, lifestyle choices, sexual health, the dangers of illicit drugs or even the need to heed natural disaster and storm warnings. Social media networks

possess a remarkable capacity to permit movement away from or towards a belief. Some health care professionals and primary care organisations are already beginning to harness this power to drive positive health influences.

# ENVIRONMENTAL DETERMINANTS OF HEALTH

## LEARNING OBJECTIVE 5

Discuss the environmental factors contributing to the health of a community and of an individual.

The WHO reports that environmental conditions contribute to 12.6 million deaths per year (almost 24% of all deaths). Major environmental influences on health can be categorised into three distinct factors: challenges originating from the air, water or soil. The primary focus here will be on common factors that have far-reaching, grand-scale influences over multiple populations and constitute a sustained risk. While it is acknowledged that large-scale, catastrophic, man-made events, such as wars and conflicts, radiation accidents, or terrorist activities involving large numbers of casualties, or natural disasters, such as earthquakes, tsunamis or volcanic eruptions, can have a major influence on the health and welfare of those involved, these are outside the purview of this resource.

## AIR POLLUTION

As populations increase and more fossil fuel is burnt, air pollution rises from energy generation processes, transportation and industrial emissions. Other sources of ambient pollution (outdoor air pollution) can be from forest fires, waste incineration and agriculture. Pollution may consist of high levels of carbon dioxide (CO<sub>2</sub>), methane, ground-level ozone (O<sub>3</sub>—a key ingredient of smog), volatile organic compounds (VOCs—e.g. fuels, cleaning products and industrial chemicals), nitrogen oxide gases (from motor vehicles and the residential, industrial and commercial burning of fuels) or even black carbon particles. In 2014, the WHO identified that 92% of the world's population is living in conditions that do not meet WHO air-quality guidelines. Figure 2.10 shows two examples of air pollution, one from industry and the other from forest fires.

It has been demonstrated that, even at very low concentrations, small particulate matter (PM) pollution can have an observable influence on a person's health. Unfortunately, it is impossible to eliminate particulate pollution entirely. Therefore, targets for the lowest achievable concentrations have been established (see Table 2.1).

According to the WHO's Ambient Air Pollution 2016 database, between the locations where air quality is being measured in particulate matter (PM), Australia's average annual PM<sub>10</sub> is 18 µg/m<sup>3</sup> (13–22 µg/m<sup>3</sup>), and average annual PM<sub>2.5</sub> is 7 µg/m<sup>3</sup> (5–10 µg/m<sup>3</sup>). New Zealand's average annual PM<sub>10</sub> is 16 µg/m<sup>3</sup> (6–28 µg/m<sup>3</sup>), and average annual PM<sub>2.5</sub> is



A



B

**Figure 2.10**

Air pollution from various sources

(A) A factory emitting pollution high in sulfur dioxide and particulate matter prior to the installation of emission-control equipment. (B) Particulates released into the air from forest fires can exacerbate symptoms for individuals with respiratory conditions for kilometres around the source.

Source: (A) SvedOliver/Shutterstock. (B) N. F. Photography/Shutterstock.

**Table 2.1** World Health Organization’s ambient air-quality targets

Particle size	Particle volume target 24-hour mean (max)	Particle volume target Annual mean
Small particles ( $\leq 2.5$ microns in diameter— $PM_{2.5}$ )	$25 \mu\text{g}/\text{m}^3$	$10 \mu\text{g}/\text{m}^3$
Large particles ( $\leq 10$ microns in diameter— $PM_{10}$ )	$50 \mu\text{g}/\text{m}^3$	$20 \mu\text{g}/\text{m}^3$

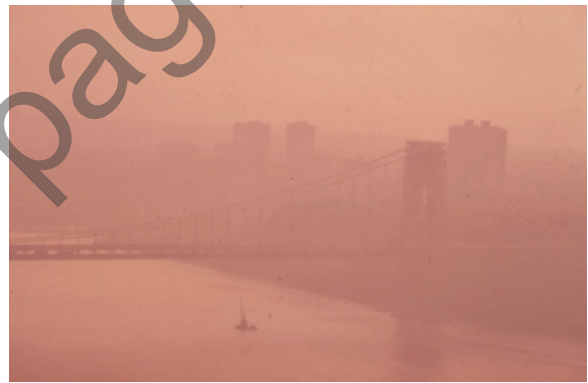
$\text{m}^3$  = cubic metres;  $PM$  = particulate matter;  $\mu\text{g}$  = micrograms

Source: World Health Organization (2016b).

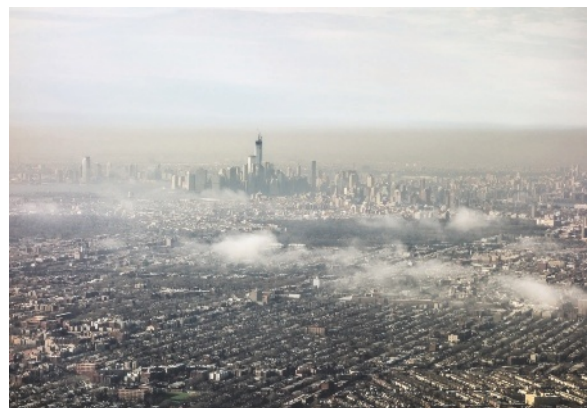
$8 \mu\text{g}/\text{m}^3$  ( $3\text{--}15 \mu\text{g}/\text{m}^3$ ). Compare these figures with the countries that have the highest average  $PM_{10}$  in the world: first, Kaduna (a major transport hub in Nigeria) had a measure of  $423 \mu\text{g}/\text{m}^3$ , Riyadh and Al Jubail in Saudi Arabia were second ( $368 \mu\text{g}/\text{m}^3$ ) and third ( $359 \mu\text{g}/\text{m}^3$ ) highest, and Shijiazhuang in China was the fourth highest ( $305 \mu\text{g}/\text{m}^3$ ). The lowest average  $PM_{10}$  and  $PM_{2.5}$  in the world is Sinclair, a town in Carbon County, Wyoming, United States, with a measure of  $3 \mu\text{g}/\text{m}^3$  and  $1.6 \mu\text{g}/\text{m}^3$ , respectively. Figure 2.11 shows how, even when the problem of pollution seems overwhelming, measures to reduce emissions can have dramatic effects over time.

**WATER POLLUTION**

Gastrointestinal (GIT) illness, the consumption of heavy metals, and chemicals are major factors in the health effects of water pollution. Major sources of water pollution include chemicals from industry, mining and farming, sewage, and other biological hazards such as toxic algae. When humans and animals consume



A



B

**Figure 2.11**

Active measures to reduce pollution can improve air quality

(A) New York City, 1973. (B) New York City, 2013.

Source: US Environmental Protection Agency.



A



B

**Figure 2.12**

Water pollution

(A) River heavily contaminated with plastic pollution. (B) The red water of a lake contaminated with copper-smelting waste.

Source: (A) Stephane Bidouze/Shutterstock. (B) Salienko Evgenii/Shutterstock.

water contaminated with heavy metals or chemicals, accumulation can result in poisoning, serious immune system suppression, or harmful reproductive effects. Exposure to inadequately treated water or water contaminated with sewage can cause water-borne infectious disease, such as gastroenteritis, cholera, skin infections and renal disease. Viral, bacterial and vector-borne parasitic infections are also common consequences of water pollution. Toxic algae blooms can contaminate water, affecting almost every body system, including the skin and GIT, respiratory and nervous systems. Unfortunately, even the water treatment process used to manage these toxic algae blooms can harm health. Dangerous by-products produced when the water treatment chemicals react with the algae are linked to cancers and reproductive and developmental risks. A basic primary health requirement is the provision of adequately treated water suitable for human consumption. Figure 2.12 demonstrates the importance of dealing with various types of water pollution, as the effects on the environment may not only harm children now, but also in years to come.

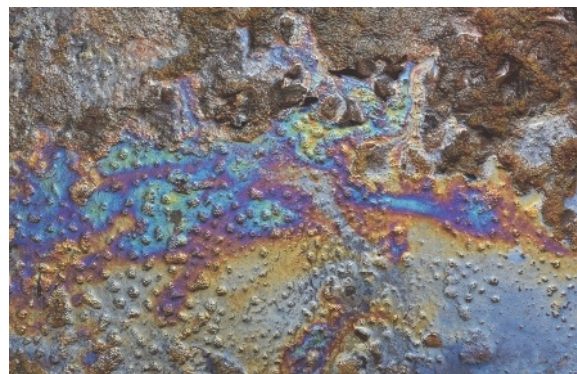
## SOIL POLLUTION

As with water pollution, soil may be contaminated with toxic heavy metals and chemicals. Such contamination can disrupt the soil–plant–human continuum normally important for flora, fauna and human health. Good-quality, unpolluted soil is essential for food security and the preservation of safe agriculture, and for inhabited and uninhabited land alike. The identification, remediation and management of soil pollution are critical to the health and wellness of individuals, communities and nations. Figure 2.13 demonstrates why soil pollution needs to be considered a population health priority.

Finally, an important component of the environment's influence on health comes directly from climate change. Figure 2.14 summarises the processes and interactions occurring as a result of increased population, the consumption of fossil fuel, and the industrial and mining contamination of the world's natural resources. These factors contribute to myriad health effects, such as infections, respiratory conditions and injury.



A



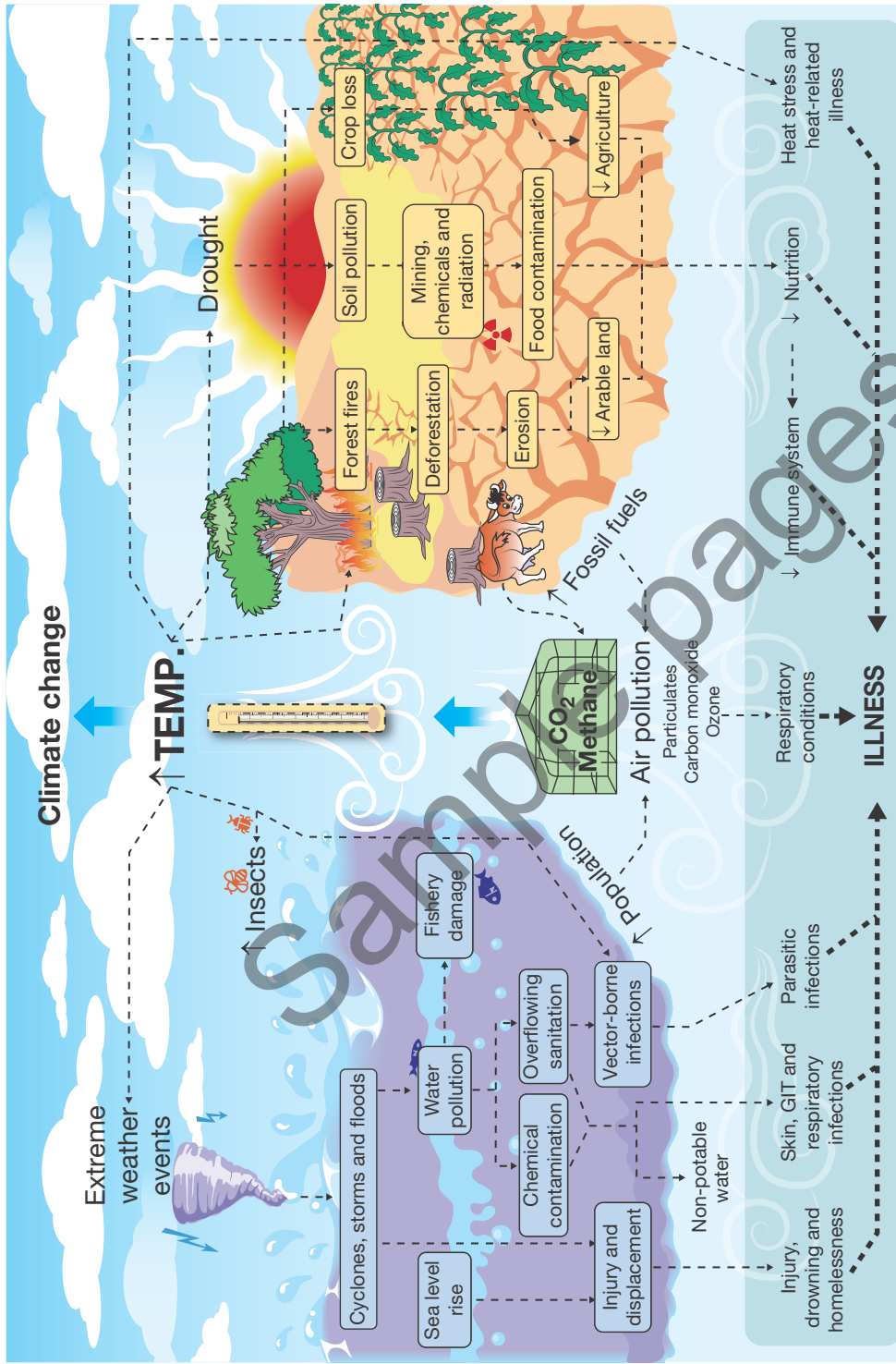
B

**Figure 2.13**

Soil pollution

(A) People scavenging on a mountainous rubbish tip. (B) Soil pollution from an oil spill.

Source: (A) Andrew Aitchison/Alamy Stock Photo. (B) Valery Orlov/Shutterstock.



**Figure 2.14**

Environmental factors influencing health

Three major influences of the environment on health are those that affect water, air and soil, each with their own unique and critical contribution to the development of ill health.

↓ = decreased; ↑ = increased; CO<sub>2</sub> = carbon dioxide; GIT = gastrointestinal tract.

Source: R. Fisher & M. Hales © Sciencopía.

## THE AUSTRALIAN CONTEXT

### LEARNING OBJECTIVE 6

Briefly describe the challenges and gains associated with the health care gap experienced by Aboriginal and Torres Strait Islander peoples.

Aboriginal and Torres Strait Islander peoples are the Indigenous peoples of Australia. They are comprised of two distinct cultural groups who have their own languages, laws, customs and communities. An immense diversity results in more than 250 language groups encompassing the land. Aboriginal and Torres Strait Islander peoples may describe themselves as being from the regions from which they have come, by the language that they speak, or by the ecological characteristics of their People's land (e.g. 'Saltwater Peoples' or 'Desert Peoples'). Figure 2.15 identifies selected information regarding the distribution of Aboriginal and Torres Strait Islander peoples across Australia.

The AIHW suggests that 39% of the health disparity between Aboriginal and Torres Strait Islander peoples and non-Indigenous peoples—known as the **health care gap**—can be explained by social determinants.

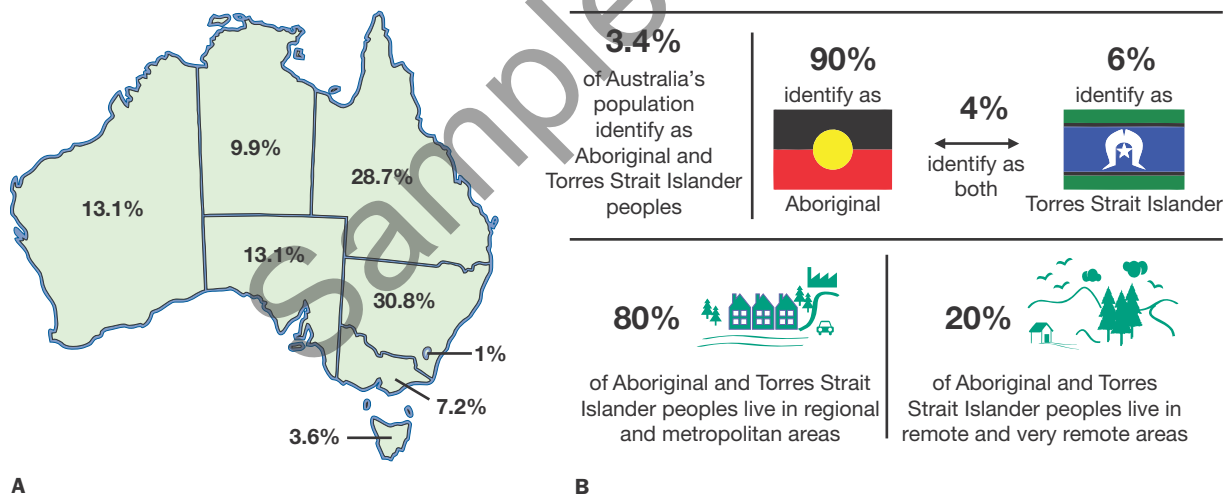
In 2008, the Council of Australian Governments (COAG) set six target areas on which to focus finances and resources in

order to close the gap, in a policy of the same name. It later added a seventh. The target areas are:

- 1 life expectancy
- 2 child mortality rates under 5 years old
- 3 early childhood education access
- 4 school attendance rates
- 5 literacy and numeracy
- 6 Grade 12 attainment rates
- 7 employment outcomes.

Despite various local, state and national attempts to reduce the health care gap for Aboriginal and Torres Strait Islander peoples, one of the most important targets, life expectancy (represented by mortality rates), has made little progress (see Figure 2.16). The Australian Government is attempting to accelerate life expectancy interventions so that it can meet the *Close the Gap* target by 2031.

Although many targets across various activities have not been met, there have been some gains that will hopefully demonstrate improved health and wellness outcomes for Aboriginal and Torres Strait Islander peoples. Table 2.2 identifies some gains achieved through education programs, improved finances and changes as to how targeted money is being spent.

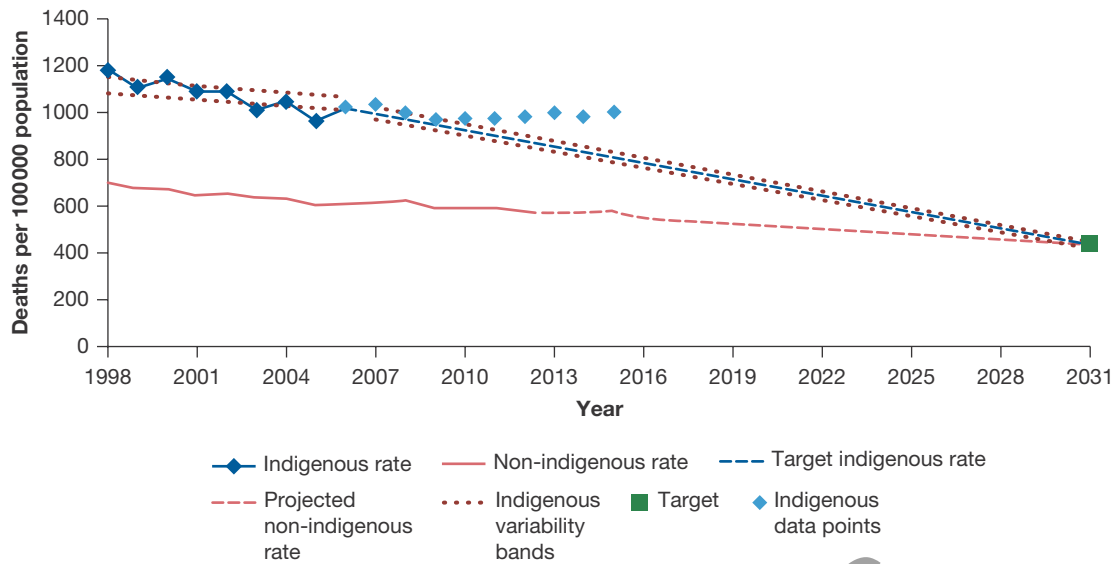


**Figure 2.15**

Distribution of Aboriginal and Torres Strait Islander peoples across Australia

(A) Distribution of Aboriginal and Torres Strait Islander peoples by state. (B) Selected population distribution characteristics of Aboriginal and Torres Strait Islander peoples. Although most Aboriginal and Torres Strait Islander peoples live in a metropolitan or a regional area, Indigenous peoples constitute 45% of Australians who live in remote areas.

Source: Data extracted from Commonwealth of Australia—Department of the Prime Minister and Cabinet (2017b).



**Figure 2.16**

Age-standardised Aboriginal and Torres Strait Islander peoples mortality rates from 1998 to 2015, with predicted targets identified until 2031

Mortality rates have remained relatively unchanged, yet non-Indigenous mortality rates have dropped—further widening the gap.

Source: Commonwealth of Australia—Department of the Prime Minister and Cabinet (2017a), Figure 2, p. 4. Licensed from the Commonwealth of Australia under a Creative Commons Attribution 3.0 Australia Licence. The Commonwealth of Australia does not necessarily endorse the content of this publication.

**Table 2.2** Gains achieved through the Close the Gap initiative

Targeted activity	Achievement
Circulatory disease	↓ 43%
Kidney disease deaths	↓ 47%
Respiratory disease deaths	↓ 24%
Smoking rates	↓ 9.7%
Binge drinking	↓ 8%
Child mortality	↓ 33%
Drinking during pregnancy	↓ 50%

Percentage differences are represented from different time periods, depending on the targeted activity.

Source: Data extracted from Department of Health (DOH) (2017). Close the Gap. Canberra: DOH. Retrieved from <<http://www.health.gov.au>>.

In relation to the remaining *Close the Gap* targets, even though *child mortality* rates have halved from 1998 to 2015, Aboriginal and Torres Strait Islander rates are still almost double that of non-Indigenous Australians. Although all of the *education-related* measures have improved to varying degrees, Aboriginal and Torres Strait Islander peoples are still almost twice as likely to be developmentally vulnerable compared to non-Indigenous Australians. Finally, there has been little change in the *employment rates* of Aboriginal and Torres Strait Islander peoples. Other comparisons related to specific diseases or conditions are discussed in greater length throughout the appropriate chapters of this book.

A model describing the complex inter-relationships between factors contributing to disparities in health care for Aboriginal and Torres Strait Islander peoples was initially conceptualised by Paradies and colleagues in 2013 from a comprehensive literature review. After minimal adaptation, it was included in the *2017 Aboriginal and Torres Strait Islander Health Performance Framework*, and appears to analyse and organise significant factors, such as the effects of racism, which need to be considered in the context of Aboriginal and Torres Strait Islander peoples’ health and well-being (see Figure 2.17).

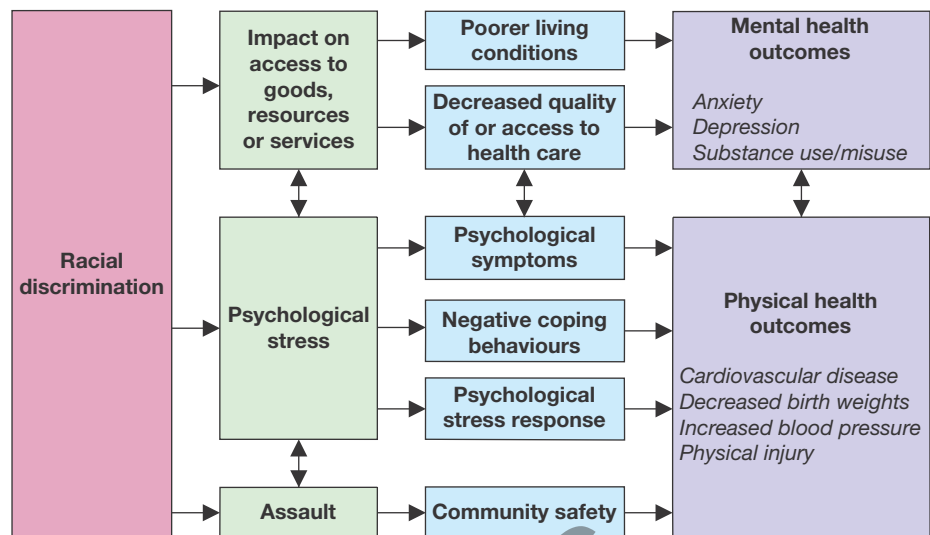


**Figure 2.17**

Pathways between racism and ill health

Various components of racism and physical and mental well-being are interconnected, complex and affect every aspect of health care design, provision and acceptance.

Source: Adapted from Commonwealth of Australia (2017b), Figure 40, p. 28. Licensed from the Commonwealth of Australia under a Creative Commons Attribution 3.0 Australia Licence. The Commonwealth of Australia does not necessarily endorse the content of this publication.



## CHAPTER REVIEW

- Health is more than just the absence of disease. It encompasses *physical, mental and social well-being*.
- *Disease burden and mortality statistics* can be used as measures of a community's or a country's health status. This information may also influence the design and construction of primary health care programs.
- The three overarching determinants of health can be categorised as factors relating to individuals, social determinants and environmental factors.
- *Individual factors* that need to be considered in relation to health include biomedical issues related to genetics, gender, age and drug resistance. *Behavioural factors* include knowledge, skills and attitudes.
- The *societal factors* that may contribute to health include socioeconomic factors, such as employment, education and income, or sociocultural factors, such as family, religion, culture, media or peer pressure.
- *Environmental factors* contributing to health include those that affect air, water and soil quality.
- The effects of *increasing populations and the use of fossil fuels* can play a significant role in the development of illness.
- The *health care gap* is an identifiable disparity between Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians, which results in significantly poorer health outcomes for Indigenous Australians.

## REVIEW QUESTIONS

- 1 In what ways could knowledge of the determinants of health influence your practice as a health professional?
- 2 Within your local area, find primary health services that directly address the socioeconomic and sociocultural factors associated with health.
  - a Create a table and list the services on the far-left column.
  - b Do any of these programs assess their influence or measure outcomes? If so, identify the measured outcomes in the next column of your table.
  - c Are any of these programs specifically designed for Aboriginal and Torres Strait Islander individuals? If so, identify these programs in the next column of your table.
  - d Review your results and form an opinion regarding the diversity, appropriateness and equity of the available services.
- 3 Find governmental resources that identify wealth within areas of Australia. Choose three areas—one that appears to represent high income, one that appears to represent middle income, and one that appears to represent low income. See if you can determine other important demographics, such as average age, the health care services available, and any other factors that you deem to be appropriate for influencing the health of a community.
- 4 What environmental factors are relevant in your local area? (For example, is there a lot of bushland that may catch fire in summer and cause increased air pollution with the potential to affect individuals in the area?) Try to identify at least three potential environmental risks.
- 5 Imagine that you are single-handedly responsible for solving the health disparities experienced by a certain group of people in a community. You may choose to invent a simulated community—be as creative and specific as you like (it will make the next task easier). Design a plan that can address all of the appropriate aspects of the determinants of health associated with your imaginary community.

## CASE STUDY

You live in a community where 'CSG-Bux', a coal-seam gas company, has its main plant nearby. CSG-Bux drills into the Tarus Basin in your region. It uses a series of mechanical rigs to drill the well and extract the gas and associated water. It owns a lot of land in the region, including a field compression station and a water treatment facility, where it also removes impurities. An Aboriginal community owns some of the land on which the plant has been established, as do local farmers. CSG-Bux runs a liquefaction facility in a nearby part of the region, and this is where further processing, impurity removal and storage occurs. The company has three 120 000m<sup>3</sup> tanks at the liquefaction facility to store the liquefied natural gas (LNG). CSG-Bux has a relationship with a multinational transport and shipping company, so it can transport the LNG to multiple destinations locally, nationally and internationally.

## CRITICAL THINKING

- 1 What is coal-seam gas, and why is it important?
- 2 What does the process of mining coal-seam gas entail? Do any of the processes result in steps that may cause injury or illness? (This may occur in the normal process or as a result of an accident.)
- 3 What are the effects of coal-seam gas mining on the aquifer and surface water? How may this affect the health of individuals in the surrounding areas? Consider your response in the context of short-term and long-term consequences.
- 4 What are the effects of coal-seam gas mining on agriculture? How can these result in ill health for current and future generations?
- 5 Describe how the mining of coal-seam gas might affect the health of its workers and the community with respect to the following aspects:
  - a individual factors
  - b societal factors
  - c environmental factors

## BIBLIOGRAPHY

- Arcaya, M.C., Arcaya, A.L. & Subramanian, S.V. (2015). Inequalities in health: definitions, concepts, and theories. *Global Health Action* 8: 27106. doi: 10.3402/gha.v8.27106 Retrieved from <<https://www.ncbi.nlm.nih.gov>>.
- Arora, G., Sajid, A. & Kalia, V. (Eds) (2017). *Drug resistance in bacteria, fungi, malaria, and cancer*. Cham: Springer International Publishing.
- Arousell, J. & Carlbom, A. (2016). Culture and religious beliefs in relation to reproductive health. *Best Practice and Research Clinical Obstetrics and Gynaecology* 32:77–87. Retrieved from <<http://www.sciencedirect.com>>.
- Australian Bureau of Statistics (ABS) (2011). *Causes of death, 2009*. Canberra: ABS. Retrieved from <[www.abs.gov.au](http://www.abs.gov.au)>.
- Australian Health Ministers' Advisory Council's National and Aboriginal and Torres Strait Islander Health Standing Committee (2017). *Cultural respect framework 2016–2026: for Aboriginal and Torres Strait Islander health—a national approach to building a culturally respectful health system*. Canberra: Australian Government Department of Health. Retrieved from <<https://nacchocommunique.files.wordpress.com>>.
- Australian Indigenous HealthInfoNet (2017). *Summary of Aboriginal and Torres Strait Islander health, 2016*. Perth, WA: Australian Indigenous HealthInfoNet. Retrieved from <<http://www.healthinonet.edu.au>>.
- Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) (2015). *Indigenous Australians: Aboriginal and Torres Strait Islander people*. Acton, ACT: AIATSIS. Retrieved from <<https://aiatsis.gov.au>>.
- Australian Institute of Health and Welfare (AIHW) (2016a). *Australia's health 2016*. Australia's Health series no. 15. Cat. No. AUS 199. Canberra: AIHW. Retrieved from <<https://www.aihw.gov.au>>.
- Australian Institute of Health and Welfare (AIHW) (2016b). *Burden of Disease Study: impact and causes of illness and death in Australia, 2011*. Disease Study series no. 3. Cat No. BOD 4. Canberra: AIHW. Retrieved from <<https://www.aihw.gov.au>>.
- Australian Institute of Health and Welfare (AIHW) (2017a). *Australia's welfare 2017*. Australia's Welfare series no. 13. AUS 214. Canberra: AIHW. Retrieved from <<https://www.aihw.gov.au>>.
- Australian Institute of Health and Welfare (AIHW) (2017b). *Detailed disease burden tables for Australia*. Canberra: AIHW. Retrieved from <<https://www.aihw.gov.au>>.
- Australian Institute of Health and Welfare (AIHW) (2017c). *Risk factors to health*. Canberra: AIHW. Retrieved from <<https://www.aihw.gov.au>>.
- Bullock, S. & Manias, E. (2017). *Fundamentals of pharmacology* (8th edn). Sydney: Pearson.
- Choe, S., Cho, S. & Kim, H. (2017). Gender gap matters in maternal mortality in low and lower-middle-income countries: a study of the global Gender Gap Index. *Global Public Health* 12(9):1065–76.