4.1 Impacts of the natural environment on health

The health of the Australian population is linked to the state (or health) of our natural environment—the air we breathe, the water we drink and bathe in, and the soils our food grow in (EPA Victoria 2017). The Department of Health uses the World Health Organization's (WHO's) definition of environmental health:

> Environmental health addresses all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviours. It encompasses the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments (WHO 2017b).

This article presents a selection of evidence on the impact of the 'natural environment' on the physical and mental health of Australia's population (Box 4.1.1). It also describes government policies and community programs currently in place in Australia to prevent and manage ill health that is related to the natural environment.

Box 4.1.1: What is meant by the 'natural environment'?

The meaning of the word 'environment' is very broad. Essentially, our environment is made up of all the external elements that surround, influence and affect life. One way to view it is to see it as two interlinked domains: the 'natural environment' and the 'built environment'.

The 'natural environment' can be classified as all the landscapes, habitats (on land, and in the air and water) and species on earth, and the 'built environment' as everything made by people (AIHW 2012). The natural environment can be positively and negatively affected by human intervention and impact. It, in turn, can positively and negatively affect people and their physical and mental health.

What is the current state of the natural environment and its effect on human health?

Most Australians have access to clean drinking water, safe food products, and effective waste collection and sanitation. However, factors such as population growth and distribution, extreme weather events and climate change (see Box 4.1.2) place increasing pressure on Australia's natural environment. This may, in turn, adversely affect the health of its population.

Australian Institute of Health and Welfare 2018. *Australia's health 2018*. Australia's health series no. 16. AUS 221. Canberra: AIHW.

Australia's population is steadily increasing. The population of 22.7 million as at June 2012 is projected to increase to between 36.8 and 38.3 million by 2061—in September 2017, the population sat at around 24.7 million (ABS 2013; ABS 2017). This growth and the changing geographical distribution of the population are placing increasing pressure on the natural environment. The growing concentration of people in urban areas, particularly in south-eastern cities and coastal regions, has led to increased land clearing and construction of further infrastructure such as water and sewerage facilities (ABS 2014b).

Air quality

Air becomes polluted when it contains gases, particles, dust or fumes in amounts considered harmful to humans and animals, or damaging to plants and natural materials. Pollutants emitted directly into the atmosphere, from either natural sources or human sources such as factories and cars, are called primary pollutants (organic compounds and nitrogen oxide are two such pollutants); they can undergo chemical changes in the atmosphere to form secondary pollutants such as ozone (Keywood et al. 2016).

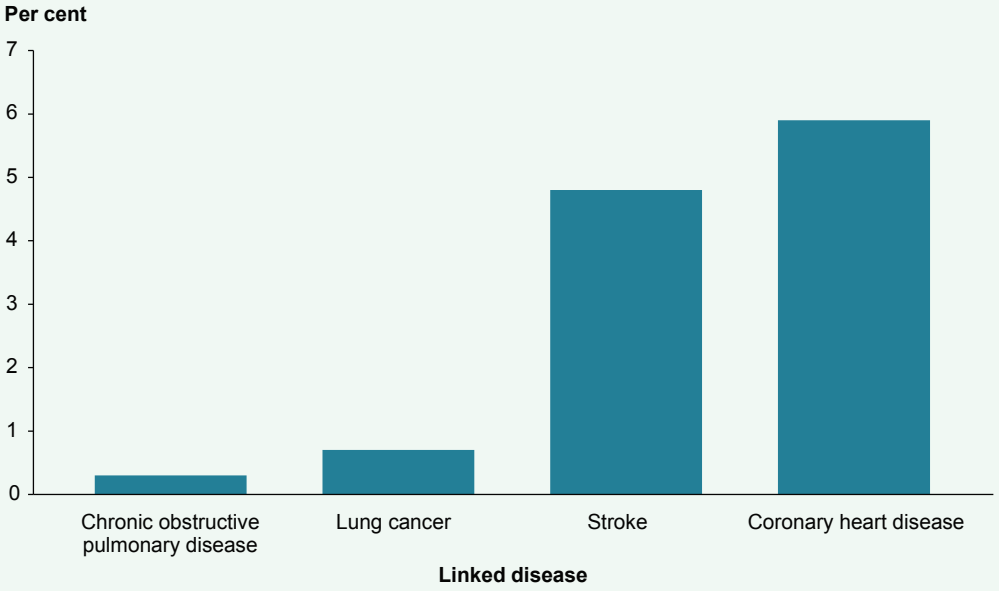
Long-term exposure to air pollution increases the risk of morbidity and mortality from cardiovascular disease and respiratory diseases (particularly asthma) (WHO 2013). Barnett et al. (2005) demonstrated that exposure to air pollutants was associated with short-term increases in respiratory hospitalisations for children aged 0–14, while a study by Bowatte et al. (2017) found a strong correlation between traffic-related air pollution and an increased risk of asthma, wheezing and worsening lung function.

Australia has national air quality standards, known as the National Environment Protection Measure for Ambient Air Quality. These standards set the acceptable levels of key pollutants, which are monitored across 75 sites across all states and territories.

Compared with many other developed countries, Australia has very clean air (OECD 2017). All its capital cities have very good air quality, based on assessment of PM2.5 (fine particulate matter less than 2.5 microns in diameter) (see also Chapter 9.2 of *Australia's Welfare 2017*). Further, the landmark report *Australia: State of the Environment 2016* notes that Australia's air quality is improving, with declining levels of lead and nitrogen dioxide since 2011 (Keywood et al. 2016). This positive trend aside, there is no safe lower threshold for health impacts, and continued improvement in air quality will result in continued population health benefits (Broome et al. 2015; Pope & Dockery 2006).

The Australian Burden of Disease Study (ABDS) 2011 reported that 1.3% of all fatal burden, 5.9% of the fatal burden due to coronary heart disease and 4.8% of the fatal burden due to stroke was attributable to air pollution (AIHW 2016a; Figure 4.1.1). (See Box 4.4.1 in Chapter 4.4 'Contribution of selected risk factors to burden of disease' for more information on burden of disease and definitions on fatal and non-fatal burden.)

Figure 4.1.1: Fatal burden of disease attributable to air pollution, by linked disease, 2011



Source: AIHW 2016a; Table S4.1.1.

Climate change and extreme weather events (see section 'Extreme weather events' later in this article) are increasing our population's exposure to air pollution. Ozone formation increases in warmer weather. Increasing fire weather drives more bushfires and fuel reduction burns, which increase the population's exposure to episodes of severe air pollution. One such example was the hazard reduction burning that took place near Sydney in May 2016; it is estimated to have caused 14 deaths and 87 admissions to hospital for heart and lung conditions (Broome et al. 2016).

Water quality

Water quality relates to the physical, chemical and biological properties of water, including colour, clarity, salinity, acidity, chemical contaminants (such as pesticide residues and heavy metals) and microbial contaminants (such as bacteria, viruses and protozoa). Most water sources in Australia need some treatment, or ongoing management, to ensure that they are safe for human consumption or recreational activity. The effects on human health of contaminated water may include skin and eye irritation, and conditions such as gastroenteritis (including infections like giardiasis and cryptosporidiosis).

States and territories are largely responsible for managing water supplies and achieving optimal water quality as defined in the Australian Drinking Water Guidelines 2011. The Bureau of Meteorology reported that, in 2015–16, the average proportion of the population where microbiological compliance was achieved was almost 100% (Bureau of Meteorology 2017).

While some water treatment practices remove disease-causing organisms, others fortify water sources to prevent disease, such as fluoridation to prevent tooth decay. Fluoride occurs naturally in water, but at levels below those set out in the current guidelines to prevent and manage tooth decay, particularly among children and people with limited access to dental services (NHMRC 2017b). Optimum levels of water fluoridation are achieved by adding fluoride to the drinking water supply—a practice that has been occurring in parts of Australia for over 60 years—and is the responsibility of local councils in cooperation with state and territory governments. In 2016, the National Health and Medical Research Council (NHMRC) reported that water fluoridation in Australia reduces tooth decay by between 26–44% in children and adolescents and 27% in adults (NHMRC 2017a).

Food safety

Food is a vital feature of the natural environment. It is declared unsafe when its contamination is likely to physically harm a person who consumes it. Some food is contaminated through exposure to microbes, chemicals, biotoxins and other pollutants in the air, water or soil. Contamination can also occur when foods are not correctly handled before consumption, such as during production, packaging and preparation.

When unsafe food is consumed, people commonly develop symptoms of gastroenteritis. Campylobacteriosis (caused by the *Campylobacter* bacterium) is the most commonly notified gastrointestinal disease in Australia, followed by salmonellosis (caused by the *Salmonella* bacterium). In Australia, foodborne illness is common—in 2017, around 16,400 cases of salmonellosis and 26,700 cases of campylobacterosis were reported in the National Notifiable Diseases Surveillance System, although it is not known how many of these cases resulted from the consumption of unsafe food (Department of Health 2018). In 2016–17, there were 61 food recalls conducted by Food Standards Australia New Zealand in response to the consumption of potentially unsafe food. Of these, microbiological, chemical or biotoxin contamination was the cause in 14% of the recalls (FSANZ 2017). A study by Kirk et al. (2014) showed that unsafe food was responsible for an estimated 4.1 million cases of foodborne gastroenteritis, more than 30,800 hospitalisations and nearly 100 deaths in Australia in 2010.

The ABDS 2011 reported that gastrointestinal infections (including camplyobacteriosis, salmonellosis, rotavirus and other gastrointestinal infections) accounted for 41% of the non-fatal infectious burden and 3.8% of the fatal infectious disease burden (AIHW 2016a).

Ultraviolet radiation: sun exposure, Vitamin D and skin cancer

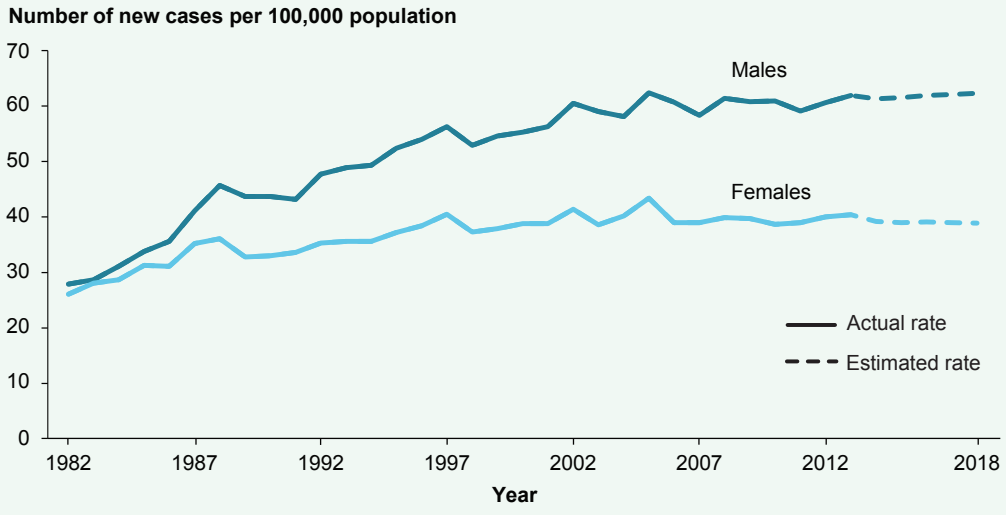
Compared with other countries, Australia has a high level of solar ultraviolet (UV) radiation (Olsen et al. 2015). UV radiation can both positively and negatively affect a person's health—adequate exposure to UV radiation can guard against Vitamin D deficiency and reduce the risk of chronic musculoskeletal conditions (Lucas et al. 2006), while excessive exposure has been linked to various types of skin cancer.

In Australia, adequate blood levels of Vitamin D are considered to be greater than or equal to 50 nmol/L; however, in 2011–12, 23% of Australian adults (or 4 million people) had a Vitamin D deficiency (ABS 2014a). Low levels of Vitamin D are associated with an increased risk of osteoporosis through increased risk of falls in older Australians, and bone and joint pain; low levels in women can also affect the levels of Vitamin D in unborn children (Joshi et al. 2010; Osteoporosis Australia 2017).

Excessive exposure to UV radiation—either from the sun, or by other means such as tanning and solariums (which emit cancer-causing UVA and UVB radiation)—is the main risk factor for skin cancer (AIHW 2016a; Cancer Council Australia 2018). Melanoma is the most common skin cancer reported as cause of death (of all skin cancers) (AIHW 2017). The ABDS reported that high sun exposure, as an environmental risk factor, accounted for 0.8% of total burden of disease and injury in 2011, due to melanoma and non-melanoma skin cancers (AIHW 2016a). In 2016, there were an estimated 13,300 new cases of melanoma, which accounted for 10% of all cancers diagnosed that year (excluding basal cell carcinoma and squamous cell carcinoma) (AIHW 2016b).

While the rate of new diagnoses of melanoma increased between 1982 and 2006 (from 28 to 61 cases per 100,000 population for males and 26 to 39 cases per 100,000 for females), rates have remained relatively steady since 2006 (Figure 4.1.2). This stabilisation may be due in part to increased awareness of the risks of excessive sun exposure through long-running education campaigns (see section 'How are we managing the impact of the natural environment on human health?').

Figure 4.1.2: Trend in age-standardised incidence rates for melanoma, by sex, 1982–2018



Notes

1. Cancer coded in the International Classification of Diseases and Related Health Problems, 10th revision (ICD-10) as C43.
2. The rates were age standardised to the Australian population as at 30 June 2001, and are expressed per 100,000 population.
3. The 2014–2018 estimates for incidence are based on 2004–2013 incidence data.

Source: AIHW 2017; Table S4.1.2.

Extreme weather events

'Extreme weather events' are classified as unusual weather events or phenomena that are at the extremes of a 'typical' historical distribution, such as violent storms, exceptionally high levels of rainfall, and heat waves or droughts that are longer or hotter than is typical.

Extreme weather events often have substantial social and economic impacts and may be hazardous to human life. Resulting health effects may be immediate and physical (such as death and injury due to bushfires), short term (for example, loss of shelter or access to clean water due to cyclone or floods) or long term (such as mental health problems or chronic injury) (Morrissey & Reser 2007).

Thunderstorm asthma

'Thunderstorm asthma' is defined as asthma triggered by an uncommon combination of high pollen and a particular type of thunderstorm, during which pollen grains are swept into the clouds as the storm forms (Asthma Australia 2017). Several thunderstorm asthma events have been reported in Australia in recent years—Wagga Wagga in 1997, Canberra in 2010, and Victoria in 2016 (Victorian Department of Health and Human Services 2017b). The Victorian event was the most noteworthy of these events on record. It resulted in a 58% increase in presentations to public hospital emergency departments on 21–22 November 2016 (9,900 compared with a previous 3-year average of 6,300) and 9 deaths (Victorian Department of Health and Human Services 2017b).

Heatwaves

A heatwave is defined as 3 or more days of high maximum and minimum temperatures that are unusual for a location and are monitored by the Bureau of Meteorology. It is expected that extreme heat events, such as heatwaves, will occur more often and with greater intensity in the future (Bureau of Meteorology 2018). Understanding the health impacts of heatwaves is important in Australia (Tong et al. 2010). Potential conditions resulting from heatwaves range from minor rashes and body cramps, through to those that require hospitalisation and sometimes result in death, such as heat stroke (severe hyperthermia). A report by the WHO stated that heat related deaths in Australasia attributable to climate change are predicted to increase from 217 in 2030 to 605 in 2050, based on the current climate (WHO 2014).

The Victorian Department of Health and Human Services (2009) reported a 62% increase in deaths during a heatwave period from 26 January to 1 February 2009, compared with the average number of deaths for the same week between 2004–08.

Bushfires

The frequency and intensity of bushfires is increasing in Australia (Dutta et al. 2016); it is important, therefore, to understand the effects of these events on human health and ways to mitigate these effects (Johnston 2017). Numerous studies have described the impact of bushfires on human health:

- Between 1967 and 2013, bushfires accounted for 433 deaths (173 alone during 'Black Friday' in 2009) and more than 8,000 injuries (Geoscience Australia n.d.; Parliament of Victoria 2010).

- Johnston et al. (2014) examined 46 validated fire smoke event days between 1996 and 2007 in Sydney, and found marked increases in same-day emergency department attendance—23% for asthma, 12% for chronic obstructive pulmonary disease and 7.0% for respiratory conditions, while Haikerwal et al. (2015) found a 7.0% increase in risk for out-of-hospital cardiac arrests during the 2006–07 Victorian bushfires.
- Bushfires increase the risk of burns, physical trauma such as injury from car accidents, psychological trauma such as post-traumatic stress, depression, substance abuse and domestic violence (Johnston 2009; McDermott & Palmer 1999; Yzermans et al. 2005).
- Severe bushfires also put population water reservoirs at risk (Johnston 2009) through silting up (loss of storage capacity), and through contamination from run-off and toxic algal blooms.

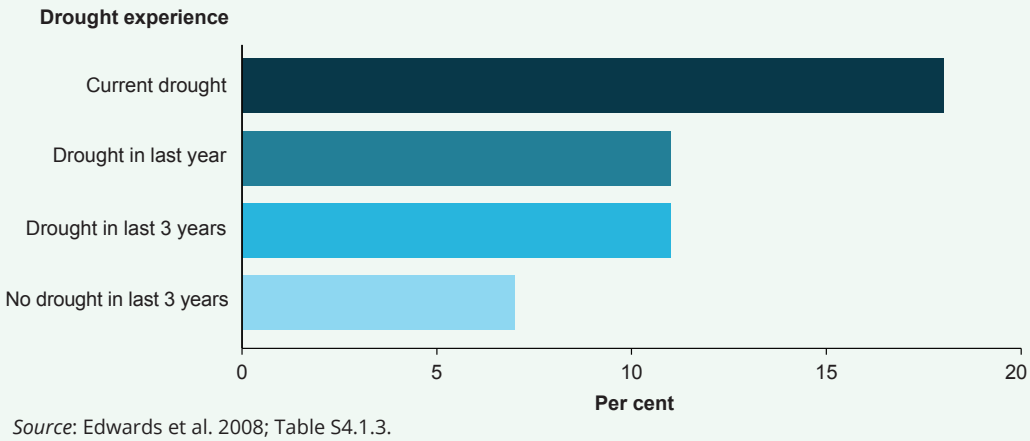
Drought

Although some areas of Australia are naturally dry, periods of below-average rainfall, known as drought, have adverse outcomes for the natural environment, and flow-on effects for human health. Not only does drought reduce the supply and quality of water and food, it increases the probability of bushfires and affects air quality (for example, via dust storms) (Centres for Disease Control and Prevention 2017; Kalis et al. 2009).

Drought, rain following drought, and human adaptation to drought (in the form of water storage tanks) has also been shown to increase the risk of vector-borne (mosquito) disease, such as dengue fever and Ross River virus (Trewin et al. 2013).

Results from the Rural and Regional Families Survey showed that, in 2007, 18% of farmers currently experiencing drought reported mental health problems, compared with 11% who had experienced drought in the past year or past 3 years and 7.0% who had not experienced drought in the past 3 years (Edwards et al. 2008; Figure 4.1.3). Hanigan et al. (2012) found that increasing drought was associated with a 15% increased relative risk of suicide among men aged 30–49.

Figure 4.1.3: Proportion of farmers reporting mental health problems, by drought experience, 2007



Source: Edwards et al. 2008; Table S4.1.3.

Box 4.1.2: Climate change and human health

Human activities, such as burning fossil fuels, agriculture and deforestation, have led to an increase in greenhouse gas (GHG) emissions, contributing to a phenomenon known as climate change (Department of the Environment and Energy n.d.d).

Between 1995 and 2005, Australia's GHG emissions increased from 24.2 to 25.8 tonnes of GHG per capita (OECD 2016). In 2007, Australia became a signatory to the Kyoto Protocol, an international agreement among nations to collaboratively reduce GHG emissions. Since then, Australia has reduced emissions by 13%, from 25.6 to 22.3 tonnes of GHG per capita (OECD 2016).

The WHO has reported that climate change is negatively affecting both social and environmental determinants of human health—access to clean air and safe drinking water and adequate food resources (WHO 2017a). Likely effects of climate change on the natural environment include increased temperatures (due to excess GHG in the atmosphere), changes to rainfall and wind patterns, and acidification of the oceans (Department of the Environment and Energy n.d.c).

Climate change is predicted to increase the risk of extreme weather events (Department of the Environment and Energy n.d.b). Further, research on climate change highlights a strong correlation between the frequency and intensity of extreme weather events and changes to the natural environment. These factors are likely to amplify the adverse impact of the natural environment on human health.

Changes to weather patterns (such as increased rainfall and tidal changes) are expected to increase disease vector populations such as mosquitoes, which, in turn, will lead to larger areas of disease transmission over longer durations (Garnaut 2008). While major vector-borne diseases such as dengue fever are currently not common in Australia, the predicted increase in temperatures and rainfall as a result of climate change has the potential to increase and change the geographic distribution of vector populations, and affect human infection rates (McMichael et al. 2006; Russell 1998).

How are we managing the impact of the natural environment on human health?

Although Australia ranks highly in terms of environmental performance in a global context, the *Australia: State of the Environment 2016* report noted that, if current local trends continue, Australia's natural environment in 2050 will be markedly different from what it is today. The detrimental effects of climate change (such as rising temperatures and reduced precipitation), the reduction in the quality of Australia's groundwater resources, increased demands for land in coastal areas (placing increasing demands on resources) and potential threats to human health from extreme weather events and disease will have profound effects on the health of Australia's population (Jackson et al. 2017).

There are many areas where Australia's natural environment is predicted to improve because of current policies and programs; it is expected that these improvements will have a positive effect on human health. Examples of those initiatives currently in place at the national, state and local level—and their observed or predicted impact on human health—include:

- the National Clean Air Agreement, developed in 2015, which aims to reduce pollution and improve air quality through actions undertaken by the community and government at all levels. Actions include increasing the standards against which air particles are reported (Department of the Environment and Energy n.d.a). It is expected that ongoing improvements to air quality will reduce the level of respiratory disease and acute respiratory events
- the Australian Drinking Water Guidelines, which is a framework by which good management of water supplies assures safety at point of use, and which is reported against by the Bureau of Meteorology (Bureau of Meteorology 2017; NHMRC & NRMMC 2011). Improved reporting, improved sampling, and early detection and mitigation of problems have been shown to have a positive impact on water quality in New South Wales (Byleveld et al. 2016)
- a number of SunSmart campaigns, which have been enacted in Australia since the early 1980s to increase awareness of the dangers and health risks associated with UV radiation exposure. These campaigns have been shown to have a positive impact on the detection and diagnosis of melanoma and other skin cancers. Since the launch in 2007 of one of the most publicly recognised campaigns—Clare Oliver: No Tan is Worth Dying For—incidence rates of melanoma have stabilised (Figure 4.1.2).

See Chapter 7.1 'Health promotion' for more information on other health programs and policies.

In 2016, the Environmental Health Standing Committee (formed by the Australian Government and state and territory governments) developed a 2016–2020 Strategic Plan. The Plan highlighted the importance of anticipatory, integrated responses to changes in the natural environment that may affect health and of an early understanding of the risk factors that result from environmental variation—for example, the health impacts of changes to air and water quality and extreme weather events resulting from climate change (enHealth 2016).

Tracking and forecasting extreme weather events is one way to lessen the impact on human health by warning of forecasted weather events. This gives governments, communities and individuals a better chance to respond. For example:

- the Victorian State Government has been working with the Bureau of Meteorology to forecast the risk of thunderstorm asthma events (Victorian Department of Health and Human Services 2017a)
- the Sentinel National Bushfire Monitoring System provides 144 national observations per day (every 10 minutes), via satellite, to notify emergency services and the public about potential bushfires (Geoscience Australia 2015)

- the NSW Government issued a heatwave plan in 2011 (updated in 2018) to help in preparing for, responding to and recovering from heatwaves, with human health being the primary focus (NSW Government 2018).

At a national and global level, Australia is committed to dealing with climate change and its impacts, including the downstream adverse effects on human health (United Nations n.d.). In 2016, Australia reaffirmed its commitment to the Kyoto Protocol and endorsed the Paris Agreement, including a pledge to reduce emissions by 26–28% below 2005 levels by 2030; to further increase Australia's renewable energy capacity; and to manage climate risks by building resilience in the community, economy and environment (Department of Environment and Energy n.d.c.).

What is missing from the picture?

Understanding the impact of the natural environment on human health is complex. In recent years, research has focused on a better grasp of the causal links between human health and the environment. However, many data gaps still exist that need to be filled to ensure this continues, such as:

- consideration of real-time or more frequent data collections that gather and link data on human health and the natural environment, including determining causality, and monitoring trends and projections
- provision of data by small geographic areas to measure human exposure to factors of the natural environment at a local level.

Another area of interest is research that focuses on the effect of climate change on the health of populations at risk, including older Australians, people in low socioeconomic areas, socially or geographically isolated individuals and communities, and Aboriginal and Torres Strait Islander people (AAOS 2015).

Where do I go for more information?

The 2011 AIHW report *Health and the environment: a compilation of evidence* collates evidence on the relationship between health and a selected list of environmental factors (AIHW 2011). It also discusses the difficulties involved in assessing the broader relationship between health and the environment.

Every 5 years, the Department of the Environment and Energy produces a report on the Australian state of the environment (Australian State of the Environment Committee 2016). The 2016 edition is available from <soe.environment.gov.au/download/reports>.

References

AAOS (Australian Academy of Science) 2015. Climate change challenges to health: risks and opportunities. Recommendations from the 2014 Theo Murphy High Flyers Think Tank. Canberra: AAOS.

ABS (Australian Bureau of Statistics) 2013. Population Projections, Australia 2012 (base) to 2101. ABS cat. no. 3222.0. Canberra: ABS.

ABS 2014a. Australian Health Survey: biomedical results for nutrients, 2011–12: feature article: Vitamin D. ABS cat. no. 4364.0.55.006. Canberra: ABS.

ABS 2014b. Measures of Australia's progress, 2013. ABS cat. no. 1370. Canberra: ABS.

ABS 2017. Australian demographic statistics—September quarter 2017. ABS cat. no. 3101. Canberra: ABS.

AIHW (Australian Institute of Health and Welfare) 2011. Health and the environment: a compilation of evidence. Cat. no. PHE 136. Canberra: AIHW.

AIHW 2012. Australia's health. Australia's health series no.13. Cat. no. AUS 156. Canberra: AIHW.

AIHW 2016a. Australian Burden of Disease Study: impact and causes of illness and death in Australia 2011. Australian Burden of Disease Study series no. 3. BOD 4. Canberra: AIHW.

AIHW 2016b. Skin cancer in Australia. Cat. no. CAN 96. Canberra: AIHW.

AIHW 2017. Cancer in Australia 2017. Cancer series no.101. Cat. no. CAN 100. Canberra: AIHW.

Asthma Australia 2017. Thunderstorm asthma. Chatswood: Asthma Australia. Viewed 1 November 2017, <https://www.asthmaaustralia.org.au/sa/about-asthma/resources/onair/2017/feb/thunderstorm-asthma>.

Barnett AG, Williams GM, Schwartz J, Neller AH, Best TL, Petroeschevsky AL & Simpson RW 2005. Air pollution and child respiratory health—a case-crossover study in Australia and New Zealand. American Journal of Respiratory and Critical Care Medicine 171:1272–8.

Bureau of Meteorology 2017. National performance report 2015–16: urban water utilities, part A. Melbourne: Bureau of Meteorology.

Bureau of Meteorology 2018. About the heatwave service. Melbourne: Bureau of Meteorology. Viewed 21 February 2018, <http://www.bom.gov.au/australia/heatwave/about.shtml>.

Bowatte G, Lodge CJ, Knibbs LD, Lowe AJ, Erbas B, Dennekamp M et al. 2017. Traffic-related air pollution exposure is associated with allergic sensitization, asthma, and poor lung function in middle age. Journal of Allergy and Clinical Immunology 139(1):122–9.

Broome RA, Fann N, Cristina TJN, Fulcher C, Duc H & Morgan GG 2015. The health benefits of reducing air pollution in Sydney, Australia. Environmental Research 143:19–25.

Broome RA, Johnston FH, Horsley J & Morgan GG 2016. A rapid assessment of the impact of hazard reduction burning around Sydney, May 2016. Medical Journal of Australia 205(9):407–8.

Byleveld PM, Leask SD, Jarvis LA, Wall KJ, Henderson WN & Tickell JE 2016. Safe drinking water quality in Australia. Public Health and Research Practice 26(2).

Cancer Council Australia 2018. Skin cancer. Sydney: Cancer Council Australia. Viewed 24 October 2017, <http://www.cancer.org.au/about-cancer/types-of-cancer/skin-cancer.html>.

Centres for Disease Control and Prevention 2017. Drought and your health. Atlanta: National Center for Environmental Health. Viewed 21 February 2018, <https://www.cdc.gov/features/drought/index.html>.

Department of the Environment and Energy n.d.a. Air quality. Canberra: Department of the Environment and Energy. Viewed 24 October 2017, <http://www.environment.gov.au/protection/air-quality>.

Department of the Environment and Energy n.d.b. Climate change impacts in Australia. Canberra: Department of the Environment and Energy. Viewed 21 February 2018, <http://www.environment.gov.au/climate-change/climate-science-data/climate-science/impacts>.

Department of the Environment and Energy n.d.c. Government and international initiatives. Canberra: Department of the Environment and Energy. Viewed 24 October 2017, <http://www.environment.gov.au/climate-change/government>.

Department of the Environment and Energy n.d.d. Understanding climate change. Canberra: Department of the Environment and Energy. Viewed 6 November 2017, <http://www.environment.gov.au/climate-change/climate-science-data/climate-science/understanding-climate-change>.

Department of Health 2018. National Notifiable Diseases Surveillance System. Notifications of All diseases by State and Territory and Year. Canberra: Department of Health. Viewed 28 November 2017, <http://www9.health.gov.au/cda/source/rpt_1.cfm>.

Dutta R, Das A & Aryal J 2016. Big data integration shows Australian bush-fire frequency is increasing significantly. Royal Society Open Science 3(2):150241.

Edwards B, Gray M & Hunter B 2008. Social and economic impacts of drought on farm families and rural communities. Submission to the Productivity Commission's Inquiry into Government Drought Support. Melbourne: Australian Institute of Family Studies.

enHealth (Environmental Health Standing Committee) 2016. Preventing disease and injury through healthy environments: Environmental Health Standing Committee (enHealth) Strategic Plan 2016 to 2020. Canberra: Department of Health.

EPA Victoria (Environmental Protection Authority Victoria) 2017. Human health. Melbourne: EPA Victoria. Viewed 1 November 2017, <http://www.epa.vic.gov.au/your-environment/human-health>.

FSANZ (Food Standards Australia New Zealand) 2017. Annual report 2016–17. Canberra: FSANZ. Viewed 26 February 2018, <http://www.foodstandards.gov.au/publications/annualreport201617/Documents/FSANZ%20Annual%20Report%202016-17%20Preliminary%20information.pdf>.

Garnaut R 2008. The Garnaut climate change review. Port Melbourne: Cambridge University Press.

Geoscience Australia n.d. Bushfire. Canberra: Geoscience Australia. Viewed 28 November 2017, <http://www.ga.gov.au/scientific-topics/hazards/bushfire>.

Geoscience Australia 2015. Upgraded bushfire monitoring capability to keep communities safer. Canberra: Geoscience Australia. Viewed 8 November 2017, <http://www.ga.gov.au/news-events/news/latest-news/upgraded-bushfire-monitoring-capability-to-keep-communities-safer>.

Haikerwal A, Akram M, Del Monaco A, Smith K, Sim MR, Meyer M et al. 2015. Impact of fine particulate matter (PM2.5) exposure during wildfires on cardiovascular health outcomes. Journal of the American Heart Association 4(7).

Hanigan IC, Butler CD, Kokic PN & Hutchinson MF 2012. Suicide and drought in New South Wales, Australia, 1970–2007. Proceedings of the National Academy of Sciences of the United States of America 109(35):13950–5.

Jackson WJ, Argent RM, Bax NJ, Clark GF, Coleman S, Cresswell ID et al. 2017. Australia—state of the environment 2016: overview. Canberra: Department of the Environment and Energy.

Johnston F 2009. Bushfires and human health in a changing environment. Australian Family Physician 38:720–4.

Johnston F, Purdie S, Jalaludin B, Martin K, Henderson S & Morgan G 2014. Air pollution events from forest fires and emergency department attendances in Sydney, Australia 1996–2007: a case-crossover analysis. Environmental Health 13(105).

Johnston F 2017. Understanding and managing the health impacts of poor air quality from landscape fires. Medical Journal of Australia 207(6):229–30.

Joshi D, Center JR & Eisman JA 2010. Vitamin D deficiency in adults. Australian Prescriber 33(4).

Kalis MA, Miller MD & Wilson RJ 2009. Public health and drought. Journal of Environmental Health 72:10–1.

Keywood MD, Emmerson KM, Hibberd MF 2016. Ambient air quality: health impacts of air pollution. In: Australia—state of the environment 2016. Canberra: Department of the Environment and Energy.

Kirk M, Ford L, Glass K & Hall G 2014. Foodborne illness, Australia, circa 2000 and circa 2010. Emerging Infectious Diseases 20(11):1857–64.

Lucas R, McMichael T, Smith W & Armstrong B 2006. Solar ultraviolet radiation. Global burden of disease from solar ultraviolet radiation. World Health Organisation Environmental Burden of Disease series, No. 13. Geneva: World Health Organisation.

McDermott BM & Palmer LJ 1999. Post-disaster service provision following proactive identification of children with emotional distress and depression. Australian and New Zealand Journal of Psychiatry 33:855–63.

McMichael AJ, Woodruff RE & Hales S 2006. Climate change and human health: present and future risks. The Lancet 367(9513):859–69.

Morrissey S & Reser J 2007. Natural disasters, climate change and mental health considerations for rural Australia. Australian Journal of Rural Health 15:120–5.

NHMRC (National Health and Medical Research Council) 2017a. Information paper—Water fluoridation: dental and other human health outcomes. Report prepared by the Clinical Trials Centre at University of Sydney. Canberra: NHMRC.

NHMRC 2017b. NHMRC Public Statement—water fluoridation and human health in Australia. Canberra: NHMRC. Viewed 6 December 2017, <https://www.nhmrc.gov.au/_files_nhmrc/file/publications/17667_nhmrc_-_public_statement-web.pdf>.

NHMRC & NRMMC (National Resource Management Ministerial Council) 2011. Australian Drinking Water Guidelines: paper 6. National Water Quality Management Strategy. Canberra: NHMRC & NRMMC.

NSW Government 2011. State Heatwave Sub Plan: a sub plan of the NSW State Disaster Plan. Sydney: NSW Government. Viewed 26 March 2018, <https://www.emergency.nsw.gov.au/Documents/plans/sub-plans/SubPlan_HeatWave.pdf >.

OECD (Organisation for Economic Co-operation and Development) Data 2016. Air and GHG emissions. Paris: OECD. Viewed 6 November 2017, <https://data.oecd.org/air/air-and-ghg-emissions.htm>.

OECD 2017. Exposure to PM2.5 in countries and regions in OECD.Stat. Paris: OECD. Viewed 23 February 2018, <http://stats.oecd.org/>.

Olsen CM, Wilson LF, Green AC, Bain CJ, Fritschi L, Neale RE et al. 2015. Cancers in Australia attributable to exposure to solar ultraviolet radiation and prevented by regular sunscreen use. Australian and New Zealand Journal of Public Health 39(5):471–6.

Osteoporosis Australia 2017. Vitamin D. Sydney: Osteoporosis Australia. Viewed 1 November 2017, <https://www.osteoporosis.org.au/vitamin-d>.

Parliament of Victoria 2010. 2009 Victorian Bushfires Royal Commission: final report summary. Melbourne: Parliament of Victoria. Viewed 28 November 2017, <http://royalcommission.vic.gov.au/finaldocuments/summary/PF/VBRC_Summary_PF.pdf>.

Pope CA & Dockery DW 2006. Health effects of fine particulate air pollution: lines that connect. Journal of the Air and Waste Management Association 56:709–42.

Russell RC 1998. Mosquito-borne arboviruses in Australia: the current scene and implications of climate change for human health. International Journal for Parasitology 28(6):955–69.

Tong S, Ren C & Becker N 2010. Excess deaths during the 2004 heatwave in Brisbane, Australia. International Journal of Biometeorology 54:393–400.

Trewin BJ, Brian H, Kay BH, Darbro JM & Hurst TP 2013. Increased container-breeding mosquito risk owing to drought-induced changes in water harvesting and storage in Brisbane, Australia. International Health 5(4):251–8.

United Nations n.d. Sustainable development goals—goal 13: take urgent action to combat climate change and its impacts. New York: United Nations. Viewed 15 January 2018, <http://www.un.org/sustainabledevelopment/climate-change-2/>.

Victorian Department of Health and Human Services 2009. January 2009 heatwave in Victoria: an assessment of health impacts. Melbourne: Victorian Department of Health.

Victorian Department of Health and Human Services 2017a. Epidemic thunderstorm asthma forecasting. Melbourne: Victorian Government Department of Health. Viewed 28 November 2017, <https://www2.health.vic.gov.au/public-health/environmental-health/climate-weather-and-public-health/thunderstorm-asthma/forecasting>.

Victorian Department of Health and Human Services 2017b. The November 2016 Victorian epidemic thunderstorm asthma event: an assessment of the health impacts—The Chief Health Officer's Report, 27 April 2017. Melbourne: Victorian Department of Health.

WHO (World Health Organization) 2013. Review of evidence on health aspects of air pollution—REVIHAAP project: technical report. Bonn: WHO European Centre for Environment and Health.

WHO 2014. Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: WHO. Viewed 28 March 2018, <http://www.who.int/globalchange/publications/quantitative-risk-assessment/en/>.

WHO 2017a. Climate change and health. Geneva: WHO. Viewed 20 November 2011, <http://www.who.int/mediacentre/factsheets/fs266/en/>.

WHO 2017b. Environmental health. Geneva: WHO. Viewed 7 November 2017, <http://www.searo.who.int/topics/environmental_health/en/>.

Yzermans CJ, Donker GA, Kerssens JJ, Dirkzwager AJE, Soeteman RJH & ten Veen PMH 2005. Health problems of victims before and after disaster: a longitudinal study in general practice. International Journal of Epidemiology 34:820–6.