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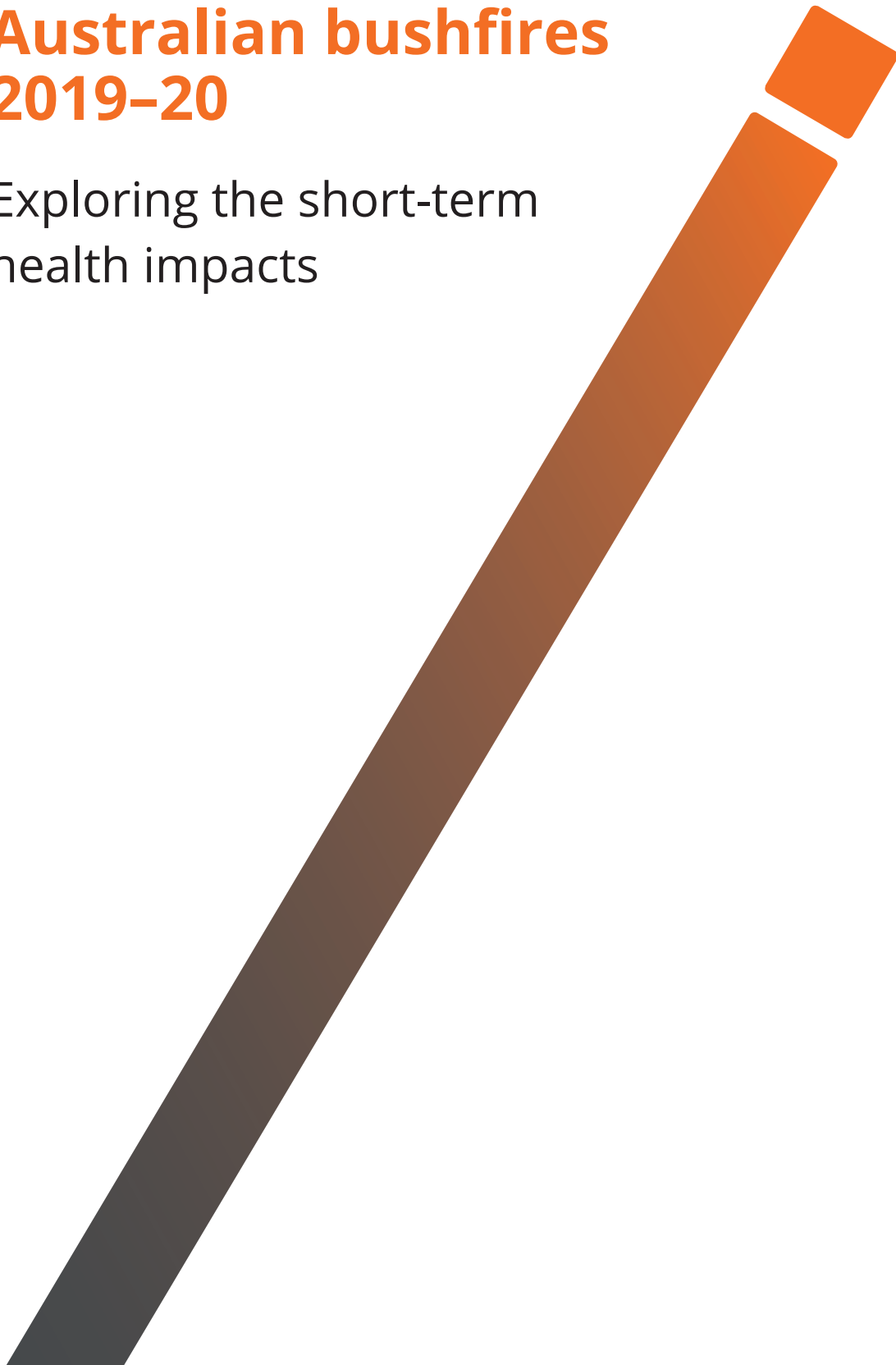
Australian bushfires 2019–20

Exploring the short-term
health impacts



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Australian Institute of Health and Welfare

Board Chair

Mrs Louise Markus

Director

Mr Barry Sandison

Any enquiries relating to copyright or comments on this publication should be directed to:

Australian Institute of Health and Welfare

GPO Box 570

Canberra ACT 2601

Tel: (02) 6244 1000

Email: info@aihw.gov.au

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Summary

The bushfire season in 2019–20 saw unprecedented fires sweep across Australia with a massive impact on many communities (Australian Academy of Science 2020). In a season marked by severe and protracted drought, the natural environment was particularly devastated; scientists have estimated that, in the forests and woodlands that were burned during the 2019–20 bushfire season, there would have been almost 3 billion native vertebrates (World Wide Fund for Nature Australia 2020).

Thirty-three people lost their lives in the 2019–20 bushfire season (Parliament of Australia 2020). There were substantial property losses, as well as threats to lives and property that forced people to evacuate from their homes (Biddle et al. 2020). Smoke blanketed parts of Australia as the bushfires burned, leading to public health advice to stay indoors.

This report examines short-term health impacts of the 2019–20 bushfires—those that became apparent in the immediate days and weeks thereafter—with a focus on providing insights from health data. Data in this report concentrate on the period from September 2019 to March 2020.

Understanding the more immediate and short-term physical and mental health impacts of bushfires can help to ensure health services are sufficiently equipped to deal with them in any future bushfire event.

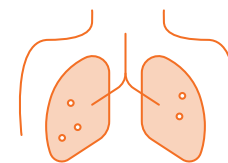
The full health and related impacts of the 2019–20 bushfires will not be known for some time; however, psychological health can be affected for many years and, while more research is needed into the effects of long-term exposure to bushfire smoke specifically, long-term exposure to air pollution is potentially related to a small increase in the risk of some chronic diseases (enHealth 2020).



Key findings

What impact did the 2019–20 bushfires have on respiratory health?

Hospital emergency department data for New South Wales analysed for this report show a clear increase in presentations for respiratory problems during the bushfire season compared with data for the previous year. Data for smaller geographical areas below the state level—Statistical Area Level 4 (SA4)—show strong impacts in this regard in regions where bushfires burned nearby.



For example, for people residing in the Riverina SA4 where the Dunns Road megafire burned at Emergency Warning level near Batlow for several days, respiratory-related presentations to an emergency department increased by 86% for the week beginning 5 January 2020 when compared with presentations for the same week in the previous year.

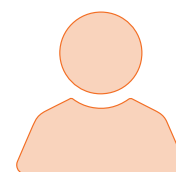
Sales data from pharmacies showed large increases in sales of inhalers for shortness of breath corresponding with the spread of bushfires throughout the bushfire season when compared with the same weeks in the previous year. For example, in the Mid North Coast SA4, inhaler sales increased by 144% for the week beginning 10 November 2019, when several fires were burning at Emergency Warning level in the area.

Pharmaceutical Benefits Scheme (PBS) data for scripts dispensed for salbutamol (commonly marketed as Ventolin or Asmol and used for the relief of respiratory symptoms) also show changes that coincide with bushfire activity. In south-eastern New South Wales in the week beginning 29 December 2019, salbutamol prescriptions increased by 63% in the Capital Region SA4 (which includes towns such as Batemans Bay) compared with the same week in the previous year. There was a 73% increase the following week, beginning 5 January 2020. Dispensing rates for salbutamol prescriptions remained high in this SA4 up until the last week of January.

Compared with the same weeks in the previous year, salbutamol scripts dispensed in the Hume SA4 in Victoria increased by 74% and 30%, respectively, in the weeks beginning 5 January 2020 and 12 January 2020 as 3 fires burned on the New South Wales and Victoria border.

How did the bushfires affect mental health?

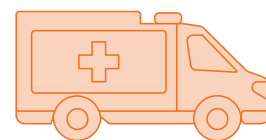
Biddle and colleagues (2020) estimated that directly after the 2019–20 bushfires more than half of Australian adults felt anxious or worried about them. Bushfire-related calls to the Lifeline crisis support hotline increased, resulting in the introduction of a telephone line for people affected by the bushfires (Lifeline 2020).



Additional Medicare items to allow people whose mental health was adversely affected by the 2019–20 bushfires to access mental health and wellbeing services were introduced in January 2020. From 19 January to 11 October 2020 there was an average of 498 services claimed, per week, across Australia. Although emergency department data for New South Wales show little impact of the bushfires on presentations for mental health, they capture only one means by which people may seek help for their mental health. Further, many people would have found it more difficult to physically access a hospital during the bushfires. More will be known about this topic as other data become available.

Other effects on health

There is evidence to suggest cardiovascular and cerebrovascular health are affected by bushfire smoke (see, for example, Haikerwal et al. 2015 and Finlay et al. 2012); however, this was not apparent in data analysed for this report on presentations to emergency departments in New South Wales.



This may be at least partly due to people in the community heeding public health advice to stay indoors and reduce their exposure to smoke. Similarly, there was little change in presentations to emergency departments in New South Wales for dehydration.

During peaks in the bushfires, the number of people visiting a general practitioner (GP) dropped. The largest decreases in claims for GP attendances were seen in affected regions during weeks when air quality was recorded as particularly poor, including the Capital Region, Riverina and Southern Highlands and Shoalhaven SA4s in New South Wales; this drop in attendance may also have been influenced by health advice to stay indoors, which could likely have encouraged people to delay GP visits for minor health reasons.

Deaths are the most extreme health impact of the bushfires; 33 people tragically lost their lives during the 2019–20 bushfire season (Parliament of Australia 2020). Analysis of data for deaths certified by a doctor showed no change during the 2019–20 bushfire season compared with data for previous years. Deaths referred to a coroner (coroner certified deaths) account for around 10% of deaths and these data are not yet available—the total number of deaths for this period will change with their inclusion (ABS 2020).

Future work

Future analysis and updates will aim to explore hospital emergency department data beyond New South Wales as well as hospital admitted patient data. As relevant data become available, future work will also look more closely at the effects of the bushfires on health conditions that were out of scope for this report.



As well, the Australian Institute of Health and Welfare will further analyse air quality data and fire danger index data in relation to health data sets to provide a more comprehensive picture of the relationship between population exposure to bushfire smoke (fine particle pollution) and health.

1 Introduction

1.1 Australia's 2019–20 bushfire season at a glance

Australia's land area is almost 7.7 million square kilometres or 770 million hectares. Around 25 million people, and between 600,000 and 700,000 species, call Australia home, with 84% of its plants, 83% of its mammals and 45% of its birds found nowhere else in the world (NSW DPIE 2020c). The continent experiences some of nature's extremes, including droughts, floods, tropical cyclones, bushfires and storms. There is a growing recognition in the 21st century that the Earth's climate is progressively changing due to human activity.

Australia is seeing an increase in extreme fire weather in terms of both intensity and frequency, a trend that projections suggest will continue to rise (BoM and CSIRO 2018). Fire danger is very likely to continue increasing for many regions of Australia, with more heat events—and more dangerous weather conditions for bushfires—predicted to occur with climate change from increasing greenhouse gas emissions (NESP 2019). It has been suggested that 'catastrophic fire conditions may render traditional bushfire prediction models and firefighting techniques less effective' (Royal Commission into National Natural Disaster Arrangements 2020b; p.22).

The bushfire season of 2019–20 was marked by severe and protracted drought. Rainfall across the country in 2019 was the lowest on record (BoM 2020); 2019 also had the driest spring on record, with rainfall 62% below average. Daytime temperatures were above average (including the highest on record) over most of Australia (BoM 2019).

Above average daytime temperatures, very low humidity and gusty winds led to dangerous fire conditions for south-east Queensland and north-east New South Wales during 2019–20. High fire danger was exacerbated by '...widespread and severe rainfall deficiencies and hydrological drought' (BoM 2020). For some areas of New South Wales, the start of the bushfire season was brought forward to 1 August by the New South Wales Rural Fire Service.

Forest Fire Danger Index (FFDI) values are a common measure of fire weather conditions; daily FFDI values can be accumulated (summed) to indicate fire weather across periods of time. Accumulated FFDI values were well above average for 95% of the Australian land area for the spring of 2019 (BoM 2019). On 6 September 2019, some areas of New South Wales had FFDI values of 100 or above (Catastrophic category), marking the onset of many large fires that burned across eastern Australia. For the first time since the rating was introduced in 2009, the highest fire danger rating ('Catastrophic') was forecast.

Unprecedented fires burned across south-eastern Australia over the 2019–20 bushfire season and devastated the natural and built environment; about one-fifth (21%) of the New South Wales and Victorian section of Australia's temperate broadleaf and mixed forests biome burned, compared with the 2% devastation typical of previous major fire years (Boer et al. 2020). Scientists have estimated that, in the forests and woodlands that were burned during the 2019–20 bushfire season, there would have been almost 3 billion native vertebrates; comprising 143 million mammals, 2.46 billion reptiles, 180 million birds and 51 million frogs (World Wide Fund for Nature Australia 2020).

In New South Wales, the fire ground from the 2019–20 fires included:

- 5.4 million hectares of land
- 37% of national park estate
- 4% of all freehold land
- 81% of the Greater Blue Mountains World Heritage Area
- 25% of suitable koala habitat in Eastern New South Wales (NSW DPIE 2020a).

Atmospheric monitoring showed that, in early January 2020, the bushfires released 400 megatonnes of carbon dioxide into the atmosphere, equal to three-quarters of Australian industry emissions in 2018–19 (ECMWF 2020). The reach of the bushfire smoke was not limited to fire-affected areas or even Australia—by 6 January 2020, smoke had drifted as far away as Argentina and Chile (World Meteorological Service 2020).

1.2 Toll on Australians

The 2019–20 bushfire season affected the lives of many Australians. Major bushfires started in Queensland and then in New South Wales in early September 2019, followed by the ignition of more fires in the Northern Territory and Western Australia later that month. By the end of October, there were also fires in Tasmania and South Australia; 60 then broke out across Victoria in November. Fire activity peaked in early January 2020 in New South Wales and Victoria (O'Mallon & Tierman 2020). Bushfire smoke travelled widely and impacted areas well beyond where the bushfires burned.

Loss of life and property

Tragically, 33 people lost their lives during this bushfire season, including 9 firefighters (Parliament of Australia 2020). The unprecedented evacuations to manage community safety, and the use of technology, played vital roles in preventing the loss of more lives, particularly SMS evacuation warnings and mobile phone apps such as the Fires Near Me app developed by the NSW Rural Fire Service. Over November and December 2019, this app was downloaded 1.6 million times (around 6% of the population) as users watched the fire crisis unfold in the worst hit state (Kaye 2020). The app allowed users to see details of the fires (including Emergency Warning levels) and whether a fire was out of control.

With thousands of people forced to evacuate, there was a large amount of property loss in the 2019–20 bushfire season. Over 3,000 houses were destroyed, including around 2,500 in New South Wales (Parliament of Australia 2020). Some of the greatest losses were in Lake Conjola, New South Wales, where over 130 houses were destroyed or extensively damaged (Royal Commission into National Natural Disaster Arrangements 2020b). One cattle farmer near Cobargo, New South Wales, estimated the cost of loss of fences on his property alone at more than \$250 thousand (ABC 2020). Fires on Kangaroo Island, South Australia, affected over 200 livestock properties and killed over 40,000 livestock (Primary Industries and Regions South Australia 2020).

Impact on health costs

Research conducted at the University of Tasmania has conservatively estimated the smoke-related health costs of the 2019–20 bushfire season to be \$1.95 billion; this figure is unprecedented and is 9 times higher than the median of the previous 19 bushfire seasons (Johnston et al. 2020). The health outcomes examined included premature deaths (all causes), hospital admissions for cardiovascular diseases and respiratory diseases, and emergency department attendances for asthma. The authors of this study reported that costs associated with health outcomes not included in their analysis may also be substantial.

Documenting the impact

There were more than 1,700 submissions made for consideration by a Royal Commission into National Natural Disaster Arrangements, sometimes referred to as the 'Bushfires Royal Commission'. Many described the conditions they endured across Australia at different times throughout the bushfire season and recounted their experiences in their submissions (Royal Commission into National Natural Disaster Arrangements 2020c).

People who experienced some of the most ferocious bushfires over the 2019–20 New Year period described townships around Greater Mogo in New South Wales as 'war zones', with no water, no power and no petrol (Royal Commission submission NND.001.01313). One family described sheltering from flames with strangers before returning to find their home burned to the ground at Yatte Yattah, New South Wales (Royal Commission submission NND.600.00449.0003). A farmer described how 6 family members lost their houses in fires in the Cobargo area in New South Wales (ABC 2020). Many described the physical and mental health impacts from their experience with the bushfires (for example, Royal Commission submission NND.001.01125), while news channels reported the evacuation by Royal Australian Air Force helicopters of people from Mallacoota, Victoria, with respiratory and other health issues (ABC News 2020).

Box 1.1 describes the impact of widespread bushfire smoke on the Australian Capital Territory.



Box 1.1: Case study—bushfire smoke in the Australian Capital Territory during the 2019–20 bushfires

During the 2019–20 bushfire season, Canberra residents experienced the worst air quality in the territory's history and, on some days, the worst recorded air quality in the world. In the week beginning 5 January 2020, hourly PM_{2.5} concentrations at the Florey air quality monitoring station reached 2,496µg/m³. While there is currently no national PM_{2.5} ambient air standard for one-hour averages (current standards are based on 24-hour averages), some jurisdictions have introduced hourly standards to inform health advice to the public. New South Wales, for example, has recently introduced a 1-hour average standard for PM_{2.5} where <25µg/m³ is considered 'good' air quality. Using this threshold, the PM_{2.5} concentrations recorded in Canberra during the bushfire season would be around 100 times the level considered safe.

A number of services, national institutions and government departments shut down when air quality was at its worst due to health and safety concerns, including the High Court, the National Portrait Gallery, the Australian National University, the University of Canberra, and the Department of Home Affairs offices. Australia Post temporarily suspended deliveries to Canberra, and flights to and from Canberra were cancelled for a short time. Public recreation services were also affected, with a number of public outdoor pools shutting their doors (Green et al. 2020; Lansdown & Whyte 2020; Remeikis 2020).

The poor air quality affected much of the territory's population, but the effect of smoke on local hospitals and patients was of particular concern. Documents released under the *Freedom of Information Act 1982* (Cwlth) described staff across a number of hospital and health services experiencing 'difficulty breathing and dizziness' caused by smoke entering buildings, and reported that the air in some indoor areas was 'virtually unbreathable'. Smoke also infiltrated critical care areas of the Canberra Hospital; between 6–8 January 2020, PM_{2.5} levels in some areas catering to high-risk patients ranged from 'unhealthy for sensitive groups' to 'unhealthy for all' according to Territory standards (that is, from 40 to 160µg/m³).

A range of sterile medical equipment was affected or damaged by smoke infiltration and had to be removed from hospitals, and magnetic resonance imaging equipment was rendered inoperative by smoke damage.

As indicated in documents provided under the *Freedom of Information Act*, the poor air quality affected those already being treated in hospitals; it also generated a need for treatment: 166 people presenting to a hospital emergency department between 20 December 2019 and 12 January 2020 reported their symptoms or condition to be 'smoke-related'.

Pharmacy sales of inhalers for shortness of breath in the Territory (e.g. Ventolin, Asmol, Bricanyl) that were analysed for this report show a 194% increase in the rate of sales in the week beginning 29 December 2019 compared with sales figures for the same week in the previous year, and a 204% increase for the following week (beginning 5 January 2020) (see Supplementary Table S11). Similarly, there were increases in prescriptions dispensed for inhalers through the PBS, with increases of 81% and 134%, respectively, for these weeks compared with the same weeks in the previous year (see Supplementary Table S8).

To explore health and air quality data for the Australian Capital Territory and other areas in Australia, see *Maps by region* and *Interactive graphs*.

Recovery efforts

The recovery process following natural disasters such as bushfires can last many years and is more than simply rebuilding and providing financial assistance. While complex, when conducted well, the recovery process can provide ‘hope, a sense of future and opportunity for healing’ (Royal Commission into National Natural Disaster Arrangements 2020b; p. 427). The importance of coordination and placing communities at the centre of recovery efforts has been noted (Royal Commission into National Natural Disaster Arrangements 2020b).

The 2019–20 bushfire season highlighted the willingness of volunteers to donate their time and resources. Volunteers included, for example, first responders, individuals and community service organisations. Their significant support, particularly in the immediate aftermath, was widely acknowledged.

Conservative estimates of recovery expenditure suggest \$8 billion was provided during and after the 2019–20 bushfires. Sources of recovery expenditure include, but are not limited to, federal and state/territory governments, charities and insured loss value (Royal Commission into National Natural Disaster Arrangements 2020b).

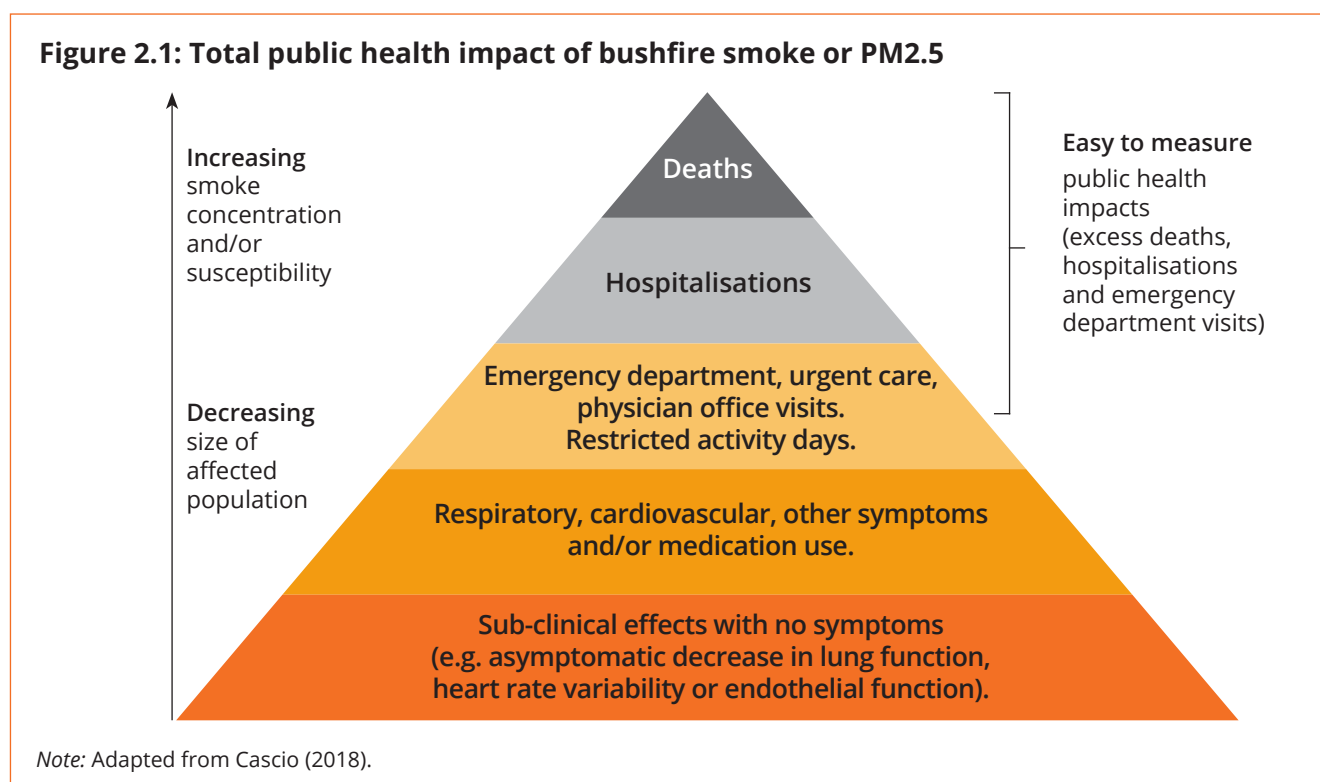
In January 2020, the National Bushfire Recovery Agency was established to lead and coordinate the Commonwealth-supported recovery and rebuild for the 2019–20 bushfires. The Agency is guided by the National Bushfire Recovery Plan and funded by the Australian Government’s National Bushfire Recovery Fund (National Bushfire Recovery Agency 2020).



2 Bushfires and health

Bushfires are associated with a range of health issues as well as loss of life. Fire presents immediate risks to health, including radiant heat leading to burns, dehydration and heat exhaustion; smoke inhalation; and trauma (both physical and psychological harm). Public health is affected by bushfires through smoke pollution, impacts on water supplies and destruction of major infrastructure, such as roads and powerlines (Johnston 2009). The impacts of bushfire smoke are the most widespread.

Figure 2.1 depicts the public health impacts of bushfire smoke. The wider population may experience 'sub-clinical' effects, with no symptoms, such as asymptomatic decrease in lung function. Others may experience respiratory and/or cardiovascular symptoms and require medication (medications are measured in this report). A smaller affected population may require general practice or emergency department visits (also measured in this report), particularly as smoke concentration increases. Hospitalisations and deaths are the most severe health impacts.



2.1 Air pollution

Air pollution occurs when gases, dust and fumes are present in amounts considered harmful to the health or comfort of humans and animals, or which could cause damage to plants and materials. It can comprise many individual components, including elements not easily detectable by sight or smell; examples include carbon monoxide, nitrogen dioxide, fine particulate matter (PM2.5) and airborne biological pollutants such as mould (Fisher et al. 2007).

Fine particulate pollution

Fine particulate pollution is generated by motor vehicles, coal-fired power stations, wood burning fires and other human-made sources, but also through events such as bushfires or dust storms (ANSTO 2020). Levels of air pollution may fluctuate from day to day or remain at similar levels over a longer time. Health effects may therefore differ depending on whether people are subjected to long- or short-term exposure to air pollutants.

Particulate matter (PM) is a key indicator of air pollution and has the most substantial effect on humans (for further information on particulate matter, see Appendix). Fine particulate pollution can reach extremely high concentrations during events such as bushfires and dust storms. It can be suspended in the air and travel in wind over long distances, which makes air pollution from bushfire smoke a major public health concern (Kim et al. 2015; Vardoulakis et al. 2020).

Some particles, such as soot and smoke, are clear to the naked eye. Others such as PM_{2.5} and PM₁₀ are visible only with a microscope. To gauge the size of a PM_{2.5} particle, consider this: a single hair on one's head is roughly 70 micrometres in diameter, yet it is 30 times bigger than the largest PM_{2.5} particle (United States Environmental Protection Authority 2018).

Impacts on health loss and health costs

The Australian Burden of Disease Study 2015 estimated the health loss (both fatal and non fatal burden) due to air pollution measured by PM (PM_{2.5}µg/m³). It estimated that in 2015 around 2,566 deaths (1.6% of deaths) were attributable to air pollution in Australia. Air pollution contributed 7% of coronary heart disease, 4% of stroke, 3% of chronic obstructive pulmonary disease (COPD), 2% of lower respiratory infections and 1% of lung cancer burden (AIHW 2019).

The Australian Institute of Health and Welfare (AIHW) is currently updating these estimates for 2018 as part of the Australian Burden of Disease Study 2018 (due for release in late 2021) and will include type 2 diabetes as an additional linked disease. Future work could also be undertaken to estimate the health burden due to air pollution during the 2019–20 bushfire season using similar methods.

Although bushfire smoke can affect anyone's health, there are some groups who are more vulnerable: those with asthma and other lung diseases, those with chronic heart disease, those with diabetes, older people, infants and children, and pregnant women (Porta Cubas et al. 2019).

Fisher et al. (2007) estimated that long-term elevated PM₁₀ exposure is responsible for up to 85% of health costs related to air pollution in New Zealand, while the World Health Organization claims that PM_{2.5} has a significant impact on mortality in Europe (Lucas et al. 2006). The most common adverse health outcomes in relation to air pollution are disorders of the respiratory and cardiovascular systems (both chronic and acute)—these effects are well documented (WHO 2013). However, further research is required as there is limited information about the long-term implications of prolonged exposure, particularly in relation to bushfire smoke.

Interpreting the data in this report

In this report, data from air quality monitoring stations in New South Wales, the Australian Capital Territory and parts of Victoria are used to describe the impact of the bushfires at different time points.

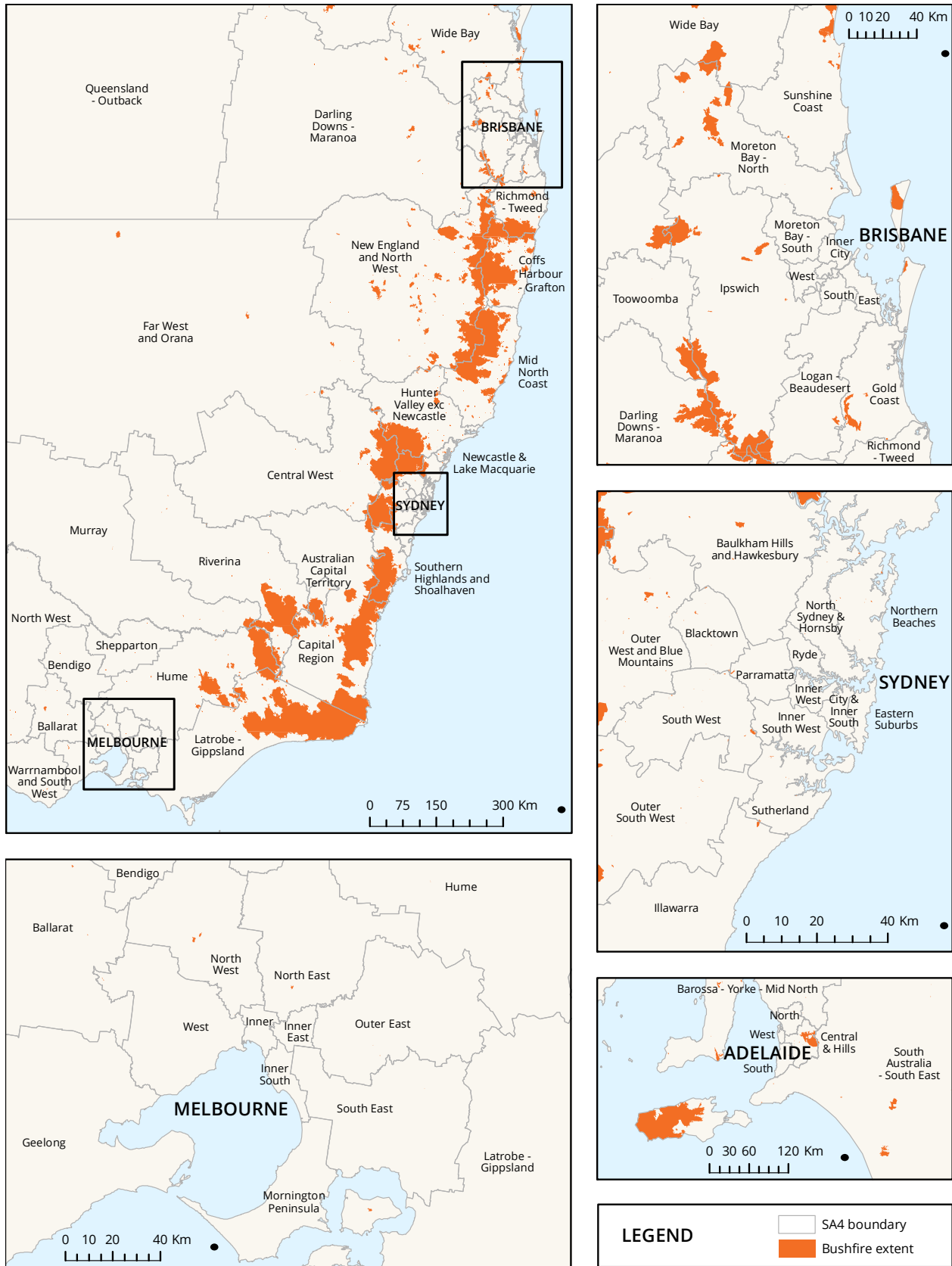
This report is accompanied by interactive tools that allow users to analyse health data as they relate to air quality data for specific geographical areas at different times during the 2019–20 bushfire season. For detailed results from the AIHW analysis included in this report, as well as these data tools, see the online version at *Australian bushfires 2019–20: Exploring the short-term health impacts*.

SA4 is the main geographical unit used to describe data in this report and in the accompanying online content. Australia is divided into 89 geographic SA4s. A populated SA4 has around 100,000 to 300,000 people; metropolitan SA4s tend to have larger populations of around 300,000 to 500,000 people. Geographical boundaries of relevant SA4s for New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory, as well as burned land area from the 2019–20 bushfire season, are presented in Figure 2.2.

In interpreting hospital emergency department results, note that where summary data are described at the state level (whole of New South Wales) the data include hospitals in areas that were smoke-affected as well as in areas not affected by smoke; this influences results at the state level. Therefore, interpretation of data at the state level is complemented by analysis at the SA4 regional level, to provide added detail in relation to short-term health effects of the 2019–20 bushfires.



Figure 2.2: Statistical Area Level 4 geographical boundaries and burned land area, selected jurisdictions



2.2 Respiratory health

The association between bushfire smoke and respiratory issues has been demonstrated both in Australia and internationally. A systematic review of international evidence found that bushfire smoke exposure was significantly associated with an increased risk of respiratory morbidity for almost all of the 45 included studies (Liu et al. 2015).

Finlay and colleagues (2012) summarise the difference in the impact on health for urban versus bushfire PM in smoke, and note a stronger inflammatory response for bushfire smoke. Johnston (2017) likens the complex chemical composition of bushfire smoke to tobacco smoke.

While the majority of research on the impact of bushfire smoke focuses on the impact of increasing PM_{2.5} levels, bushfire smoke can contain a range of other harmful chemicals—such as carbon monoxide, nitrogen dioxide and volatile organic compounds—and exposure to these can drive a range of immunological changes, particularly in the lungs and respiratory systems (Johnston 2017; Reid et al. 2016).

Australian studies have documented the relationship between increased bushfire smoke exposure and a range of respiratory symptoms. Data show a rise in hospital admission and emergency department presentations and treatment, particularly for asthma and COPD (Borchers Arriagada et al. 2019; Dennekamp et al. 2011; Elliot et al. 2013; Henderson & Johnston 2012; Horsley et al. 2018; Johnston et al. 2002; Morgan et al. 2010). For example, same day emergency department presentations for asthma have been observed to increase by up to 23% on days with poor air quality due to bushfire smoke (Johnston, Purdie et al. 2014). Similar findings have been documented internationally (for example, Reid et al. 2016; Stowell et al. 2019).

A survey by Asthma Australia conducted between December 2019 and January 2020 found that 94% of participants with asthma reported symptoms; 70% of participants without asthma also reported respiratory symptoms. 'Increasing use of reliever inhaler' was the most common action taken by people with asthma to relieve their symptoms during the bushfire season. More serious action was also required—people with asthma were found to be 4 times as likely as those without asthma to attend an emergency department or be hospitalised (Asthma Australia 2020).

To examine the short-term impacts of the bushfires on respiratory health, this report uses hospital emergency department data for New South Wales, respiratory testing data and medication sales and dispensing data from both the PBS and over-the-counter sales.

Emergency department presentations for respiratory health

For this report, the AIHW analysed hospital emergency department presentations in New South Wales from September 2019 to February 2020. New South Wales emergency departments were able to provide data through expedited processes for the purpose of this report. To explore respiratory health, the AIHW's analysis included data on:

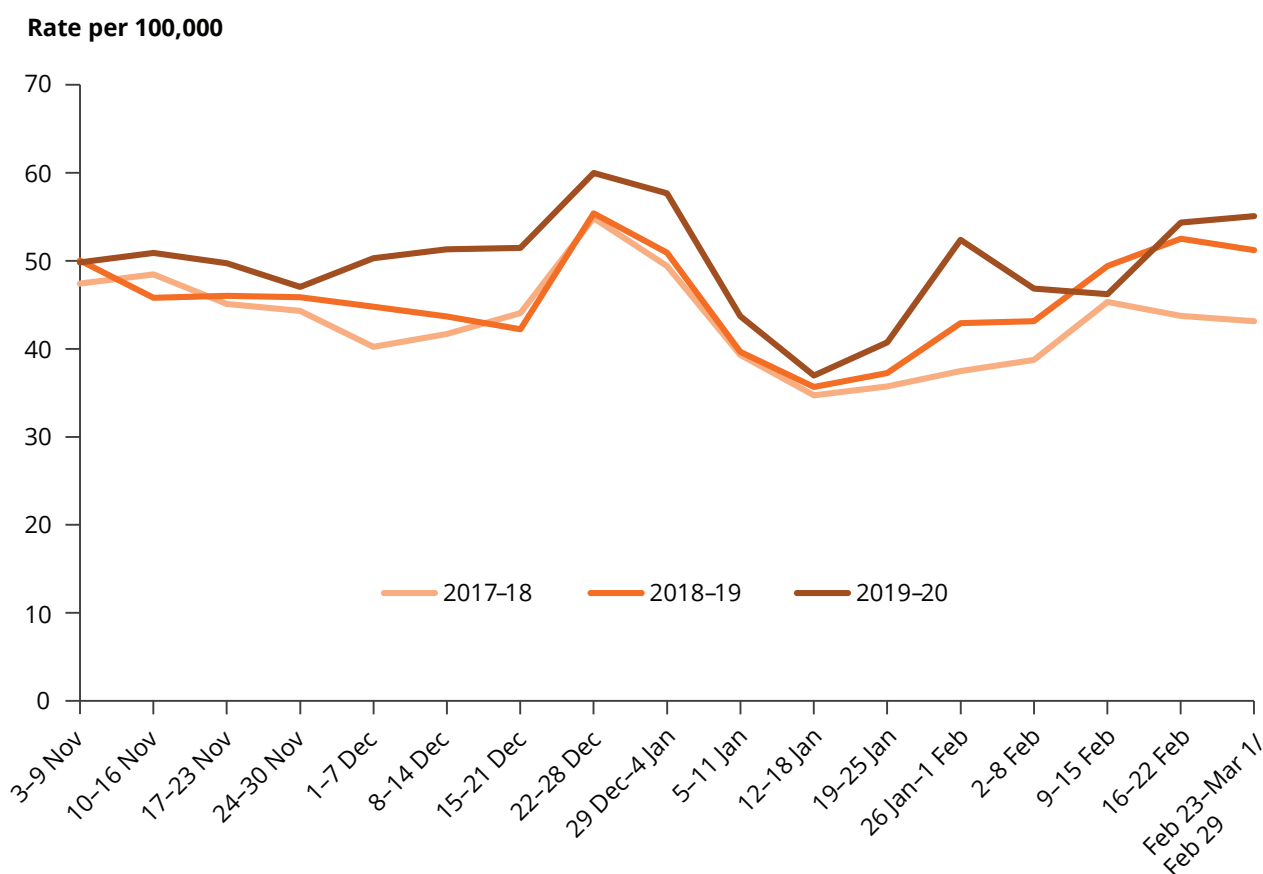
- respiratory disease (all)
- asthma
- abnormalities of breathing
- COPD with acute exacerbation.

For details on the specific disease coding used for this analysis, see *Technical supplement*.

Data from New South Wales emergency departments show a clear rise in presentations for respiratory problems during the bushfire season (Figure 2.3). For the first 3 weeks of December 2019, the number of presentations to New South Wales emergency departments with a principal diagnosis related to diseases of the respiratory system gradually increased. This rate increase ranged from 12% in the week beginning 1 December 2019 (from 44.8 to 50.3 presentations per 100,000 population) compared with the same week in 2018, to a 22% increase in the week beginning 15 December.

The rate of presentations to New South Wales emergency departments for respiratory health peaked at 60.0 per 100,000 population (or a total number of 4,946 presentations) during the 2019 Christmas week (beginning 22 December), representing an 8% increase compared with the same week in the previous year. The volume remained high for the week beginning 29 December (4,814 presentations, or 57.7 per 100,000 population—a 13% increase compared with the same week in the previous year) (Figure 2.3).

Figure 2.3: Age-standardised rate of all respiratory presentations to New South Wales emergency departments, by week, 2017–18 to 2019–20



Notes

1. 'All respiratory' includes International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) codes J00-J99 for all study years and corresponding Systematized Nomenclature of Medicine Clinical Terms (SNOMED) codes for 2017-18.
2. The final week for the period ends on 1 March for 2017-18 and 2018-19 and on 29 February for 2019-20 to accommodate the leap year.

Source: AIHW analysis of National Non-admitted Patient Emergency Department Care Database (NNAPEDCD) 2017-18, 2018-19 and 2019-20.

The bushfires that burned across Australia during the 2019–20 bushfire season affected people living in different geographical regions at different times. In the absence of a data source that comprehensively maps bushfire smoke to geographical areas, we can look at where the bushfires burned and at measures of air quality recorded at air quality monitoring stations (specifically, PM2.5). To explore regional areas using interactive data tools, see *Maps by region* and *Interactive graphs*. Results show, for example, increases of more than 50% in the rate of emergency department presentations for all respiratory diseases during peak bushfire times at hospitals in the Capital Region SA4, which includes Batemans Bay, NSW, in the north down to Eden near the Victorian border (for weeks beginning 29 December 2019 and 5 January 2020). Similarly, in the Riverina SA4 where the Dunns Road fire burned at Emergency Warning levels near Batlow for several days, there was an 86% increase in respiratory-related presentations to emergency departments in this area for the week beginning 5 January 2020.

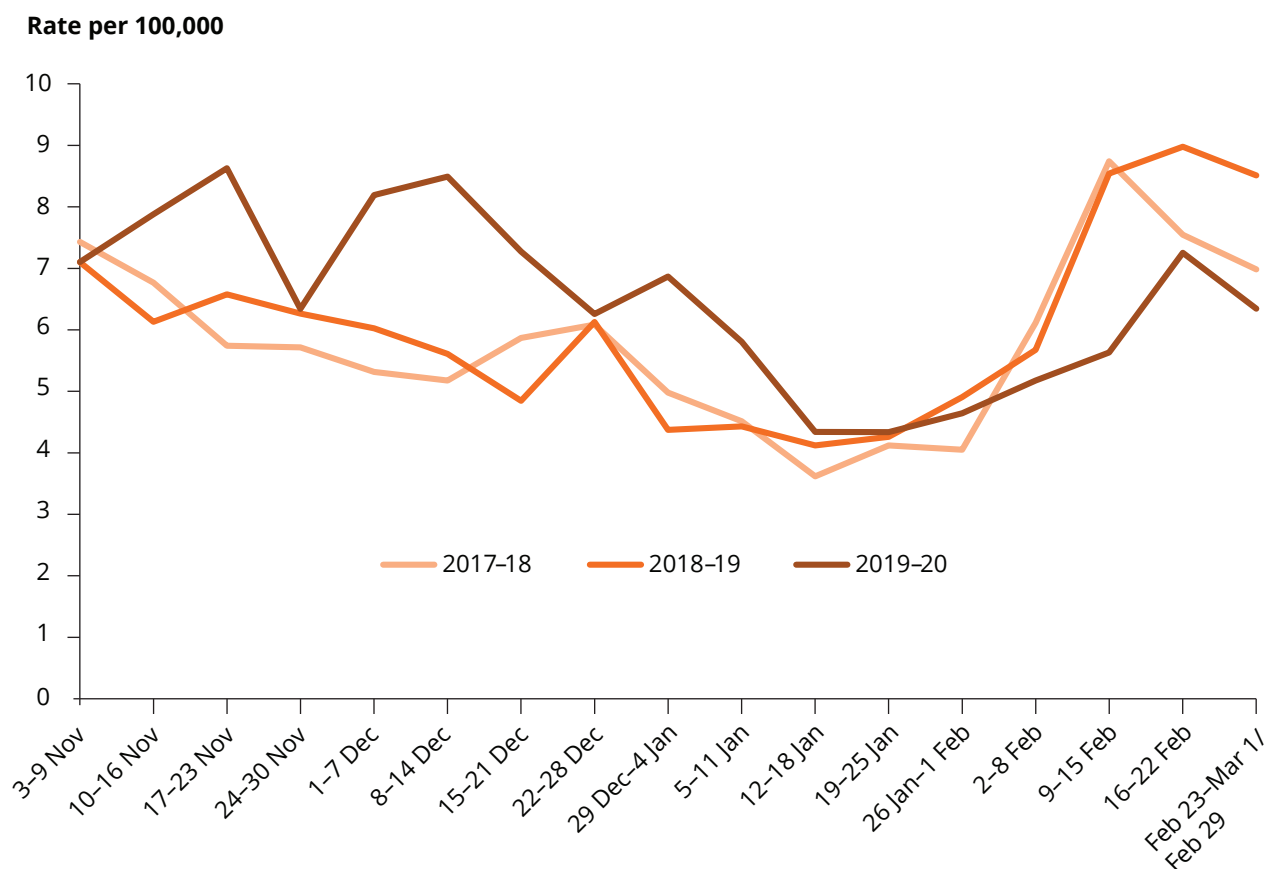
Emergency department presentations for asthma

The association between bushfire smoke and asthma exacerbations is well documented; for this reason, asthma is a focus of this report. Analysis for this report showed presentations to New South Wales emergency departments for asthma accounted for around 1 in 10 (or a total of 12,864) of those related to respiratory disease (see Supplementary Table S1).

Consistent with the patterns observed in presentations to emergency departments for all respiratory disease, the largest increases in rates of presentations for asthma were in December 2019; however, at the state level, there was a much greater observed difference for asthma than for all respiratory presentations when comparing the bushfire season with the previous year. There were large increases in presentations (per 100,000 population) throughout December 2019, including a 51% increase in the week beginning 8 December (compared with the same week in 2018) and a 50% increase in the week beginning 15 December (Figure 2.4). There was then a 57% increase in the week beginning 29 December, from 4.4 to 6.9 presentations per 100,000 population (equal to a total of 554 presentations for this week in 2019). While Figure 2.4 shows the overall patterns of changes in emergency department presentations, data for SA4s affected by the bushfires show a clearer effect. For detailed data, see *Maps by region* and *Interactive graphs*.



Figure 2.4: Age-standardised rate of asthma presentations to New South Wales emergency departments, by week, 2017–18 to 2019–20



Notes

1. Asthma includes ICD-10-AM codes J45–J46 for all years of study, and corresponding SNOMED codes for 2017–18.
2. The final week for the period ends on 1 March for 2017–18 and 2018–19 and on 29 February 2019 for 2019–20 to accommodate the leap year.

Source: AIHW analysis of NNAPEDCD 2017–18, 2018–19 and 2019–20.

The sharp increases in 2019–20 appear to be driven by female emergency department presentations for asthma. This is consistent with both Australian and international literature (Borchers Arriagada et al. 2019; Haikerwal et al. 2016; Liu et al. 2015). Haikerwal and colleagues (2016) found a strong association between PM2.5 levels from bushfire smoke during the 2006–07 bushfires in Victoria and presentations by women 20 years and over to emergency departments for asthma. The authors refer to evidence of inherent structural differences (lung size and growth), differences in fine particle deposition, and potential differences in airway cells in explaining this association. Perception of symptoms and health care usage, as well as differences in indoor and outdoor exposures, may also have had an effect (Haikerwal et al. 2016).

In the week beginning 8 December 2019, there was a 90% increase in the rate of female presentations to an emergency department for asthma compared with the same week in the previous year (10.0 compared with 5.3 presentations per 100,000 population). There was also a 59% increase for the week beginning 29 December 2019.

For males, the largest increase in the rate of asthma presentations was in the week beginning 15 December 2019, where there was a 51% increase compared with the same week in the previous year (6.8 presentations compared with 4.5 presentations per 100,000 population).

Female presentations to an emergency department for asthma were higher than for males during the peak of the bushfires in New South Wales, both for the week beginning 29 December 2019 where the rate was 52% higher, and for the week of 5 January 2020 where the rate was 64% higher.

Examining emergency department presentations for asthma does not provide a complete picture of all asthma sufferers who may have had moderate and severe flare-ups during the bushfires. This is because much asthma management—through inhaled preventative and relieving medications—is done at home and with visits to primary health care services. Data that are focused on presentations to emergency departments are likely to capture only the most severe exacerbations.

Emergency department presentations for abnormalities of breathing

Analysis of presentations to a New South Wales emergency department for abnormalities of breathing (which, as with asthma, is one component of the respiratory diseases described in Section 2.1 of this report) showed a similar pattern to that shown for asthma.

Rates of presentations began to increase in mid-November 2019. They peaked in the week beginning 8 December 2019, with a 23% increase (a total of 830 presentations) compared with the same week in 2018, followed by a 19% increase the following week (beginning 15 December). Presentations for breathing abnormalities remained high around the New Year period between 29 December 2019 and 11 January 2020, which is consistent with bushfire activity in New South Wales (see Supplementary Table S1).

Emergency department presentations for chronic obstructive pulmonary disease

Visits to an emergency department in New South Wales also increased for presentations relating to COPD. Rates for COPD with acute exacerbation were at least 17% higher for the months of December 2019 and January 2020 compared with these months in the previous year. Rates peaked in the week beginning 12 January 2020, when they were 64% higher (a total of 186 presentations) than in the same week in 2019 (see Supplementary Table S1).

Pharmaceutical sales and dispensing

To assess possible changes in asthma and other respiratory symptoms in the community due to bushfire smoke, we can examine data on pharmaceutical dispensing and sales. In this report dispensing of medications is reported through PBS data, and sales data from IQVIA. While hospital emergency department data indicate those who sought treatment for severe asthma and COPD exacerbations, medications data may provide insight into any changes of asthma or other respiratory symptoms being treated in the community through their medications.

The pharmaceutical sales data component of the analysis in this report was focused on inhalers for shortness of breath (for the purposes of this analysis, inhalers with active ingredients salbutamol and terbutaline). These medications are inhaled into the lungs to relieve symptoms of asthma and other breathing problems. Inhalers for shortness of breath are often marketed as Ventolin or Asmol (salbutamol) or Bricanyl (terbutaline). These inhalers may only be provided by a pharmacist but may be obtained as over-the-counter medications or with a prescription. Analysis of PBS prescriptions dispensed included a broader range of respiratory medications but did not include medications purchased over-the-counter.

In January 2020, in response to access issues that were caused by the bushfires (including irregular stock deliveries to pharmacies in affected areas and evacuations), the Therapeutic Goods Administration (TGA) gave temporary permission to pharmacies to advertise until 30 April 2020 that:

- people with asthma or COPD could obtain salbutamol puffers or dry powder inhalers from a particular pharmacy; and
- people with asthma or COPD could obtain salbutamol puffers or dry powder inhalers from pharmacies with or without prescription if necessary (TGA 2020a).

The TGA also kept the public informed on the availability of salbutamol inhalers throughout the bushfire season, to discourage stockpiling or 'panic-buying' of these inhalers, and granted pharmacies permission to run advertisements reminding people with asthma or COPD to remember to take any salbutamol medications or prescriptions they had with them in the event of an evacuation. These permissions also extended to advertising in evacuation centres (TGA 2020b).

Pharmaceutical Benefits Scheme data

The PBS data collection contains information on all prescription medicines dispensed under the PBS. (The PBS does not cover medicines supplied to public hospital in patients, over-the-counter medicines or private prescriptions.) PBS data are an indication of medications dispensed and do not reflect usage or prescriptions provided to a patient.

Analysis of PBS data by state shows some change in rates of dispensing for all respiratory medications (ATC Code R03) through December 2019 and January 2020, most notably in the Australian Capital Territory where rates of dispensing increased by 20–80% for the weeks between 8 December and 18 January. In the week beginning 29 December 2019 there was a 64% increase in the rate of dispensing of all respiratory medications compared with the same week the previous year, followed by an 80% increase for the week beginning 5 January 2020. There were also some increases for the Northern Territory across the whole period, but this may reflect volatility in the data due to the lower rates of dispensing of these medications in that jurisdiction.

Rates of prescriptions dispensed through the PBS for salbutamol inhalers (ATC code R03AC02; excluding nebulas) varied across states. Compared with the same time period in the previous year, there were increases of around 20% in New South Wales first in early December 2019 and again in late December 2019 and early January 2020. Increases of up to 40% were observed in Victoria in the weeks between 5–18 January 2020. There was a sustained period of increased dispensing of salbutamol inhalers in the Australian Capital Territory for the weeks between 8 December 2019 and 26 January 2020; with the largest increase occurring in the week beginning 5 January 2020 (a 134% rate increase compared with the same week in the previous year).

The effects of the bushfires are evident in regional data, as the fires moved from north to south of the eastern seaboard. In the Coffs Harbour—Grafton SA4, there were increases of 70% and 43%, respectively, in the rate of scripts for salbutamol inhalers dispensed, during the weeks beginning 10 and 17 November 2019. Extensive fires were burning in the area at the time. Similarly, there were increases of 70% and 42%, respectively, for these same weeks in the Mid North Coast SA4.

There was a prolonged period (from 10 November 2019 through to 18 January 2020) during which the rate of salbutamol inhaler scripts dispensed for the Sydney—North Sydney and Hornsby SA4 was elevated, with rate increases ranging from 20% to 40% compared with the same weeks in the previous year. Similarly, there was a sustained period of increased salbutamol inhaler scripts dispensed in the Sydney—City and Inner South SA4 from 1 December 2019 through to 11 January 2020 with rate increases ranging from 21% to 35% compared with the same weeks in the previous year.

Further south, in the week beginning 29 December 2019, there was a 63% increase in the rate of salbutamol inhaler scripts dispensed in the Capital Region SA4, compared with the same week in the previous year. A 73% increase in dispensing rate was recorded in the following week beginning 5 January 2020. The dispensing rate remained high in this SA4, relative to the corresponding weeks in the previous year, until the last week of January.

There were increases in the rate of salbutamol inhaler scripts dispensed in the Hume SA4 in Victoria of 74% in the week beginning 5 January 2020 and 30% in the week beginning 12 January 2020, as 3 fires burned on the New South Wales and Victoria border (the Dunns Road fire, the East Oumie Creek fire and the Green Valley fire, which merged to create a megafire).

There were substantial increases in salbutamol scripts dispensed in many SA4s around greater Melbourne in early January; for example, for the Melbourne—Inner South SA4, there were rate increases of 39% and 76%, respectively, in the weeks beginning 5 and 12 January 2020, compared with the same weeks in the previous year.

Formoterol and Budesonide (ATC code R03AK07, often sold under the brand name Symbicort) is an example of a combination inhaler medication that can be used to manage asthma and COPD exacerbations. There were notable increases in scripts dispensed for this drug, particularly in the Australian Capital Territory. For example, in the weeks beginning 29 December 2019 and 5 January 2020 there were 80% and 112% increases in the dispensing rate, respectively, relative to the corresponding week in the previous year.

For detailed data see *Supplementary Tables S6–S10*, and *Maps by region*.

IQVIA data

IQVIA is a private data agency that collects data on the supply and sale of pharmaceuticals in Australia. National data provided to the AIHW by IQVIA covered over-the-counter and prescription sales of inhalers for shortness of breath (with the active ingredients salbutamol or terbutaline). As with PBS prescriptions data, there were clear increases in sales of these inhalers at times when bushfire activity peaked (by SA4). For example, the Capital Region SA4—which includes Batemans Bay, New South Wales, in the north, and Eden near the Victorian border in the south—there was a 149% increase in the rate of sales of these inhalers for the week beginning 29 December 2019, compared with the same week in the previous year (from 1,087 to 2,702 units sold per 100,000 population). As fires burned in Mallacoota, Victoria, there was a 77% increase in the same week within the Latrobe–Gippsland SA4.

Elsewhere, the large increases in the rate of sales of inhalers for shortness of breath show a clear link with the spread of bushfires throughout the bushfire season. For example, in the Mid North Coast SA4, there was a 144% increase in sales of these inhalers for the week beginning 10 November 2019, compared with the same week in the previous year. There were several fires burning at Emergency Warning level in the area at the time.

For detailed data and interactive data tools see *Supplementary Table S11*, and *Maps by region*.

Respiratory testing

Spirometry testing to confirm airflow limitation and the diagnosis of asthma and/or COPD is performed by trained medical personnel in the community setting and can be billed to the Medicare Benefits Schedule (MBS). MBS data for respiratory function testing (spirometry items 11505, 11506 and 11512) were analysed for the 2019–20 bushfire season. In Victoria, there was a 39% increase in the rate of MBS claims for respiratory testing between 2018 and 2019 for the week beginning 22 December. There was a 29% decrease in the rate of testing in the state the following week (beginning 29 December 2019). There was little change for respiratory testing in Victoria throughout the month of January 2020 compared with January 2019 (see *Supplementary Table S3*).

In New South Wales, there was a 35% increase in claims for respiratory testing between 2018 and 2019 for the week beginning 22 December; this is in contrast to a 29% decrease for the same week between 2017 and 2018. January 2020 data for New South Wales show fluctuations that are consistent with other months and not attributable to the bushfires. Respiratory testing data for the Australian Capital Territory show quite volatile results, with large fluctuations due to the relatively small numbers of tests being done in the territory (see *Supplementary Table S3*).

It should be noted that MBS claims data, including GP visits and other health services, are affected by public holidays when comparing data between years. The timing of these public holidays has a substantial impact on the volume of services able to be processed. In some cases, variation may reflect the number of service days in the week compared with the previous year.

For detailed data see *Supplementary Table S3*, and *Maps by region*.

2.3 Cardiovascular health and stroke

The rates of New South Wales emergency department presentations for cardiovascular disease showed modest decreases for the months of November and December 2019 during the bushfire season, compared with the same months in the previous year (see *Supplementary Table S1*).

Results from this analysis also showed little difference in presentations to New South Wales emergency departments for cerebrovascular disease (see *Supplementary Table S1*).

Cardiovascular health and stroke were included in this analysis as evidence suggests that exposure to bushfire smoke may increase the risk of symptoms or disease. Previous research based on bushfires in Sydney, New South Wales, showed slight increases in emergency department presentations for ischemic heart disease and cardiovascular mortality on days where there was air pollution from bushfires (Finlay et al. 2012). Further, increased ambulance dispatches for stroke were observed during the 2016 bushfire season in Tasmania (Edwards et al. 2018).

Bushfire smoke was found to have triggered acute coronary events during the 2006–07 bushfire season in Victoria (Haikerwal et al. 2015). Dennekamp and colleagues (2015) estimated that the air quality in Melbourne from the 2006–07 bushfires was associated with between 24 and 29 excess out-of-hospital cardiac arrests.

Outside Australia, a study of over 100,000 Chinese men and women for a project relating to cardiovascular disease risk found an association between increased exposure to PM2.5 and stroke (Huang et al. 2019). However, the evidence to suggest an impact on cardiovascular health from bushfire smoke is not as strong as the evidence for impacts on respiratory symptoms and health (Liu et al. 2015; Walter et al. 2020).

It is difficult to determine why there was no change to emergency department visits for cardiovascular and cerebrovascular health in New South Wales during the 2019–20 bushfire season; however, there was consistent and strong health advice in the media during the bushfires to stay inside and avoid the smoke. The population may have heeded this advice and thus avoided emergency department visits for their cardiovascular and cerebrovascular health. The long-lasting nature of the bushfires may have allowed people to be prepared to stay at home and not risk their health. Further, this report focused on emergency department presentations to hospitals; admitted patient data might provide a more comprehensive insight into the broader health effects of bushfires.

2.4 Mental health

There is strong evidence to suggest that disasters, including bushfires, can have a detrimental effect on the mental health of people who are directly and indirectly affected (Clayer et al. 1985; Gibbs et al. 2016; Laugharne et al. 2011; Yelland et al. 2010).

There are limited data sources available to examine the short-term impacts of the bushfires on mental health in the context of the current report, however some data are available from the MBS.

In response to the 2019–20 bushfires, the Australian government introduced a number of additional MBS subsidised mental health items in January 2020 for Australians adversely affected by a bushfire (for details on these items, see *Technical supplement*). The new services are provided by eligible psychologists, GPs and medical practitioners, social workers, and occupational therapists. Patients are not required to have a diagnosed mental health condition, GP mental health treatment plan or referral prior to requesting these additional services.

Since the introduction of the additional bushfire response items, a total of 18,945 bushfire mental health services had been accessed through the MBS (as at 11 October 2020) by 5,094 patients. Almost two-thirds of these services were face-to-face (64%) and the remainder were telehealth services. In general, telehealth consultations have increased as the COVID-19 pandemic affected the way people chose to seek health advice and treatment.

Between mid-January (when the items were introduced) and mid-March 2020, claims against these items by bushfire affected people increased sharply from 148 services claimed in the week ending 26 January 2020 (the first full week after the new items were available) to 510 services in the week ending 15 March 2020. Claims for services were highest in the weeks ending 21 June and 28 June 2020 with 619 and 652 services, respectively. The number of bushfire response mental health services accessed by people affected by the bushfires has fluctuated but, remained above 400 per week from the week ending 23 February onwards (as at 11 October 2020), and averaged 498 per week between 19 January and the 11 October 2020.

MBS mental health bushfire items were most commonly used to consult a registered psychologist (46%) or a clinical psychologist (41%). Social workers, occupational therapists and GPs were also consulted using the bushfire items.

In addition to the specific bushfire response mental health MBS items, MBS subsidised mental health treatment may also have been provided to those affected by the bushfires through existing MBS mental health items. Similarly, MBS items for mental health treatment that were introduced for people affected by the COVID-19 pandemic may have also been utilised. Therefore, the actual number of mental health MBS services delivered to people affected by the bushfires may be higher than the numbers presented here.

For this report, analysis of visits to emergency departments in New South Wales was restricted to the 2019–20 bushfire season (1 September 2019 to 29 February 2020). Visiting an emergency department is only one means through which people affected by bushfires may seek help for their mental health, and therefore does not capture the full impact.

Rates of presentations to New South Wales emergency departments for mental and behavioural problems were not notably higher in the 2019–20 bushfire season compared with the same weeks in 2018–19. Higher rates of presentations in the last weeks of December and first weeks of January for 2019–20 were consistent with those for previous years, and coherent with published literature that suggests that presentations to an emergency department, particularly those for psychiatric problems, increase during the Christmas and New Year period (Halpern et al. 1994; Zheng et al. 2007).

In the direct aftermath of the 2019–20 bushfires, it has been estimated that more than half of Australian adults felt anxious or worried about the bushfires (Biddle et al. 2020). There was also a 10–15% increase in calls to the Lifeline crisis support hotline, resulting in the introduction of a bushfire-specific call line (Lifeline 2020).

Evidence suggests that, while some mental health impacts may be observed during or directly after bushfires (Reifels et al. 2012), an increase in reported mental illness and increased mental health service use can be expected in the months and years following fires (Reifels et al. 2015).

Mental health impacts have been observed up to and longer than 12 months after bushfire events in Australia (Gibbs et al. 2016; McFarlane et al. 1997). Cavanagh and colleagues (2018) found almost half (45%) of the participants in a study on the impact of the 2013 Blue Mountains bushfires reported probable Post Traumatic Stress Disorder (PTSD), 23% reported psychological distress and 16% reported heavy drinking nine months after the fires (Cavanagh et al. 2018). Three to four years after the 2009 Black Saturday bushfires in Victoria, people in areas highly affected by bushfire were between 2 to 16 times more likely to report symptoms of PTSD, 1.5 to 2 times more likely to report depression and 2 times more likely to report severe psychological distress compared with people in low- and medium-affected areas (Bryant et al. 2014).

This evidence suggests that it will be important to monitor mental health impacts in communities after the 2019–20 bushfires.

For detailed data on mental health see *Supplementary Tables S1, S2 and S13*.

2.5 Visits to general practitioners

Visits to GPs claimed through the MBS showed some variation at the jurisdiction level. Data are based on the patient's postcode. Rates of visits to GPs were higher across New South Wales, Victoria and the Australian Capital Territory in the week beginning 22 December 2019 compared with the same week in 2018 (see Supplementary Table S3). This compares with substantial decreases in all 3 jurisdictions between 2017 and 2018.

The largest increase in the age-standardised rate of GP visits in the Australian Capital Territory was in the week beginning 22 December 2019 (4,098 compared with 3,248 per 100,000 population in the same week in the previous year; equal to a 26% increase in the age-standardised rate) (see Supplementary Table S3).

In the following week, beginning 29 December 2019, there was a decrease in the rate of visits to GPs across all of New South Wales, Victoria and the Australian Capital Territory compared with the same week in the previous year. All 3 of these jurisdictions experienced some of their worst fire conditions during this week. The effects are most apparent when looking at smaller geographical data (SA4s) (see Supplementary Table S4). The largest decreases in visits to GPs were in the Capital Region SA4 (where the age-standardised rate of GP consultations decreased by 19% compared with the same week in 2018), the Riverina SA4 (18% decrease) and the Southern Highlands and Shoalhaven SA4 (18% decrease).

Within these 3 bushfire-affected areas, the decreases in GP consultations coincided with poor air quality in towns and cities that had air quality monitoring stations. While we cannot attribute the readings at specific air quality monitoring stations to larger geographic areas, these are interesting observations. In the week beginning 29 December 2019, Goulburn in the Capital Region SA4 recorded a highest hourly average PM_{2.5} reading of 2,182µg/m³; the Wagga Wagga North air quality monitoring station recorded a highest hourly average PM_{2.5} reading of 1,799µg/m³ in the week beginning 5 January 2020; and Bargo, which sits just outside the Southern Highlands and Shoalhaven SA4, recorded 770µg/m³ in the week beginning 15 December 2019.

Decreases in GP visits may be partly explained by people in the community heeding health advice to stay indoors to minimise smoke exposure, particularly for minor health conditions. People may also have been evacuated to areas away from their usual GP and therefore not attended or sought appointments.

Medicare data do not include the reason that a person visited a GP; if available, this could provide a more complete picture of the decrease in visits, and any changes in the reasons for attendance. In addition to providing important insight into the impacts of natural disasters including bushfires, primary health care data could be better linked to other health and environmental data sets (Royal Commission into National Natural Disaster Arrangements 2020b).

It should be noted that MBS data, including GP visits, are affected by public holidays when comparing data between years. The timing of these public holidays has a substantial impact on the volume of services able to be processed. In some cases, variation may reflect the number of service days in the week when compared with a week in the previous year.

To explore GP visits across areas of Australia see *Maps by region*.

2.6 Heat-induced illness

Australian bushfire seasons often coincide with extreme heat events (Steffen et al. 2019). Hotter and drier conditions can put populations at an elevated risk of heat-related illnesses, including heat stroke, heat exhaustion and dehydration (Patz et al. 2000).

Results from analysis for this report showed little difference in emergency department presentations for dehydration in New South Wales during the bushfire season compared with the same time in the previous year (see Supplementary Table S1). This may be attributable to highly publicised health advice to stay inside to decrease the risk to health.

Firefighters have been noted to be at particularly high risk for heat-induced illness (Finlay et al. 2012). Limited research in this area shows that firefighters are at high risk of dehydration, particularly when working long shifts of up to 12 hours, and that they may not be able to adequately rehydrate between shifts (Raines et al. 2008). Injury reports from several fire services across Australia have documented that, from 2003 to 2006, 2–6% of all fire-ground injuries were heat-related ailments (Aisbett et al. 2017). No data relating to first responders were available for analysis in this report.

2.7 Deaths

In the course of the 2019–20 bushfire season 33 people, including 9 firefighters, tragically lost their lives as a direct result of the fires (Parliament of Australia 2020). Comparison of preliminary deaths data from the Australian Bureau of Statistics for the 2019–20 bushfire season with 5-year average data for the same period shows no clear change in pattern for deaths from all causes by SA4 (for data, see Supplementary Table S12). However, these preliminary data include only doctor certified deaths. Deaths referred to a coroner (coroner certified deaths) account for around 10% of deaths and these data are not yet available—the total number of deaths for this period will change with their inclusion (ABS 2020).

Further, the number of deaths included as part of this analysis is relatively small and therefore the natural volatility from year to year makes it difficult to assess meaningful change.

2.8 Homelessness

Bushfires can cause a substantial and rapid growth of the homeless population as people lose their homes to fires. Media outlets covering the 2009 Black Saturday bushfires reported that up to 5,000 Victorians were left homeless by the fires (Smith 2009).

During the 2019–20 bushfire crisis, more than 3,000 homes were lost. There was rapid deployment of messaging and advice to Specialist Homelessness Services (SHS) agencies about how to accurately record people receiving assistance who had been affected by bushfires. Specifically, a prompt was added to remind agency staff to use the category *Unable to return home due to environmental reasons*, an existing category in the data collection.

In January 2020, there was an increase of around 300 SHS clients (to a total of around 750 clients) who were unable to return home due to environmental reasons compared with the same month in the previous year. These clients, mostly in Victoria and New South Wales, received a relatively short period of support. Given the scale of the disaster, the limited number of clients affected by environmental reasons who received SHS support may reflect a number of issues, including:

- SHS-funded accommodation services may not have had the capacity to support increased demand
- SHS services and staff are sometimes also affected by the natural disaster event and may have reduced resources to respond
- government-funded emergency services providing emergency response may not necessarily be provided through the SHS-funded pathways, and therefore are not captured in the data collection
- affected households may not have requested services through any government-funded avenue, instead relying on informal housing options such as couch surfing with friends/relatives, use of a holiday home or caravan, and so on.



3 Literature on health impacts beyond the scope of this report

3.1 Burns

An obvious risk of bushfires is burns—both direct flame burns and thermal burns (Finlay et al. 2012). Deep or widespread burns can be life threatening. The midday sun on a summer's day reaches about 1 kilowatt (kW) of energy per square metre and a person's pain tolerance is about 2kW; bushfires can reach 100kWs or more (DEA 2017). Severe burns can be a long-term health issue that require years of treatment and procedures.

During the 2003 Canberra bushfires (specifically 18–19 January), burns accounted for 10% of major fire-related presentations (24 out of 233) to the Canberra Hospital. Of these, about half were admitted for further treatment, and 2 patients required transport to interstate burns centres (Richardson & Kumar 2004).

Burn injuries from bushfires can have long-term impacts on bushfire survivors. After the 2009 Victorian Black Saturday bushfires, burns victims were found to suffer from high to very high levels of general distress and impaired physical functioning up to 3 years later (Pfitzer et al. 2016).

3.2 Eye health

Exposure to the dirt, ash and chemical compounds in smoke from bushfires is a major risk factor for an environmental form of conjunctivitis, and for the exacerbation of allergic conjunctivitis. Symptoms include watery or dry eyes, burning, stinging and itching (UNSW 2020).

Australian evidence on the impact of bushfires on eye health is limited. However, analysis of the major Canberra bushfires of 2003 showed presentations to the hospital emergency department for eye problems (irritation, ulcer, foreign body) were second only to breathing problems/smoke inhalation (Richardson & Kumar 2004).

Internationally, corneal abrasions have been reported as immediate health effects of wildfires, making up 13% of fire-related emergency department presentations in the week following a 1991 fire in California (Shusterman et al. 1993). Eye irritation symptoms have also been noted in a study of children in California, where 6 days of fire smoke resulted in a 4-fold increase in these symptoms (Kunzli et al. 2006; Youssouf et al. 2014).

3.3 Substance use

Increased alcohol, tobacco and drug use has been noted internationally in the aftermath of a number of natural disasters and other traumatic events (Cerdá et al. 2011; Flory et al. 2009).

In the Australian context, a study conducted on the impacts of the 1983 Ash Wednesday bushfires found that, compared with people not exposed to bushfires, bushfire survivors were twice as likely to report alcoholism and drug problems (Clayer et al. 1985).

A study on the impact of the Black Saturday bushfires in Victoria found that the proportion of those in high-impact bushfire areas reporting heavy alcohol consumption was 1.3 times as high as those in medium-impact and low-impact areas (Bryant et al. 2014). Increased tobacco use was also found in young adults who were directly impacted by the 2003 Canberra bushfires (Parslow & Jorm 2006).

Men appear to be more prone to increased alcohol consumption post-disaster than women (Cavanagh et al. 2018). However, both single-occasion and lifetime risky drinking is more common in men than women in the general population (ABS 2018).

3.4 Domestic and family violence

A number of pressures on people's lives emerge in the wake of a bushfire. Homelessness, unemployment and drug and alcohol use have been observed to increase after bushfires, and experiencing bushfires can cause immense stress, trauma and grief. These factors have been cited as possible underlying factors in observed increases in domestic violence following natural disasters, including bushfires (Parkinson & Zara 2013). In addition, those people who have experienced domestic violence prior to a bushfire are at higher risk of further domestic violence after it, and services designed to support and prevent domestic violence can be undermined or destroyed by fires (Molyneaux et al. 2020).

International evidence supports a link between disaster and increased domestic violence. A study following Hurricane Katrina found a 4-fold increase in reports of intimate partner violence (Anastario et al. 2009) and New Zealand police call-out data indicated a 53% increase in domestic violence calls over the weekend of the Canterbury earthquakes (Parkinson & Zara 2013).

In Australia, a qualitative study undertaken in a Victorian community affected by the 2009 Black Saturday bushfires indicated an increase in domestic violence following the fires (Parkinson & Zara 2013). Another study following the Black Saturday bushfires found that, in the 3 to 4 years after the fires, women living in areas of high fire impact were up to 7 times as likely to report experiencing assault or violence as women living in medium- or low-affected areas (Molyneaux et al. 2020).

4 Future work

To examine the short-term impact of the 2019–20 bushfire season on health, this report used available data from New South Wales emergency departments, national pharmaceutical data (PBS and over-the-counter), primary health care data from the MBS and deaths data (see *Supplementary tables*). Air quality data for New South Wales, the Australian Capital Territory and parts of Victoria are also included in the interactive data products that accompany this release (see *Maps by region* and *Interactive graphs*).

Future data updates will aim to expand hospital emergency department analysis beyond New South Wales and examine these data and other data sources, including fire danger index data, in more detail. Admitted patient data from hospitals will also likely be explored when available. Analysis of population groups who are more vulnerable to the effects of bushfire smoke exposure was out of scope for this report but it is hoped that these groups can be explored in future data updates. Deaths data will also be updated to include coroner certified deaths, which were not available for this report.

Primary health care data could provide insight into the impacts of natural disasters including bushfires and could be better linked to other health and environmental data sets (Royal Commission into National Natural Disaster Arrangements 2020b).

4.1 Longer term health impacts

While this report examined the more immediate physical and mental health impacts of bushfires with available data, more health impacts may become apparent in the following months and years. Australia generally experiences good air quality, and exposure to bushfire smoke is typically infrequent and sporadic for the majority of the population (enHealth 2020). For this reason, there is limited information available about prolonged exposure to bushfire smoke or long-term effects (enHealth 2020). Further research to characterise long-term health effects of bushfire smoke could inform the ‘effectiveness and health equity implications of related health protection advice’ (Vardoulakis et al. 2020; p. 353).

The Royal Commission has noted the need for more knowledge about the

‘...underlying biological mechanisms involved in respiratory impacts; the longitudinal and long-term health impacts of repeated, time-limited and prolonged exposure to smoke at different concentrations; the time taken to recover between smoke events; and the impacts on vulnerable groups’ (Royal Commission into National Natural Disaster Arrangements 2020b; p.327).

Some vulnerable groups have been of particular focus with regards to bushfire smoke and further research would be valuable. For example, bushfire smoke exposure in pregnant women (PM2.5 in particular) during the second trimester has been positively associated with pre-term birth (Abdo et al. 2019).

Three to four years after the Black Saturday bushfires in Victoria in 2009, a study identified a high level of resilience in a survey of some of the affected population; it also found that, depending on the level of impact in their community, 12–15% of study participants were still experiencing concerns with their mental health that likely required professional support, and at a rate twice as high as would be expected in the non affected population. The fire itself was not the only major life stressor—changes in income, accommodation and personal relationships all had an impact (Gibbs et al. 2016). Mental health problems and substance use problems may only become apparent in years rather than months after bushfires and should continue to be explored.

The Medical Research Future Fund will fund \$5 million of research into the physiological impacts of prolonged smoke exposure and the impact on the mental health of communities affected by bushfires. Information on the biological, psychological and behavioural impacts of prolonged smoke exposure will be explored and will help in understanding the experiences and coping strategies of people and communities heavily affected by bushfires (Hunt, the Hon. G 2020).

With regard to managing the impact of bushfires on the community, Vardoulakis and colleagues (2020; p. 353) suggest that:

‘close collaboration between health, education, environmental, fire management and emergency response agencies is essential for achieving the best overall outcomes for population health and wellbeing’.

4.2 Air quality data

Air quality data from air quality monitoring stations in Australia were used to describe the impact of the bushfires for different time periods in this report, and used to indicate the intensity of the bushfires in the interactive online content that accompanies this report. These stations are more numerous in some metropolitan centres and more sparsely dispersed in regional Australia; emergency monitoring stations were set up during the bushfires to negate some of this effect (Appendix).

While there is a published ‘burnt area map’ that predicts the severity of the burnt canopy based on satellite imagery, and similarly, a national bushfire ‘scar’ map from the 2019–20 bushfires (DAWE 2020), there would be benefits from developing a ‘smoke inventory’. An inventory would establish the spread of the smoke while taking into account the prevailing conditions. Arbitrary measures have been used in the past—for example, applying recordings from an air quality monitoring station to a designated area around it—but an inventory would provide better accuracy and consistency.

Presenting air quality data to the public requires converting pollution concentration measurements to an easy-to-understand scale relating to health advice. Due to different conventions and changes in implementation, agencies have created varied scales to categorise air quality data, which leads to differences worldwide. In early 2020, the New South Wales Department of Planning, Industry and the Environment funded work to assess the definitions and approaches used by jurisdictions in Australia and internationally. Across states and territories, there was no consensus on how to report PM pollution (NSW DPIE 2020b). Some jurisdictions used an Air Quality Index while others used concentration levels as their primary metric for public information provision; and methods for calculating averages varied, too.

The need for nationally consistent air quality advice, actions and health warnings across jurisdictions was highlighted in the Royal Commission into National Natural Disaster Arrangements, the New South Wales Bushfire Inquiry (NSW Government Premier and Cabinet 2020) and the CSIRO (2020) report on climate and disaster resilience.

The Commonwealth, state, and territory governments have now agreed to a national air quality messaging framework for 1 hour reporting of PM 2.5 through the Australian Health Protection Principal Committee, providing consistent and colour-coded concentration thresholds that indicate health advice for ratings of, for example, “good”, “fair”, and “poor” air quality.

Further to this, the Royal Commission into National Natural Disaster Arrangements report (2020a) and CSIRO (2020) report recommend a national approach to air quality measurement and prediction, including smoke plume forecasting in all states and territories. The Australian Government is proposing to support this initiative through the Disaster Risk Reduction Funding Package (Royal Commission into National Natural Disaster Arrangements 2020a).

Consistency in presenting air quality data among jurisdictions is key to providing public health advice (Vardoulakis et al. 2020). General health advice, such as staying indoors and reducing outdoor exercise at times when air quality is poor, is generally tailored to shorter periods of poor air quality. Vardoulakis and colleagues (2020) suggest that it is necessary to be able to provide more targeted advice—guided by nearby air quality monitoring stations (based on PM2.5 rather than an index)—to plan activities and minimise exposure to pollution.

4.3 Royal Commission into National Natural Disaster Arrangements

A Royal Commission into National Natural Disaster Arrangements (the Commission) was announced on 20 February 2020 in the wake of the 2019–20 bushfire season. Acknowledging the risks associated with global climate change, the Commission examined Australia’s resilience and preparedness, including actions needed to mitigate any future natural disasters (Royal Commission into National Natural Disaster Arrangements 2020b).

In particular, the Commission considered how a range of key preparedness and resilience actions could be employed to reduce future bushfire damage. These include:

- land management, including hazard reduction measures
- wildlife management and species conservation, including biodiversity, habitat protection and restoration
- land-use planning, zoning, and development approval (including building standards), urban safety, construction of public infrastructure, and the incorporation of natural disaster considerations
- ways in which the traditional land and fire management practices of Indigenous Australians could improve Australia’s resilience to natural disasters (Royal Commission into National Natural Disaster Arrangements 2020b).

The Commission received over 1,700 public submissions, and held a number of hearings. These submissions and hearings included the experiences of, for example, people in fire-affected communities, first responders and government agencies.

The Royal Commission made a total of 80 recommendations across a number of areas, including national coordination arrangements, national emergency response capability, emergency planning, air quality, health, and land management.

Some of the recommendations and findings of the Commission's final report highlighted:

- the opportunity to improve air quality monitoring and associated public health advice
- differences in state and territory reporting of air quality, having the potential to undermine the utility of the data and pose risks to the vulnerable
- the need to include local health professionals in emergency planning for response, or recovery arrangements
- the need for a consistent bushfire alert system and fire danger rating system across Australia
- the need to refine arrangements to support localised planning and the delivery of appropriate mental health services following a natural disaster (Royal Commission into National Natural Disaster Arrangements 2020b).

The Commission notes that some recommendations should be implemented as a matter of urgency because of the time it will take time to achieve the intended outcome, noting that meaningful steps will be important.

Outcomes from the Commission will be of interest to the community, health services and to policy makers ahead of future bushfire seasons.

4.4 Things to consider when interpreting results

Much of the data in this report show associations between bushfire events and health outcomes. While there is evidence of bushfire smoke having ill health effects, the results should be interpreted with caution. Other triggers of poor health, including dust that may have been present at the time, have not been accounted for.

The data compare 2019–20 health data on a weekly basis with data from roughly the same week in the previous year. To ensure that the weeks matched as closely as possible, the dates differ by a day or two. See *Technical supplement* for detailed methodology.



Appendix: Data used in this report

The 2019–20 bushfire season started early, in July 2019, with major fire activity peaking during December 2019 and January 2020 across various states and territories. All fires in New South Wales were not extinguished completely until 4 March 2020. Note that there is no formal definition of a single bushfire season across Australia and each state and territory defines periods of peak fire risk or fire activity differently. The reference period used in this report varies with data availability but generally focuses on the period from September 2019 to March 2020.

Health and the health system

To understand some of the more immediate impacts of the bushfire season on health, this project examined a selected number of available data sources including:

- emergency department presentations data for New South Wales
- respiratory medications data, including over-the-counter and prescription medications
- Medicare data
- deaths data.

Details of these data sources are provided in the accompanying *Technical supplement*.

Air quality

The AIHW was supplied with air quality monitoring station data for New South Wales, the Australian Capital Territory and parts of Victoria. For a list of these stations see the accompanying *Technical supplement*.

The pollutant with the most substantial effects for humans is PM. For this reason, PM_{2.5} was chosen as the indicator of air quality for this report. Time periods used to calculate average particle concentrations—which can then be used in creating an air quality index—vary across jurisdictions. This inconsistency makes air quality index data difficult to consider beyond a single jurisdiction.

PM refers to particles suspended in the air with a diameter in a specified range, typically either 0–10 microns (PM₁₀ from sources such as construction debris and road dust) or 0–2.5 microns (PM_{2.5} from sources such as fossil fuel combustion). PM_{2.5} refers to PM with an equivalent aerodynamic diameter of 2.5 micrometres or less. PM_{2.5} data are calculated in micrograms per cubic metre ($\mu\text{g}/\text{m}^3$).

Average weekly and maximum weekly PM_{2.5} concentration data were calculated based on PM_{2.5} hourly averaged data provided by the New South Wales Department of Planning, Industry and Environment's Climate and Atmospheric Science Branch. The original PM_{2.5} hourly averaged data were collected at routine, emergency and project monitoring stations between 1 September 2019 and 29 February 2020. These PM_{2.5} data are collected using compliance methods. Instruments used were:

- BAM 5014i (AS/NZS 3580.9.12:2013)
- SHARP 5030 (US EPA equivalency EQPM-0609-184)
- 1405-DF FDMS TEOM (AS/NZS 3580.9.13:2013).

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Abbreviations

AIHW	Australian Institute of Health and Welfare
COPD	chronic obstructive pulmonary disease
FFDI	Forest Fire Danger Index
GP	general practitioner
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification
kW	kilowatt
MBS	Medical Benefits Schedule
NNAPEDCD	National Non-admitted Patient Emergency Department Care Database
PBS	Pharmaceutical Benefits Scheme
PM	particulate matter
PTSD	post-traumatic stress disorder
SA4	Statistical Area Level 4
SHS	Specialist Homelessness Services
SNOMED	Systematized Nomenclature of Medicine, Clinical Terms

Glossary

angina: temporary chest pain or discomfort when the heart's own blood supply is inadequate to meet extra needs, as in exercise.

Ash Wednesday: the Ash Wednesday bushfires were a series of bushfires that occurred in south-eastern Australia on 16 February 1983. Within 12 hours, more than 180 fires caused widespread destruction across the states of Victoria and South Australia.

asthma: a common, chronic inflammatory disease of the air passages that presents as episodes of wheezing, breathlessness and chest tightness due to widespread narrowing of the airways and obstruction of airflow.

Australian Statistical Geography Standard (ASGS): common framework defined by the Australian Bureau of Statistics for collecting and disseminating geographically classified statistics. It replaced the Australian Standard Geographical Classification (ASGC) in July 2011.

biome: a large area characterised by its vegetation, soil, climate, and wildlife.

Black Saturday: the Black Saturday bushfires were a series of bushfires that either ignited or were already burning across Victoria on and around Saturday, 7 February 2009. The fires resulted in Australia's highest-ever loss of human life from a bushfire, with 173 fatalities. As many as 400 individual fires were recorded on Black Saturday.

bushfire: a fire burning in the bush that is difficult to control and sometimes spreads quickly, sometimes also referred to as 'wildfire.'

canopy: the above-ground portion of a vegetation type, formed by plant crowns. In a woodland or forest, the canopy is formed by the crowns of trees and sometimes large shrubs. The canopy can be further divided into upper, mid and lower canopy layers. The tallest plants of a vegetation type form the upper canopy layer.

cardiovascular disease: any disease of the circulatory system, namely the heart (cardio) or blood vessels (vascular). Includes angina, heart attack, stroke and peripheral vascular disease. Also known as circulatory disease.

chronic obstructive pulmonary disease (COPD): serious, progressive and disabling long-term lung disease where damage to the lungs (usually because of both emphysema and chronic bronchitis) obstructs oxygen intake and causes increasing shortness of breath.

couch surfing: a couch surfer is a Specialist Homelessness Services client who typically moves from household to household intermittently, who is not regarded as being part of the household, and who does not have any form of leased tenure over any accommodation

COVID-19 pandemic: COVID-19 is a disease caused by the new coronavirus SARS-CoV-2. It is a major health threat and international crisis, which has led to substantial disruption to almost all parts of society worldwide. The outbreak first came to international notice through a cluster of unexplained pneumonia cases in Wuhan, China, in late December 2019. The COVID-19 epidemic was declared a pandemic (the worldwide spread of a new infectious disease) by the World Health Organization (WHO) on 11 March 2020.

diabetes: a chronic condition where the body cannot properly use its main energy source—the sugar glucose. This is due to a relative or absolute deficiency in insulin, a hormone produced by the pancreas that helps glucose enter the body's cells from the bloodstream and be processed by them. Diabetes is marked by an abnormal build-up of glucose in the blood; it can have serious short- and long-term effects.

domestic violence: a set of violent behaviours between current or former intimate partners—typically, where one partner aims to exert power and control over another, usually through fear. Domestic violence can include physical violence, sexual violence, and emotional and psychological abuse.

Emergency Warning level: during a bush fire, Alert Levels are used to give the Australian public an indication of the level of threat from a fire. An Emergency Warning is the highest level of Bush Fire Alert and indicates that members of the public may be in danger and need to take action immediately.

fine particle (particulate) pollution: fine particle pollution is generated by urbanisation, the operation of industry, motor vehicles, coal-fired power stations, wood-burning heaters and other man-made sources but can also be generated by events such as volcanic eruptions, bushfires and dust storms.

Forest Fire Danger Index: the McArthur Forest Fire Danger Index uses dryness (a product of rainfall and evaporation), wind speed, temperature and humidity to indicate the degree of danger of fire in Australian Forests.

greenhouse gas emissions: greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, ozone and some artificial chemicals such as chlorofluorocarbons (CFCs).

heart attack: a life-threatening emergency that occurs when a vessel supplying blood to the heart muscle is suddenly blocked completely by a blood clot. The medical term commonly used for a heart attack is myocardial infarction. See also cardiovascular disease.

hypertension/high blood pressure: definitions can vary but a well-accepted definition is from the World Health Organization: a systolic blood pressure of 140 mmHg or more or a diastolic blood pressure of 90 mmHg or more, or if [the person is] receiving medication for high blood pressure.

intimate partner violence: set of violent behaviours between current or former intimate partners. See also domestic violence.

ischaemic heart disease: see heart attack and angina. Also known as coronary heart disease. See also ischaemia.

ischaemia: reduced or blocked blood supply. See also ischaemic heart disease.

lifetime risky drinking: the accumulated risk from drinking either on many drinking occasions, or on a regular (for example, daily) basis over a lifetime. The lifetime risk of harm from alcohol-related disease or injury increases with the amount of alcohol consumed. For healthy men and women, drinking no more than 2 standard drinks on any day reduces the lifetime risk of harm from alcohol-related disease or injury.

megafire: there is currently no precise scientific definition of megafire, and what is called a 'megafire' may vary between countries. In Australia fires are commonly referred to as megafires when they are formed from several other fires meeting and burning over 100,000 acres (or almost 40,500 hectares) of land.

over-the-counter medications: medicines that are obtained without a prescription and are not complementary medicines. Over-the-counter medicines include, pharmacy medicines pharmacist-only medications, and general sales medicines.

PM2.5: atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometres (0.0025 millimetres).

post-traumatic stress disorder: the development of a set of reactions in people who have experienced a traumatic event that might have threatened their life or safety, or the safety of others around them. Examples of traumatic events can include war or torture, serious accidents, physical or sexual assault, or disasters. A person who has PTSD can experience feelings of helplessness, horror or intense fear.

primary health care services: these are services delivered in many community settings, such as general practices, community health centres, Aboriginal health services and allied health practices (for example, physiotherapy, dietetic and chiropractic practices) and come under numerous funding arrangements.

respiratory disease: a chronic respiratory disease or condition affecting the airways and characterised by symptoms such as wheezing, shortness of breath, chest tightness and cough. Conditions include asthma and chronic obstructive pulmonary disease (COPD)—which includes emphysema and chronic bronchitis.

salbutamol: a medicine for the relief of respiratory symptoms associated with asthma, chronic obstructive pulmonary disease (COPD) and other respiratory diseases. Salbutamol inhalers are marketed in Australia under the trade names Ventolin, Asmol and Airomir and are available with or without a prescription.

single-occasion risky drinking: a single-occasion risk, in the context of alcohol, is defined as the risk of alcohol-related injury arising from having a sequence of drinks without the blood alcohol concentration reaching zero in between them. The risk of an alcohol-related injury arising from a single occasion of drinking increases with the amount consumed. For healthy men and women, drinking no more than 4 standard drinks on a single occasion reduces the risk of alcohol-related injury from that occasion.

spirometry: spirometry tests measure the flow and volume of air entering and leaving the lungs. It is used to assess ventilatory function and differentiates between normality and diseases causing obstructive and possibly restrictive defects.

Statistical Area Level 4 (SA4): SA4 regions are the largest sub-state geographical unit in the main structure of the Australian Bureau of Statistics' Australian Statistical Geography Standard (ASGS). Most SA4 regions have a population above 100,000 persons to provide sufficient sample size for Labour Force estimates. In regional areas, SA4 regions tend to have smaller populations (100,000 to 300,000). In metropolitan areas, the SA4s tend to have larger populations (300,000 to 500,000). SA4 regions are aggregations of whole SA3s.

stroke: an event that occurs when an artery supplying blood to the brain suddenly becomes blocked or bleeds. A stroke often causes paralysis of parts of the body normally controlled by that area of the brain, or speech problems and other symptoms. It is a major form of cerebrovascular disease.

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The page features several large, abstract geometric shapes in shades of orange and brown. A large, dark brown trapezoidal shape is positioned in the upper right, containing the main text. To its left, there are several smaller orange shapes, including a long vertical bar and a small square. In the lower right, another long orange bar and a small square are visible, mirroring the shapes in the upper left.

The 2019–20 bushfire season saw unprecedented fires sweep across Australia with a massive impact on many communities, devastating the natural environment and compromising air quality. This report examines a range of health data sources to assess the short-term health impacts of the bushfires, including: emergency department visits, prescription and purchase of asthma medicines, mental health service use, and GP visits. Results show clear associations between increased bushfire activity, including poor air quality, and people seeking assistance for their health.

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