GRATTAN Institute

The health effects of the 2019-20 bushfires

Submission to the Royal Commission into National Natural Disaster Arrangements

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1 The health impacts of the 2019-20 bushfires

Hundreds of bushfires ravaged south-eastern Australia over the 2019-20 summer, burning millions of hectares and billowing large plumes of smoke into the atmosphere. The fires and the smoke claimed many lives, and caused mental health problems that will last.

This 2019-20 bushfire season was not a one-off. Climate change is increasing the likelihood of ever more severe, intense, and longer-lasting bushfires into the future.

1.1 There was extreme fire risk leading up to the 2019-20 bushfires

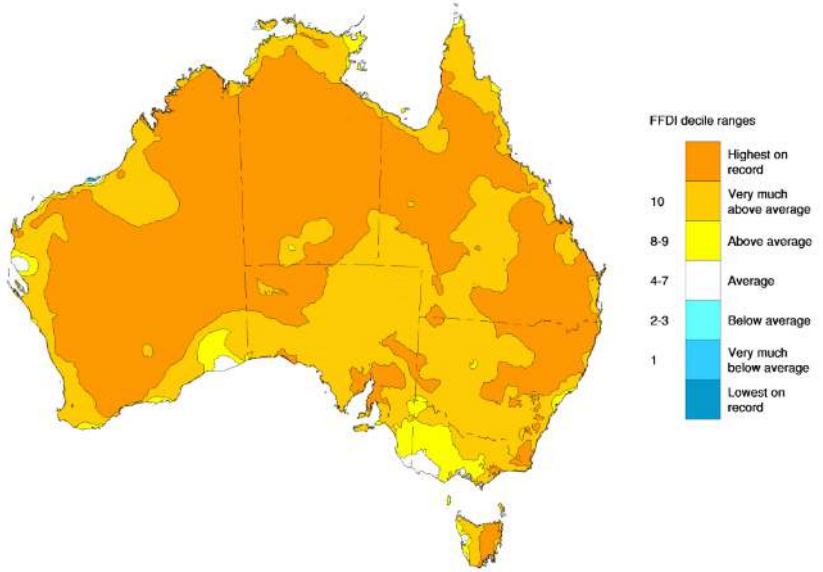
Hot weather and drought leading up to the summer of 2019-20 primed much of south-eastern Australia for bushfires.

2019 was Australia's hottest year on record.[1] Temperatures across the country were 1.5 degrees warmer than the long-term trend.[2] 2019 was also Australia's driest year on record.[3] Areas of south-eastern Australia that subsequently burned had their lowest rainfall on record.[4]

There had been extensive hazard reduction burns in the decade leading up to the 2019-20 summer, but dry and hot conditions limited the scope of hazard reduction burns in the winter before.[5]

By the spring of 2019, the Bureau of Meteorology reported that most of Australia had the highest fire danger weather on record (Figure 1.1).[6] In early September the fire season had kicked in, just five months after

Figure 1.1: Fire danger in the lead-up to 2019-20 was high
Forest Fire Danger Index (FFDI) in spring 2019



Source: Bureau of Meteorology (2019a, p. 11).

1. Bureau of Meteorology (2020a).
2. Long-term trend is the average between 1961 and 1990.
3. Bureau of Meteorology (2020a).
4. Ibid.
5. RMIT ABC Fact Check (2020); and Hannam and Mannix (2020).
6. Bureau of Meteorology (2019a).

the previous season ended.[7] By 9 September, more than 50 fires were burning in NSW, and 80 in Queensland.[8]

The dangerous fire weather continued through the summer. In December, the fire danger index was the highest on record across most of the country.[9]

By the end of January 2020, about 21 per cent of all Australia's forests had burnt.[10]

1.2 The bushfires had direct impacts on many Australians

Across south-eastern Australia, the fires directly killed at least 34 people and destroyed 2,100 homes.

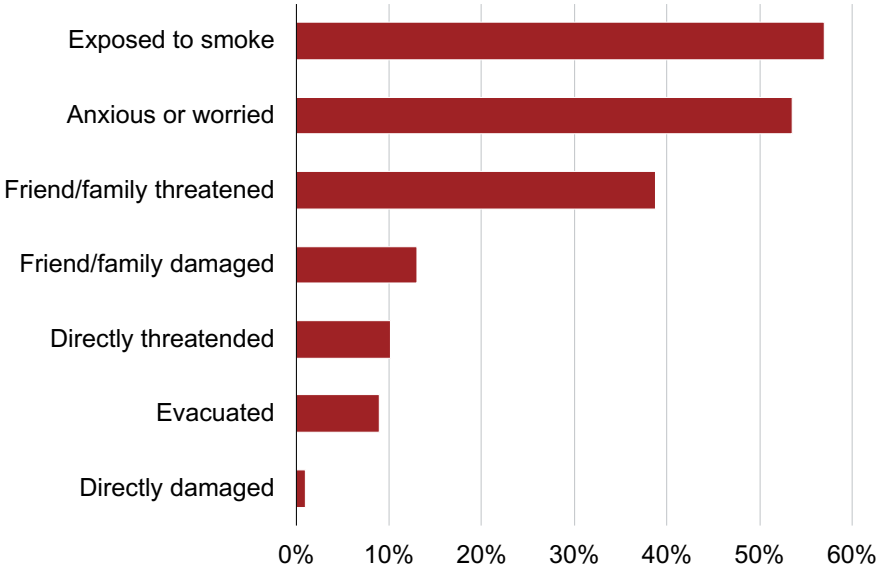
A survey of 3,000 Australians in January 2020 found that one-in-seven were directly affected by the bushfires through their property being damaged or threatened, or by being told to evacuate.[11]

Figure 1.2 shows that 10 per cent of Australians reported being directly threatened by the fires. About 1.8 million people were forced to evacuate their homes.[12]

1.3 The bushfires caused dangerously poor air quality for prolonged periods

As fires burned across NSW, the ACT, South Australia and Victoria, many people were exposed to the smoke that rose, drifted, and blanketed towns and cities. The bushfire smoke caused air pollution to be many times the 'hazardous' levels. About 11 million Australians

Figure 1.2: Three-in-five Australians were affected by bushfire smoke last summer
Proportion of Australian adults



Source: Biddle et al (2020, p. 5).

7. Bureau of Meteorology (2019b).
8. Ibid (p. 25).
9. Bureau of Meteorology (2020b, p. 9).
10. Boer et al (2020). This figure excludes the fires in Tasmania.
11. Biddle et al (2020, p. 5).
12. Ibid (p. 5).

reported some exposure to smoke caused by the 2019-20 bushfires (Figure 1.2).[13]

Bushfire smoke is made up of a complex mix of particles and gases. This includes particles less than 2.5 micrometres in diameter ('particulate matter', known as $PM_{2.5}$) – about 30 times thinner than a human hair.[14]

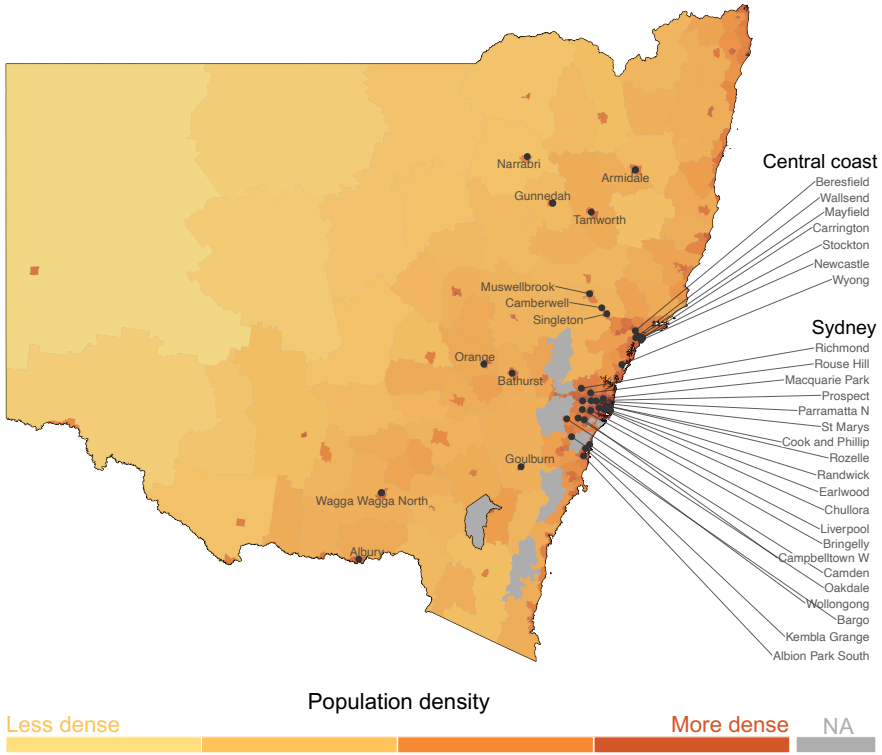
The micrograms of these small particles per cubic metre of air – $PM_{2.5}\mu g/m^3$ – is the key measurement to monitor air quality related to bushfires.[15]

While there is no safe level of $PM_{2.5}$ exposure, the World Health Organisation[16] and Australian National Air Quality Standards[17] set the 'safe' threshold at 25 $PM_{2.5}\mu g/m^3$ on average over 24 hours.

The distribution of air quality monitors to measure $PM_{2.5}$ varies between states. For example, the Victorian Environmental Protection Agency (EPA) locates most of its air quality monitors in Melbourne and its surrounds, and in the Latrobe Valley.[18]

The NSW Department of Planning, Industry and Environment monitors air quality through 17 monitors in Sydney and its surrounds, and the rest in major towns such as Bathurst, Goulburn, Singleton, Tamworth, and Wagga Wagga (as Figure 1.3 shows). There is no $PM_{2.5}$ monitoring in the state's west, where population density is low.

Figure 1.3: Air quality stations monitoring $PM_{2.5}$ in NSW
Air quality monitors and population density



Sources: Grattan analysis of NSW DPIE (2020); ABS (2020).

13. Ibid (p. 5).
14. United States Environmental Agency (2018).
15. Particulate matter is predominately made up of mineral dust, water, black carbon, sodium chloride, sulphate, ammonia, and nitrates: World Health Organisation (2018). The toxicity of $PM_{2.5}$ from bushfire smoke can vary dramatically and will depend on what materials are being burnt: Johnston et al (2019).
16. World Health Organisation (2018).
17. *National Environment Protection (Ambient Air Quality) Measure* (2016, Schedule 2, Table 1).
18. EPA Victoria (2020).

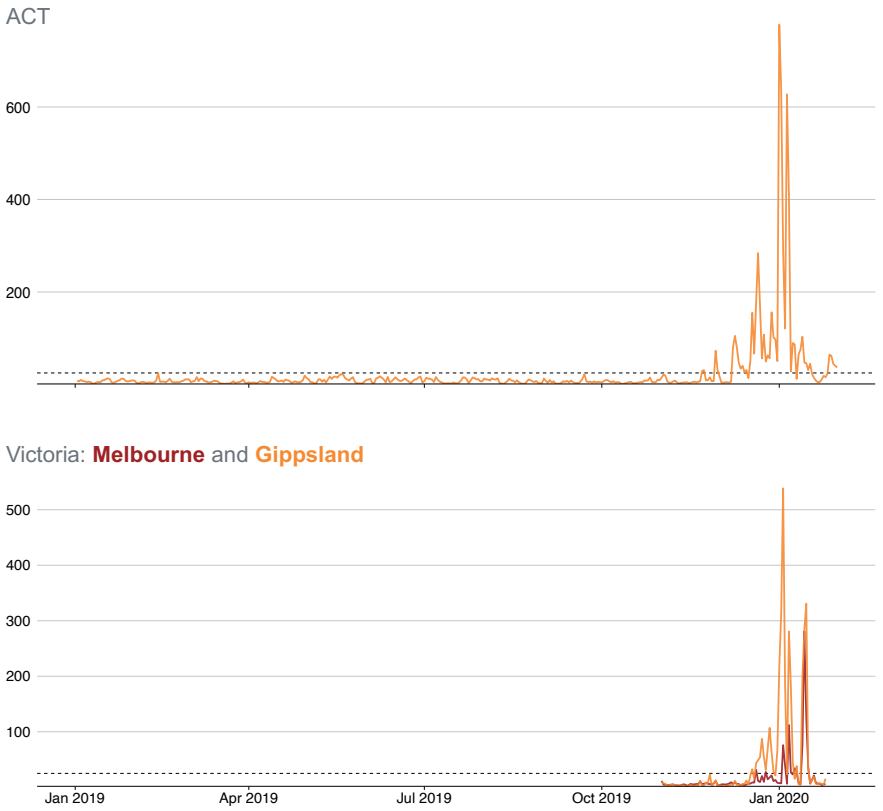
Across south-eastern Australia, air quality monitors recorded very high levels of $PM_{2.5}$. The ACT was reported to have the worst air quality in the world at the start of January (Figure 1.4).[19]

Victoria also had bad air pollution, particularly in January 2020. In Melbourne, $PM_{2.5}$ levels reached over 300. This was even worse for the bushfire affected region of Gippsland, which reached $PM_{2.5}$ levels over 500 (see Figure 1.4).

Many regions in NSW were badly affected for prolonged periods. Figure 1.5 and Figure 1.6 show that there were high levels of $PM_{2.5}$ in Sydney and regional NSW from October 2019 to February 2020. The $PM_{2.5}$ levels in Sydney during the 2019-20 bushfire season spiked to extremely high levels; with the hourly readings reaching up to 600 and 800 for parts of the city (see Figure 1.5). And parts of regional NSW had significantly worse readings (see Figure 1.6). For example, Goulburn's hourly reading at one point in early 2020 went over $PM_{2.5}$ levels of 2,000.

Both Figure 1.5 and Figure 1.6 also show the NSW air quality categories for different $PM_{2.5}$ levels (see also Figure 2.1). The 'hazardous' level of $PM_{2.5}$ in NSW is 50 $\mu g/m^3$. Numerous days last summer were above the 'hazardous' level. Some days peaked at 10-to-14 times the 'hazardous' level.

Figure 1.4: Air pollution from the bushfires was many times the 'safe' level in the ACT and Victoria
$PM_{2.5}$ levels, 2019-20; 'safe' threshold shown as dotted line



Source: Grattan analysis of ACT and Victorian air quality data.

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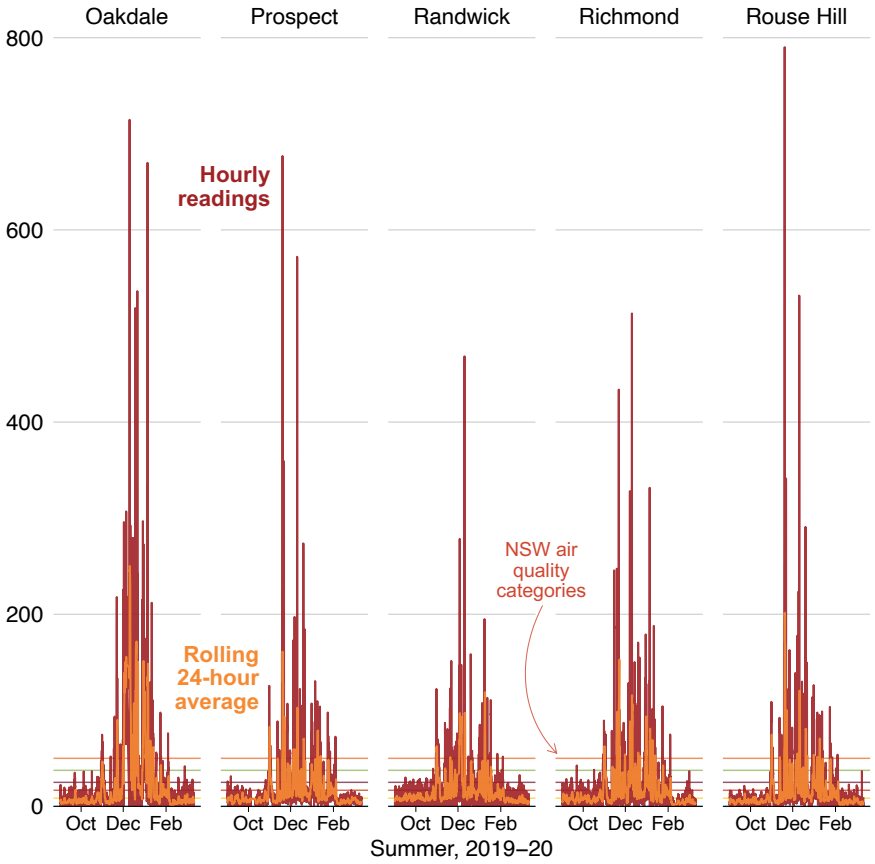
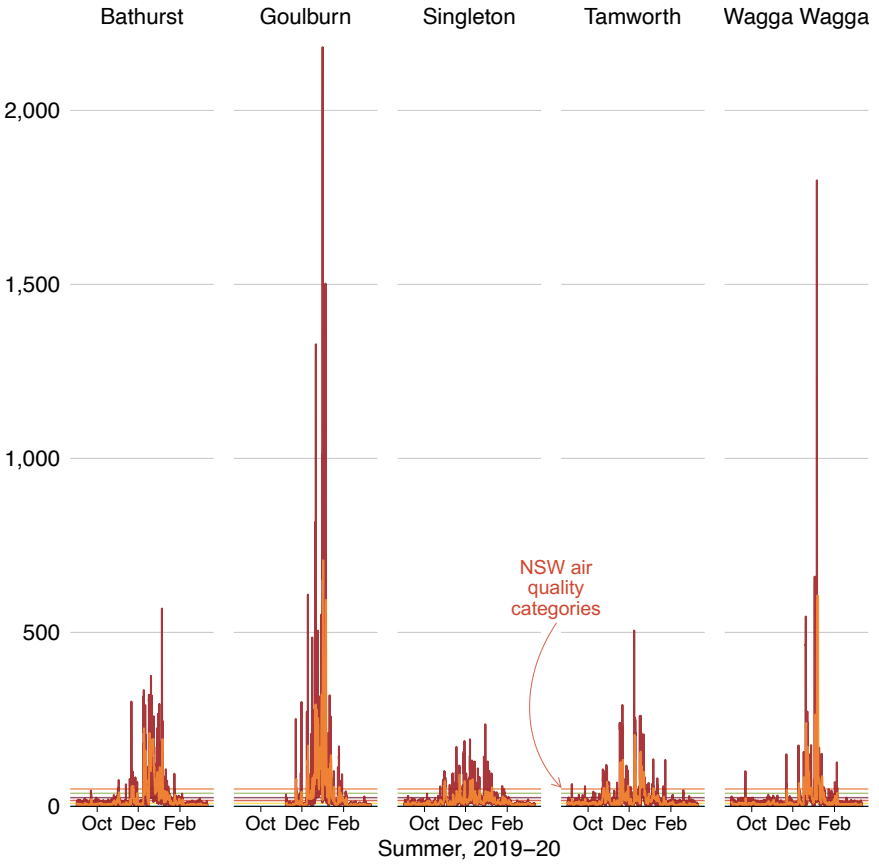
19. Remeikis (2020).

Figure 1.5: Air pollution was many times the 'hazardous' level in Sydney
$PM_{2.5}$ levels by hour and rolling 24-hour average



Source: Grattan analysis of NSW DPIE (2020).

Figure 1.6: Air pollution was even worse in some parts of regional NSW
$PM_{2.5}$levels by hour and rolling 24-hour average



Source: Grattan analysis of NSW DPIE (2020).

1.4 The bushfire smoke damaged people's physical health

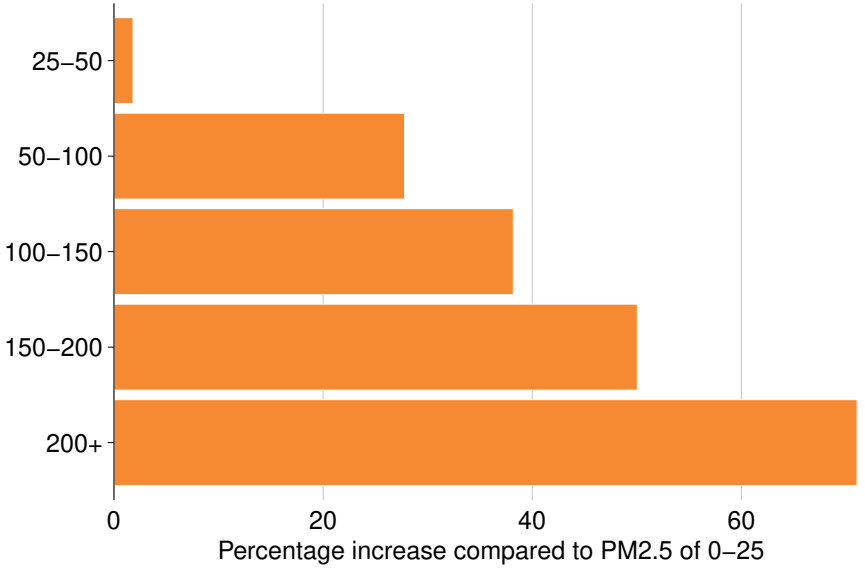
A NSW survey found that most people experienced at least one minor health symptom from bushfire smoke in December 2019 to January 2020.[20] People most commonly said they had suffered eye and throat irritation, coughing, headaches, and anxiety.

But inhaling particulate matter from bushfire smoke can also cause many serious health problems.[21] The link between respiratory issues and particulate matter is well established:[22] small particles can be inhaled deep into the lungs, causing difficulty breathing.

Victorian and ACT emergency department data show that the number of people going to hospital with respiratory problems increased significantly on days with poor air quality – by 27 per cent on days with $PM_{2.5}$ levels between 50 and 100, and by 70 per cent on days with $PM_{2.5}$ levels above 200 (compared to days with $PM_{2.5}$ levels below 25) (Figure 1.7). While emergency data from NSW was not available for this analysis, the effects are likely to have been similar.[23]

A recent study estimated that pollution from the bushfires caused 2,027 people to be admitted to hospital with respiratory problems, and 1,305 people to go to emergency departments with asthma-related conditions.[24] About 1,100 people were admitted to hospital with cardiovascular problems caused by the fires. And the bushfire smoke was responsible for 417 deaths.[25]

Figure 1.7: More people go to hospital for respiratory illness when $PM_{2.5}$ levels are high



Source: Grattan analysis of emergency department data from ACT Health and Victorian Department of Health and Human Services. The model controls for seasonal, day, temperature, and population effects.

20. FluTracking (2020).
21. See Reid et al (2016, table 1) for a critical review of the health impacts of exposure to bushfire smoke. The wide-ranging health problems exacerbated by particulate matter include respiratory, cardiovascular, Parkinson's disease, diabetes, phlebitis, thrombophlebitis, and thromboembolism: Wei et al (2019).
22. See, for example, Arriagada et al (2019), Rappold et al (2017), Broome et al (2016), Reid et al (2016), Dennekamp and Abramson (2011), Ana G. Rappold et al (2011) and Tham et al (2009).
23. Demand for health services due to poor air quality was also reported in NSW over the 2019-20 bushfire season: Nguyen and Bullen (2019) and Noyes (2020).
24. Arriagada et al (2020). This analysis covered the regions of NSW, Queensland, the ACT, and Victoria for which publicly available air quality monitoring data were available.
25. Ibid.

1.5 The bushfires damaged people's mental health

Bushfires destroy homes, livelihoods, and lives. People from affected communities suffer emotional distress, anxiety, and depression.[26]

About one-fifth of the people affected by the 2003 Canberra bushfires reported high to very-high levels of psychological distress three years later.[27]

The 2009 Black Saturday bushfires in Victoria, which killed 173 people and destroyed more than 2,000 homes,[28] also caused devastating and long-term mental health problems.[29] Three years after the fires, people in 'highly affected' communities – those in which people had died or properties had been damaged – were more than twice as likely to suffer from post-traumatic stress disorder (PTSD), depression, or severe distress than people in less-affected communities.[30] Although many people recovered, these communities still had higher rates of mental health problems than the general population five years later.[31] These mental health problems are worse for people who confront difficulties with insurance or rebuilding their properties.[32]

Firefighters on the front-line are even more likely to suffer mental health problems.[33] About 15 per cent of firefighters suffer PTSD after fighting a bushfire.[34] Alcohol abuse and domestic violence rates also increase.[35]

It's too early to know the full extent of the mental health consequences of the bushfires of 2019-20. But a January 2020 survey of 3000 Australians found that more than half (54 per cent) felt anxious or worried about the safety of themselves and others during the fires (see Figure 1.2).[36] This equates to many millions of people feeling an impact on their mental well-being – people living in both regional areas and cities.

A quarter of Indigenous Australians in Victoria and NSW live in areas that were affected by the bushfires.[37] And Indigenous Australians may feel the effects of bushfires differently to other Australians. The Yuin people from the south-coast of NSW, for example, fear that many sacred sites were damaged or destroyed in the 2019-20 bushfires.[38]

1.6 Climate change means more frequent, more intense, and longer-lasting bushfires

Bushfires have long been a part of Australian life. But a warming climate means longer heatwaves and less rainfall. These conditions mean there are more days of extreme fire risk, and larger and longer-lasting bushfires.

A study released in March 2020 found that human-caused climate change had made the 2019-20 bushfires 80 per cent more likely to happen.[39]

It found that if global temperatures continue to rise to 2^{o}C above pre-industrial levels, bushfires in Australia like those of 2019-20 will be about eight times more likely.[40]

26. Bryant et al (2018).
27. Camilleri et al (2010).
28. Victorian Bushfires Royal Commission (2009, p. 13).
29. Bryant et al (2018).
30. Bryant et al (2014).
31. Bryant et al (2018).
32. Ibid (pp. 547–549).
33. Beyond Blue Ltd (2018); and Aisbett and Nichols (2007).
34. Fullerton et al (2004, p. 1374).
35. Bryant et al (2018).
36. Biddle et al (2020, p. 5).
37. Williamson et al (2020).
38. Pickrell (2020); Perry and Hayman-Reber (2020)
39. Oldenborgh et al (2020, p. 26). The lower-bound estimate was 30 per cent. Both estimates are likely to 'severely underestimate' the attribution (p. 26) due to underestimations of the main heatwave inputs (p. 1).
40. Oldenborgh et al (ibid, p. 27). Lower bound is four times more likely.

As bushfires become more frequent and intense, they will affect more Australians more often.[41] People repeatedly exposed to bushfire smoke will be more likely to suffer serious health problems including stroke.[42]

Similarly, droughts and heatwaves are also likely to be more frequent and intense as a result of climate change.[43]

Australia faces an increased risk of natural disasters. Health authorities must be prepared and improve their response systems.

41. As discussed after the 2003 fires in Canberra: Hennessy et al (2005); and after the 2009 bushfires in Victoria: Booth (2009) and Garnaut (2011); and after the 2013 fires in NSW: Hennessy (2013).
42. Huang et al (2019); and Yuan et al (2019).
43. CSIRO and Bureau of Meteorology (2018).

2 Recommendations

Governments need to act now to minimise potentially even worse health impacts from natural disasters in the future.

Authorities should improve their communication to the public of health risks from exposure to bushfire smoke. Health departments should build more resilience in the healthcare system, so that bushfires and other natural disasters do not compromise healthcare. Governments also need to address the mental health problems people suffer as a result of natural disasters.

The actions of all states and territories need to be aligned through a national forum, and be integrated under a broader climate change response strategy.

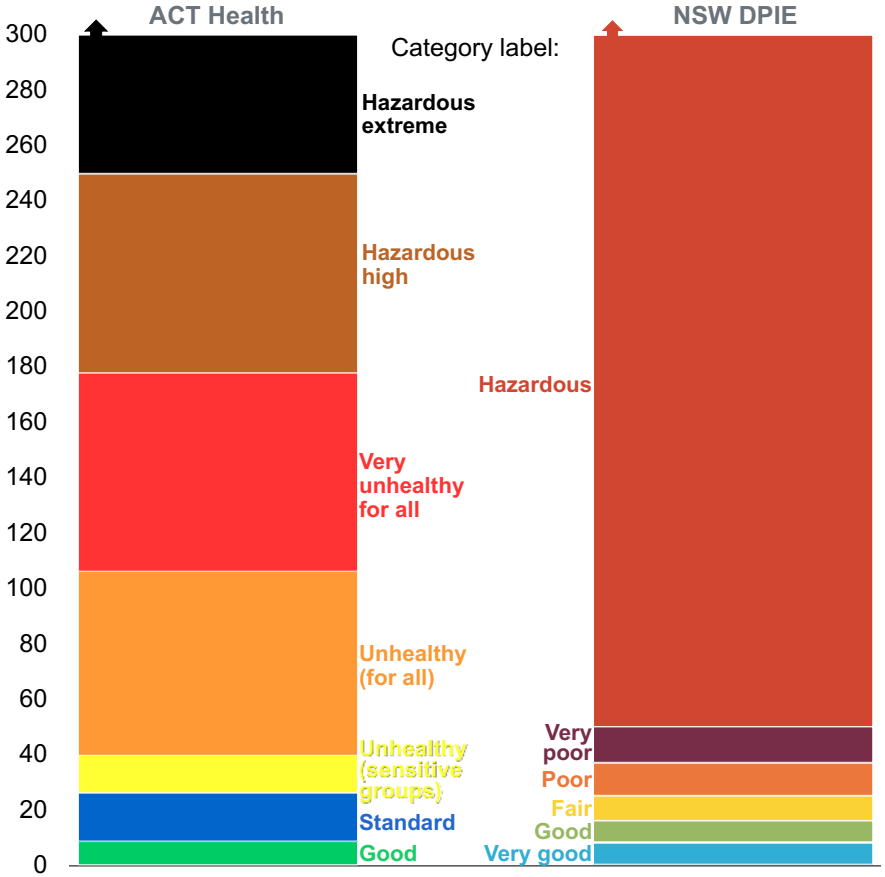
2.1 Make people more aware of the health risks from bushfire smoke

Governments must provide clearer, more detailed information that is easily available to the public when bushfire smoke causes high pollution. This should also be consistent across jurisdictions to avoid confusion.

At the moment there are inconsistencies. For example, Figure 2.1 shows that current classifications of air quality in NSW (right panel) do not distinguish between very high levels of $PM_{2.5}$. This means that the same advice is given to the public on days with $PM_{2.5}$ of 60 (as in Sydney at the start of last summer) and 200 (at the peak of the bushfire smoke haze).

The newly released categories from ACT Health (on the left panel of Figure 2.1) give people better information about the risks to health when pollution levels are high.

Figure 2.1: Air quality categories in the ACT and NSW are different
$PM_{2.5}\mu g/m^3$



Sources: ACT Health (2020); NSW DPIE (2020).

ACT Health's advice for each air quality category (see Figure 2.2) is also more detailed than other governments. For example, current advice for 'hazardous' days in NSW, provided on the DPIE website alongside air quality ratings, is: *'Sensitive groups should avoid all outdoor activities. Other adults should avoid strenuous outdoor activities.'*[44]

By contrast, ACT Health's advice for days of 'hazardous high' air quality is: *'Everyone should avoid all physical activity outdoors. Sensitive groups should temporarily relocate to a friend or relative living outside the affected area. If this is not possible, remain indoors and keep activity levels as low as possible.'*[45]

Governments should also develop health alert systems for bushfire smoke.[46] Health warning systems can reduce the number of people who get sick, by advising communities of imminent risks to their health and steps they can take to protect themselves.

Air quality alert systems should target at-risk people and provide practical information about how to minimise health risks.[47]

Air quality alert systems should also give people guidance on:

- How to minimise air pollution in the home during short- and long-exposure periods.[48]
- How to minimise exposure to air pollution if staying at home is not possible.[49]

Figure 2.2: From February 2020, ACT Health provided more detailed guidance for high air pollution days

Screenshot of the *ACT Health: Health advice for smoky air ($PM_{2.5}$)* website

Health advisory categories	$PM_{2.5}$ (24 hour) µg/m3	Potential health effects without following advice or actions	Cautionary health advice/actions**
Good	0-8.9	N/A – Below the relevant air quality standard	None
Meets air quality standard	9-25.9	N/A – Meets the relevant air quality standard	No tailored advice necessary
Unhealthy for sensitive groups	26-39.9	Symptoms may occur in sensitive groups	**Sensitive groups[1] should reduce prolonged or heavy physical activity. Where possible, these people in the community should also limit the time spent outdoors** Anyone with a heart or lung condition should take their medication as prescribed by their doctor. People with asthma should follow their asthma action plan. Anyone with concerns about their health should seek medical advice from their doctor. Anyone experiencing wheezing, chest tightness or difficulty breathing should seek urgent medical attention
Unhealthy for all	40-106.9	Increased likelihood of effects for sensitive groups Symptoms may occur in the general population	**Everyone should reduce prolonged or heavy physical activity** **Sensitive groups[1] should avoid prolonged or heavy physical activity altogether** Anyone with a heart or lung condition should take their medication as prescribed by their doctor. People with asthma should follow their asthma action plan. Anyone with concerns about their health should seek medical advice from their doctor. Anyone experiencing wheezing, chest tightness or difficulty breathing should seek urgent medical attention
Very unhealthy for all	107-177.9	Significant likelihood of effects for sensitive groups Symptoms among general population common	**Everyone should avoid prolonged or heavy physical activity** **Sensitive groups[1] should avoid all physical activity outdoors** Anyone with a heart or lung condition should take their medication as prescribed by their doctor. People with asthma should follow their asthma action plan. Anyone with concerns about their health should seek medical advice from their doctor. Anyone experiencing wheezing, chest tightness or difficulty breathing should seek medical attention
Hazardous high	>177.9	Serious likelihood of effects for sensitive groups Symptoms among general population very common	**Everyone should avoid all physical activity outdoors** **Sensitive groups[1] should temporarily relocate to a friend or relative living outside the affected area. If this is not possible, remain indoors and keep activity levels as low as possible** Anyone with a heart or lung condition should take their medication as prescribed by their doctor. People with asthma should follow their asthma action plan. Anyone with concerns about their health should seek medical advice from their doctor. Anyone experiencing wheezing, chest tightness or difficulty breathing should seek medical attention Anyone experiencing symptoms which may be due to smoke exposure should consider taking a break away from the smoky conditions
Hazardous extreme	> 250	Serious likelihood of effects for sensitive groups Symptoms among general population very common	**Cautionary health advice and actions are the same as for Hazardous high above**

Source: ACT Health (2020).

44. NSW DPIE (2020).
45. ACT Health (2020). Note that these instructions were updated in February, after the worst cases of bushfire smoke.
46. For example, NSW's air pollution health alerts: NSW DPIE (2020).
47. Ibid.
48. Vardoulakis et al (2020).
49. Ibid.

- Appropriate actions for employers, schools, and other organisations to reduce people's exposure, including whether outdoor activity should be prohibited.

Health messages should be tailored for different at-risk groups. For example, messages for people with asthma should be different to messages for pregnant women.[50]

The alert could also be used to warn of air quality risks before planned hazard reduction burns, which have been shown to increase $PM_{2.5}$ significantly.[51]

2.2 Review health system preparedness for natural disasters

Health system planning needs to take into account the likelihood of more severe, frequent, and longer-lasting natural disasters due to climate change into the future.[52]

Health services need to plan for increased pressures on resources, workforce, infrastructure, and medication supply.[53] They should review public health funding and accountability policies to ensure they are sensitive to surges and the incremental costs of short periods of high demand.

Contingency plans should include escalation protocols that quickly mobilise additional healthcare workers from outside an affected region. These protocols should include ready-to-go contractual arrangements for general practitioners to work in local evacuation centres and hospitals with high demand.[54] This would help ensure that local healthcare services that are feeling the pressure get the additional support they need.

Governments should also review the resilience of their healthcare services to natural disasters such as bushfires, to ensure there are as few disruptions to services as possible. Disasters can damage healthcare infrastructure and interrupt supply chains, compromising services.

During the 2019-20 summer, Canberra Hospital's operations were affected by bushfire smoke that polluted the air inside parts of the hospital. Many elective surgeries were cancelled, and the MRI machines were affected.[55]

Australians' access to health services can also be disrupted during disasters if local services close. State emergency protocols should ensure affected people can get their prescribed medicines without requiring a new prescription.[56] The Federal Government should ensure the Pharmaceutical Benefits Scheme (PBS) is sufficiently flexible to allow for such protocols.

2.3 Review mental health support systems

Governments should review their mental health support systems to ensure they can respond appropriately to the increased risks of and from natural disasters. This should include both early intervention measures and a scaled response when a disaster does occur.

Primary Health Networks (PHNs) across Australia should review their mental health plans to ensure they address the increased risks from

50. Arriagada et al (2019); and Abdo et al (2019).
51. Broome et al (2016).
52. Fitzgerald et al (2019); CSIRO and Bureau of Meteorology (2018).
53. Rychetnik and Stewart (2019).
54. These contractual arrangements would authorise GPs to be paid as sessional Visiting Medical Officers during disasters, potentially covered under Health Program Grants made under Part IV of the Commonwealth's *Health Insurance Act 1973* and paid in lieu of fee-for-service payments.
55. SBS News (2020).
56. See for example NSW Health's special provision during the 2019-20 bushfires: NSW Health (2020).

climate change that are relevant to their local community. They should focus on building at-risk communities' resilience to natural disasters, including longer-term disasters such as drought. Research shows the value of community development models that involve mental health literacy training and social networking.[57] People hit by natural disasters need support from their friends, family, social networks, and community groups.[58]

Public health authorities should ensure that community mental health services are equipped to respond to disasters immediately, and to provide long-term support. This is particularly important for regional and rural communities that already have fewer mental health services per person than larger towns or cities.[59] PHNs should ensure they can boost mental health services if their local area is hit by a natural disaster.

2.4 Improve health response systems under a broader climate change and health agenda

Climate change is not only increasing the severity of bushfires (see Section 1.6), it is increasing the likelihood and intensity of other natural disasters such as heatwaves, droughts, and floods.[60]

The 2019-20 summer should prompt Australian governments and health authorities to better prepare for the increasing health risks presented by climate change. Governments should look to Victoria[61] and Queensland,[62] which have begun to consider the health risks from natural disasters under a broader climate change and health agenda.

57. Hart et al (2011).
58. Gibbs et al (2016).
59. National Rural Health Alliance (2017).
60. CSIRO and Bureau of Meteorology (2018).
61. Victorian Government (2019).
62. Queensland Government (2018).

2.5 Align government response systems to ensure a national approach

Governments and health authorities across Australia should better align their disaster planning and response systems.

Australia's current national health response to natural disasters is fragmented. For example, during the 2019-20 fires, there appeared to be limited collaboration between jurisdictions to manage the health impacts.

A national approach would help avoid inconsistent public messaging that may cause confusion.[63] For example, the inconsistent health risk ratings and messaging for bushfire smoke may have undermined the overall health advice last summer (see Section 2.1 and Figure 2.1).

Governments should establish a national climate change and health forum[64] that reports to Chief Health Officers.[65] This forum should include officials[66] from the Commonwealth and all states and territories.

A national climate and health forum should work to improve Australia's health response to natural disasters. Officials should meet regularly, share strategies, and encourage coordinated and consistent national action where appropriate.

63. The inconsistent public messaging between states and also between states and the Commonwealth in response to COVID-19 has caused confusion. The Australian Medical Association said the mixed messaging potentially contributed to an increased public health risk, see Keane (2020).
64. This should be a collaborative and open forum, that does not carry any specific responsibilities or authority. It should easily be able to bring in officials from all relevant fields.
65. This could be via the Australian Health Protection Principal Committee (AHPPC), which is Australia's committee for health emergencies. It is made up of all state and territory Chief Health Officers and is chaired by the Australian Chief Medical Officer.
66. It should be made up of middle-level managers who are directly involved with implementing climate change and health policies.

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