

Bushfire smoke and health:

Summary of the current evidence

Context

Many Australians are concerned about bushfire smoke and the impact air pollution has on their health. Bushfire smoke can affect air quality some distance away, as well as close to, a fire front, as seen during the 2019 and 2020 Australian bushfire season.

Bushfire smoke, like other forms of air pollution, includes gases and particulate matter. Particulate matter is a complex mixture of solid and liquid particles and is classified according to size:

- PM₁₀ – particles smaller than 10 microns in diameter. These contribute to visible smoke haze, can irritate the eyes, throat and lungs but are too large to enter the bloodstream.
- PM_{2.5} – particles smaller than 2.5 microns in diameter. These are too small to see and when breathed in, will penetrate deep into a person's lungs and enter the bloodstream.

Most PM_{2.5} is produced from combustion of fossil fuels and biomass (for example wood), while larger particles between 2.5 and 10 microns tend to be produced by mechanical processes such as wind erosion.

Although all air pollutants from bushfire smoke have the potential to affect health, there is good evidence that PM_{2.5} is the air pollutant of greatest concern. This is because it is present in high concentrations in smoke and because there is very strong evidence of its health effects.

The Global Burden of Disease Study has shown that outdoor PM_{2.5} is the most important environmental risk factor in Australia, responsible for 1.6 percent of the total burden of disease in 2017.

Evidence shows that the likelihood of an individual experiencing health effects as a result of exposure to PM_{2.5} depends on a number of factors. These include: the concentration of PM_{2.5} in air, the duration of exposure; the person's age and whether a person has existing medical conditions (particularly cardiorespiratory disease or asthma).

It is also acknowledged that while this document focusses on the evidence relating to the physical effects that may occur as a result of bushfires smoke, bushfires have much broader mental health and societal impacts.

Evidence of health effects from PM_{2.5} exposure

There has been a large amount of research to investigate the health effects of PM_{2.5}. This research has been conducted in many locations with a wide range of PM_{2.5} sources. Comprehensive reviews of this research have been carried out by the World Health Organization (WHO) and the United States Environmental Protection Agency (US EPA).

These reviews have found there is clear evidence that PM_{2.5} contributes to respiratory disease, heart disease and mortality. Long-term exposure to air pollution, and PM as a component of air pollution, has been causally associated with lung cancer. There is emerging evidence that PM_{2.5} may also have an effect on birth outcomes, although this evidence is inconsistent. *Inconsistent* means that while some studies have found associations with reduced birth weight and premature birth other studies have found no association or a negative association. This creates uncertainty about whether or not PM_{2.5} is truly having an effect. Given the number of studies that have been conducted, if there truly is an effect that effect is likely to be relatively small.

An important question about PM_{2.5} is whether the source of the smoke (for example, combustion of fossil fuels or combustion of wood) is related to its health effects. This question has been specifically addressed in the WHO and US EPA reviews. The conclusion of these reviews has been that the amount of PM_{2.5} in the air is the best indicator of its health effects. In particular the US EPA concluded, from its recent review of health effects of bushfire smoke, that the “scientific evidence does not indicate that particles generated from [bushfire] smoke are more, or less, toxic than particles emitted from other sources.”

Below is a brief summary of the evidence of specific health effects of PM_{2.5} from the small number of studies that have specifically investigated the effects of PM_{2.5} from bushfires. Due to the transient and infrequent exposure to smoke from bushfires these effects are generally acute. There is good evidence that long-term exposure to PM_{2.5} can cause other chronic conditions (as mentioned above) but there is currently limited evidence of the health effects of long-term exposure to smoke from bushfires.

Respiratory effects

- Evidence from several studies shows that PM_{2.5} from bushfires is associated with respiratory effects including exacerbations of asthma, emergency department attendances and hospital admissions.
- Short-term exposure to PM_{2.5} is associated with increased respiratory mortality. However, evidence of increased respiratory mortality from bushfire smoke is not consistent. Some studies have reported increased deaths but others have not. It is likely to be dependent on the intensity and duration of the smoke event.

Cardiovascular effects

- There is very good evidence that short-term exposure to PM_{2.5} in general worsens existing cardiovascular disease and increases cardio-vascular mortality, while long-term exposure accelerates the progression of disease and also increases mortality.
- Evidence from bushfire smoke is less clear. However, based on the detailed assessments to the WHO and US EPA, it is likely that PM_{2.5} from bushfires exacerbates cardiovascular disease. There is evidence from Australia and the US that bushfires are associated with an increased risk of out of hospital cardiac arrests.

Effects on maternal health and pregnancy outcomes

- There is emerging evidence that exposure to PM_{2.5} during pregnancy may be related to low birth weight and preterm birth but data from bushfire studies are limited.
- One study has shown an association between birth weight and PM_{2.5} from bushfires. This study found that average birthweight was reduced by 9 grams in babies whose mothers were exposed during the second trimester of pregnancy. Another recent study of bushfire PM_{2.5} found that average birth weight was reduced by 6 grams in babies whose mothers were exposed during the first trimester of pregnancy.

Carcinogenic effects

- Occupational exposure to smoke as a firefighter is classified as a possible (Class 2B) carcinogen by the International Agency for Research on Cancer (IARC). Firefighters are regularly exposed to bushfire smoke (seasonally and over their working career).
- There is no evidence of a cancer risk in the general community from exposure to bushfire smoke.

Conclusions on long-term health effects

Evidence shows that the risk of illness declines when PM_{2.5} levels fall, even after very long periods of exposure and Australia generally has very good air quality. Public exposure to smoke from bushfires, is typically infrequent and sporadic.

Therefore while there is potentially a small increase in the risk of certain health effects after a period of exposure, this is likely to be extremely low in the long term for most individuals. However, as there is limited information about the long-term implications of prolonged exposures, research is ongoing to better characterise these longer term health effects, particularly across groups at higher risk, such as those with chronic conditions, very young children, pregnant women and their babies.