

**INQUIRY INTO HEALTH IMPACTS OF EXPOSURE TO  
POOR LEVELS OF AIR QUALITY RESULTING FROM  
BUSHFIRES AND DROUGHT**

**Organisation:** Royal Australian and New Zealand College of Obstetricians and  
Gynaecologists (RANZCOG)

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# Submission

## NSW Legislative Council - Portfolio Committee 2: Health impacts of exposure to poor levels of air quality resulting from bushfires and drought

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Thank you for the opportunity for the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) to provide feedback in relation to the NSW Legislative Council, Portfolio Committee 2 on its inquiry into the health impacts of exposure to poor levels of air quality resulting from bushfires and drought.

RANZCOG is the lead standards body in women's health in Australia and New Zealand, with responsibility for postgraduate education, accreditation, recertification and the continuing professional development of practitioners in women's health, including both specialist obstetricians and gynaecologists, and GP obstetricians.

### INTRODUCTION

In this submission, we address the following items from the terms of reference:

- 1(a) The impact of at-risk groups including pregnant women and their children
- 1(c) The long-term impacts of exposure
- 1(d) The effectiveness of various protective materials and strategies to mitigate the health impacts of exposure.
- 2(a) Measurement, reporting and public awareness.
- 2(c) The ability to ensure the health of at risk groups

RANZCOG recognises that:

- The poor air quality experienced in NSW in 2019 occurred on a background of a trend to increasingly poor air quality over preceding years, particularly affecting the Hunter Valley and Western Sydney. The sources of air pollution in NSW include industry, coal fired power stations, and transport, as well as dust and wood smoke.<sup>1</sup>
- In 2019, exceptional events (bushfires, hazard reduction burns and dust storms) led to poor air quality on 127 days, compared with 50 days in 2018. Numerous air quality records were broken.<sup>2</sup>
- Further worsening of air quality in coming years is predicted, due to continued burning of fossil fuels, and the effects of climate change.<sup>3</sup>
- Health effects of air pollution have been observed at air quality levels well below current accepted standards.

In this submission, we have considered evidence related to background urban and industrial air pollution, as well as that related to extraordinary events such as bushfires and dust storms. The reasons for doing so are:

- There is an extensive body of literature on the reproductive health effects of exposure to urban air pollution, with relatively few studies specifically assessing outcomes to exposure to bushfires and dust. However, available evidence suggests that it is possible to cautiously extrapolate the evidence

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<sup>1</sup> Clean Air for NSW: 2018 Update. Doctors for the Environment Australia, 2019. <https://www.dea.org.au/wp-content/uploads/2019/02/Clean-Air-for-NSW-2018-Update-02-19.pdf>

<sup>2</sup> NSW Annual Air Quality Statement 2019. <https://www.environment.nsw.gov.au/topics/air/air-quality-statement>

<sup>3</sup> *Climate Change, Air Pollution and Health in Australia*, 2017. A. Dean, D. Green. UNSW Sydney, Grand Challenges, Sydney Australia.

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- surrounding the health effects of urban and industrial air pollution to bushfire exposure, and that particulate matter from bushfire smoke and dust storms is at least as toxic as industrial air pollution.<sup>4</sup>
- Background levels of air quality, pre and post exposure to events such as bushfires, will have a modifying effect on health outcomes.

## AIR POLLUTION AND PREGNANCY

### **Pregnant women are at relatively increased risk of the general health effects of air pollution.**

Physiological changes in pregnancy include a 40% increase in minute ventilation (the volume of air inhaled and exhaled in one minute) and a 50% increase in cardiac output. These changes have been shown to lead to increased blood concentrations of pollutants such as inhaled volatile organic compounds, and to increase the vulnerability of pregnant women to cardiorespiratory stressors. Other physiological changes in pregnancy that may increase the susceptibility of pregnant women to the effects of air pollution include alterations in immune system functioning and an increase in insulin resistance.<sup>5</sup>

On a population level, air pollution has been associated with reduced respiratory function, respiratory and cardiovascular disease, diabetes, dementia, and reduced cognitive function – as well as adverse pregnancy outcomes.<sup>6</sup>

### **There is clear evidence that air pollution leads to an increased incidence of a number of adverse pregnancy outcomes.**

A large body of evidence suggests that ozone and particulate matter exposures can each independently induce systemic inflammation and oxidative stress, and vascular endothelial injury, which are implicated in the aetiologies of pregnancy complications.<sup>4</sup> Adverse pregnancy outcomes that have been linked to chronic air pollution exposure include fetal growth restriction, preterm birth, hypertensive disorders of pregnancy including preeclampsia, gestational diabetes, congenital defects, and stillbirth. There are limited studies on the effects of short to medium term events such as that seen in NSW and the ACT this summer, but preterm birth and fetal growth restriction are consistent findings.<sup>7</sup> Air pollution has also been associated with reduced fertility and an increased risk of miscarriage.<sup>5</sup>

A few studies have looked specifically at pregnancy outcomes following exposure to smoke from wildfires:

- A Colorado study published in 2019 assessed exposure to fine particulate matter from bushfires in over 535,000 pregnancies, using birth registry data from 2007 to 2015. The study showed that exposure to wildfire smoke PM2.5 over the full gestation and during the second trimester was positively associated with pre-term birth, while exposure during the first trimester was associated with decreased birth weight. For a woman whose second trimester corresponds to peak wildfire season (June, July, and August) and whose exposure equals the Colorado average for the season, this translated to a 7.0% increased odds of pre-term birth. For each additional 1mcg/m3 exposure to wildfire smoke PM2.5 in the first trimester the study found a 5.7g decrease in average birthweight, as well as a 14.4% increase in gestational diabetes and 14.8% increase in gestational hypertension.<sup>8</sup> To put this into context, the PM2.5 average in Richmond (North West Sydney) for November, December and January 2019-2018 was 26.0 mcg/m3, compared to 7.8mcg/m3 over the same period the previous year.

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<sup>4</sup> Weidong W et al. Inflammatory health effects of indoor and outdoor particulate matter. J Allergy Clin Immunol. March 2018 Volume 141, Issue 3, Pages 833–844

<sup>5</sup> Koman P et al. Examining Joint Effects of Air Pollution Exposure and Social Determinants of Health in Defining “At-Risk” Populations Under the Clean Air Act: Susceptibility of Pregnant Women to Hypertensive Disorders of Pregnancy. World Med Health Policy. 2018 Mar; 10(1): 7-54.

<sup>6</sup> Paton-Walsh C et al. A Clean Air Plan for Sydney: An Overview of the Special Issue on Air Quality in New South Wales. Atmosphere 2019, 10(12), 774; <https://doi.org/10.3390/atmos10120774>

<sup>7</sup> Melody S et al. Maternal exposure to short-to medium-term outdoor air pollution and obstetric and neonatal outcomes: A systematic review. Environmental Pollution 244 (2019) 915e925

<sup>8</sup> Abdo M et al. Impact of Wildfire Smoke on Adverse Pregnancy Outcomes in Colorado, 2007–2015. Int. J. Environ. Res. Public Health 2019, 16, 3720; doi:10.3390/ijerph16193720

- An Australian study of 3612 women exposed to smoke from the Hazelwood Coal Mine Fire in 2014 found an increased likelihood of gestational diabetes, but it did not show an effect on birthweight or delivery gestation.<sup>9</sup>
- Babies exposed in utero to smoke from the 2003 southern California wildfires were found to have lower birth weights, overall and for the second and third trimesters specifically, compared to babies from the same region born before or more than 9 months after the fires.<sup>10</sup>
- Pregnant women exposed to very high levels of PM<sub>2.5</sub> from agricultural burning in the Brazilian Amazon had higher rates of low birthweight babies compared to those exposed to lower levels.<sup>11</sup>

### **Pregnancy complications related to air pollution exposure may have lifelong consequences.**

Pregnancy is a critical window during human development. Babies born premature, small for gestational age, and following pregnancies complicated by gestational hypertension or gestational diabetes, have an increased risk of chronic disease throughout the lifespan. For example, even babies classified as being born moderate to late preterm (32 to 36 weeks' gestation) have higher rates of academic underperformance, lower IQ and more respiratory health problems. In childhood, they often require more hospitalisation than term children for a variety of health problems, most commonly respiratory illnesses including asthma and respiratory infections. In adulthood, they need more treatment for hypertension and diabetes, have more psychiatric problems, require more economic assistance for health problems and have lower academic achievement.<sup>12</sup>

In the case of air pollution, there are additional factors at play. Black carbon particles have been identified on the fetal side of the human placenta, in concentrations that correlate with the mother's residential exposure to black carbon during pregnancy.<sup>13</sup> Polycyclic Aromatic Hydrocarbons (a pollutant arising from the combustion of fossil fuels and organic matter, and present in bushfire smoke) have been found in the cord blood of neonates, and their levels correlate with an increased likelihood of a depressed verbal IQ index.<sup>14</sup>

Animal studies have demonstrated that exposure to fine particulate matter affects embryonic development at a cellular level, resulting in abnormalities of organ structure and function (lungs, heart, kidneys, liver, brain), metabolic and immune dysfunction, and neurological and behavioural changes.<sup>15</sup>

In humans, epidemiological studies have linked prenatal and early life air pollution exposure to delayed mental and motor development, behavioural disorders such as ADHD and autism, childhood obesity and insulin resistance, impaired lung function and growth, increased incidences of respiratory infections and asthma, increased risk of childhood leukaemia, and a predisposition towards cardiovascular disease in later life.<sup>16</sup>

Mothers who develop hypertensive diseases of pregnancy are at increased long term risk of cardiovascular, neurological and renal disease in later life.<sup>5</sup> To some extent this is related to an underlying predisposition which

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<sup>9</sup> Shannon M et al. Maternal exposure to fine particulate matter from a large coal mine fire is associated with gestational diabetes mellitus: A prospective cohort study. <https://www.ncbi.nlm.nih.gov/pubmed/31831154#>

<sup>10</sup> Holstius DM, Reid CE, Jesdale BM, Morello-Frosch R. 2012. Birth weight following pregnancy during the 2003 Southern California wildfires. *Environ Health Perspect* 120 1340 1345, doi:10.1289/ehp.1104515

<sup>11</sup> Cândido da Silva AM, Moi GP, Mattos IE, Hacon Sde S. 2014. Low birth weight at term and the presence of fine particulate matter and carbon monoxide in the Brazilian Amazon: a population-based retrospective cohort study. *BMC Pregnancy Childbirth* 14 309, doi:10.1186/1471-2393-14-309

<sup>12</sup> Doyle L and Cheong J. Long term outcomes of preterm birth. *O&G magazine*. Vol. 21 No 1 | Autumn 2019 <https://www.ogmagazine.org.au/21/1-21/long-term-outcomes-of-preterm-birth/>

<sup>13</sup> Bove H et al. Ambient black carbon particles reach the fetal side of human placenta. *Nature Communications* 10, Article number: 3866 (2019)

<sup>14</sup> Jedrychowski, W.A., Perera, F.P., Camann, D. *et al.* Prenatal exposure to polycyclic aromatic hydrocarbons and cognitive dysfunction in children. *Environ Sci Pollut Res* **22**, 3631–3639 (2015). <https://doi.org/10.1007/s11356-014-3627-8>

<sup>15</sup> Wu G et al. Adverse organogenesis and predisposed long-term metabolic syndrome from prenatal exposure to fine particulate matter. *PNAS*. June 11, 2019, vol. 116, no. 24, 11590–11595

<sup>16</sup> Air pollution and child health: prescribing clean air. Summary. Geneva: World Health Organization; 2018 (WHO/CED/PHE/18.01). Licence: CC BY-NC-SA 3.0 IGO.

is unmasked by pregnancy, but the evidence suggests that the effects of individual risks are amplified by adverse pregnancy outcomes.<sup>17</sup>

### **Communication with pregnant women and their health providers about the dangers of exposure to smoke and air pollution.**

Specific information for pregnant women exposed to bushfire smoke over the summer 2019-2020 was limited. A statement from the Royal Australian and New Zealand College of Obstetricians and Gynaecologists discussed potential effects of bushfire smoke on pregnancy<sup>18</sup>, and an excellent article reviewing the evidence for bushfire smoke exposure in pregnancy by Prof Sarah Robertson and Assoc Prof Mary Louise Hull was published in The Conversation on 9/1/2020.<sup>19</sup> The NSW Government Health website states that pregnant women “may be more sensitive to the health effects of bushfire smoke” but does not provide further details.<sup>20</sup>

It is uncertain how much information about the health effects of poor air quality on pregnancy has reached the general public. RANZCOG considers that it is vital that women be informed of potential dangers and steps that they can take to protect themselves and their children. However, given that the steps that can be taken are essentially limited to staying indoors in a sealed environment, and avoiding other sources of air pollution, it is also important to avoid creating unnecessary anxiety. It should be recognised that, as an isolated variable, the adverse consequences of air pollution exposure in pregnancy are relatively minor for most women – less marked than the consequences of cigarette smoking in pregnancy, for example.

### **Exposure to poor air quality in pregnancy is primarily a public health issue.**

Although the additional risks to pregnancy from air pollution are relatively minor for an individual woman, the number of exposed pregnancies constitutes a significant public health issue.

Air pollution is also rarely an isolated variable. Women from lower socioeconomic backgrounds are more likely to be exposed to air pollution, as a result of factors such as residential locality and inadequate housing, and they are less likely to have the resources to limit exposure by behavioural changes. They are also more likely to suffer a chronic disease burden due to reduced access to nutritious food, higher rates of smoking, and psychosocial stressors. All of these factors are themselves risk factors for adverse pregnancy outcomes such as prematurity, gestational hypertension and low birth weight.<sup>5</sup> There is evidence that the hormonal and pro-inflammatory effects of psychosocial stress interact with chemical exposures in a synergistic fashion; women and children experiencing psychosocial stress are likely to be even more susceptible to the toxic effects of air pollution.<sup>21</sup>

Peak levels of psychosocial stressors, combined with acute exposure to high levels of air pollution, are likely to have occurred in women whose homes and communities were directly threatened by bushfires.

The most effective way to reduce exposure to air pollution is to limit the production and release of pollutants. Many regulatory and technological mechanisms are available to reduce air pollution at source; documents such as the 2016 Clean Air for NSW Consultation Paper<sup>22</sup>, and the summary article “A Clean Air Plan for Sydney: An Overview of the Special Issue on Air Quality in New South Wales”<sup>6</sup> provide extensive evidence based reviews of available mechanisms to reduce air pollution at source. Unfortunately, regulations to control emissions in Australia, and incentives to move to cleaner technologies, lag behind those of other developed countries.<sup>6</sup>

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<sup>17</sup> Arabin B and Baschat A. Pregnancy: An Underutilized Window of Opportunity to Improve Long-term Maternal and Infant Health—An Appeal for Continuous Family Care and Interdisciplinary Communication. *Front Pediatr*. 2017; 5: 69.

<sup>18</sup> <https://ranzcof.edu.au/news/statement-on-prolonged-exposure-to-bushfire-smoke>

<sup>19</sup> <https://theconversation.com/pregnant-women-should-take-extra-care-to-minimise-their-exposure-to-bushfire-smoke-129349>

<sup>20</sup> <https://www.health.nsw.gov.au/environment/air/Pages/faqs.aspx>

<sup>21</sup> Clougherty, Jane Ellen, & Kubzansky, Laura Diane. (2010). A framework for examining social stress and susceptibility to air pollution in respiratory health. *Ciência & Saúde Coletiva*, 15(4), 2059-2074.

<sup>22</sup> New South Wales Environmental Protection Agency. Clean Air for NSW: Consultation Paper; New South Wales Environmental Protection Agency: Sydney, Australia, 2016. <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Air/clean-air-for-nsw-consultation-paper-160415.pdf>

Regulatory and technological measures to improve air quality would also assist in reducing greenhouse gas emissions, and hence protect against longer term issues of air quality related to climate change.

Minimising the future impacts of exceptional events such as dust storms and bushfires hinges upon the development of strategies that allow Australia to mitigate and adapt to the effects of climate change.

Public protection from the effects of air pollution can also be achieved through urban design, urban greening projects and building standards aimed at improving ventilation and insulation in homes and public buildings.<sup>6</sup> These measures would also be expected to reduce exposure to extreme heat; another factor that contributes to adverse pregnancy outcomes<sup>23</sup>, and that is expected to worsen in coming decades.

Individuals can manage their exposure to air pollution by behavioural changes such as staying indoors during times of peak pollution, avoiding areas where pollution is concentrated, and avoiding sources of indoor air pollution. The majority of available masks are ineffective in protecting against air pollution, and may give a false sense of security.<sup>24</sup> Air purifiers may assist in To maximise the ability of people to protect themselves, education campaigns are required, together with effective systems to alert people about impending poor air quality events.<sup>6</sup>

Finally, given that a certain level of exposure to air pollution is unavoidable, women, health providers and policy makers should be aware that the long-term health effects of in utero air pollution exposure are highly modifiable. Protective interventions include:

- improving maternal and child nutrition and micronutrient intake and reduce obesity rates<sup>25</sup>
- amelioration of psychosocial stressors<sup>24</sup>
- contact with greenspace and natural settings<sup>26</sup>
- promotion of breastfeeding<sup>27</sup>
- measures to reduce further indoor and outdoor air pollution exposure, especially cigarette smoke
- targeted neurocognitive and behavioral screening in at risk populations of children with early cognitive and behavioural interventions<sup>28</sup>

## Conclusion

Unusually poor air quality this summer resulting from bushfires and drought has focussed attention on potential health effects. Protecting the Australian public, in general, and mothers, unborn children and babies, in particular, from all forms of air pollution is clearly a moral and economic imperative.

In 2005, the total health costs of emissions of common ambient air pollutants from all sources in the Sydney Greater Metropolitan Region were conservatively estimated to be between \$1 billion and \$8.4 billion per annum. The study used PM10 as the index pollutant, and considered only levels over a baseline of 7.5 mcg/m3. However, they stated that, if the health impacts of PM10 were estimated without a threshold, the costs increased to between \$1.66 billion and \$15.21 billion per annum. We note that air quality levels have deteriorated since 2005, that further evidence has emerged about the health effects of air pollution, particularly

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<sup>23</sup> Wang J et al. Exposure to Heat Wave During Pregnancy and Adverse Birth Outcomes An Exploration of Susceptible Windows. *Epidemiology* • Volume 30, Suppl 1, July 2019

<sup>24</sup> Huang, W.; Morawska, L. Face Masks Could Raise Pollution Risks; *Nature*. 2019 Oct;574(7776):29-30. doi: 10.1038/d41586-019-02938-1.

<sup>25</sup> Erickson A and Arbour L. Shared Pathoetiological Effects of Particulate Air Pollution and the Social Environment on Fetal-Placental Development. *Journal of Environmental and Public Health* Volume 2014, <http://dx.doi.org/10.1155/2014/901017>

<sup>26</sup> Urban green spaces and health. Copenhagen: WHO Regional Office for Europe, 2016.

<sup>27</sup> Zielinska MA, Hamulka J. Protective Effect of Breastfeeding on the Adverse Health Effects Induced by Air Pollution: Current Evidence and Possible Mechanisms. *Int J Environ Res Public Health*. 2019 Oct 29;16(21):4181. doi: 10.3390/ijerph16214181.

<sup>28</sup> Calderon-Garciduenas L et al. Air pollution and detrimental effects on children's brain. The need for a multidisciplinary approach to the issue complexity and challenges. *Front. Hum. Neurosci.*, 12 August 2014 <https://doi.org/10.3389/fnhum.2014.00613>

at sub-threshold levels, and that short and long-term effects of in-utero exposure were not included in the assessment.<sup>29</sup>

Some things are unquantifiable. The College urges the Senate to consider children in their own families, as well as children who are born into fragile situations where families struggle to provide a stable and healthy environment. Air pollution must be adequately addressed to avoid an increased lifetime risk of poor health, lack of opportunity to meet their full potential, and lack of opportunity to actively enjoy the natural environment for future generations.

RANZCOG recommends that:

- The effects of air pollution on pregnant women and their children are routinely considered in policy decisions around air quality and urban design.
- Additional resources are directed towards research into the effects of the exposure of pregnant women to poor air quality, and into rolling out public health measures designed to protect women and their children from the impacts of poor air quality.
- Evidence-based action to improve air quality be accorded priority status by the NSW Government.

Yours sincerely,

Dr Vijay Roach  
**President**

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<sup>29</sup> Department of Environment and Conservation NSW. Air Pollution Economics: Health Costs of Air Pollution in the Greater Sydney Metropolitan Region, 2005. <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Air/air-pollution-economics-health-costs-greater-sydney-metropolitan-region-050623.pdf>