

Overview of the effects of wildfire smoke exposure in pregnancy

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Editor's note: The wildfire in Maui and those continuing in Canada and elsewhere in the United States are noted at the time this commentary went to press. Healthcare providers must remain cognizant of concerns for pregnant individuals and counseling recommendations.

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Having worked exclusively in the Philadelphia region, I was privileged to never think personally or professionally about outdoor air quality when counseling patients. This summer, after 18 years in the nursing profession, I encountered a patient question I was not prepared to answer: "How can I protect myself and my baby from the air? I'm not sure if my air conditioner has a filter, and air is coming in through the cracks around the window."

As we all saw in the news, areas of the Midwest and Northeast experienced wildfire smoke from Canada for several months negatively impacting air quality and affecting personal decision making about daily life, in-



cluding time spent outdoors, indoor air filtration, and outdoor mask usage. Being a women's health nurse practitioner (WHNP), part of my job is counseling women on reducing exposure to toxic substances, but I found myself lacking any evidence-based information on the potential effect of wildfire smoke exposure during pregnancy. With climate change affecting our collective experience and bringing up new health concerns, it is a priority for WHNPs to provide evidence-based counseling to our patients and let them know of the limitations and gaps in current research.

Wildfire smoke is known to increase air pollutants, including carbon monoxide, particulate matter, and volatile organic compounds. Higher levels of heavy metals, namely lead and mercury, and polycyclic aromatic hydrocarbons are found in wildfire smoke, as well as a combination of additional chemicals such as industrial solvents and flame retardants.^{1,2} The largest impact on air quality and adverse health effects from wildfire smoke is the particulate matter under PM_{2.5} (or 2.5 μm), which can travel deep into the respiratory system, enter the bloodstream, and potentially transfer across the placenta. PM_{2.5} from wildfire smoke is believed to be more toxic than ambient particulate matter based on information from animal studies.^{2,3} Known adverse health effects of exposure to wildfire smoke include exacerbation of asthma and chronic obstructive pulmonary disease, bronchitis, ischemic vascular disease, and increased all-cause mortality.^{1,3,4} Studies on wildfire smoke exposure in nonpregnant adults show an increase in clotting cascade proteins and factors, fibrin D-dimer, and plasma fibrinogen, suggesting an effect on blood coagulability.² Hypothesized mechanisms of these adverse health effects include increased free radicals and oxidative stress, increased inflammation, and cellular dysfunction resulting from exposure to and inhalation of wildfire smoke.²

Pregnant individuals are potentially more vulnerable to the adverse health effects of exposure to wildfire smoke due to the physiologic respiratory and cardiovascular changes of pregnancy, including increased tidal volume and minute ventilation, increased cardiac output, as well as increased coagulability.^{1,2,5} Wildfire smoke is known to increase the presence of proinflammatory mediators, including interleukin-6, interleukin-8, and C-reactive protein, which are associated with spontaneous preterm birth.² One study determined an increase in fetal Hofbauer cells, which are associated with inflammation, in placentas of pregnancies that were exposed to wildfire

smoke.⁶ However, only placentas from exposed pregnancies were biopsied, leaving the data with low power.⁶

High-quality studies are lacking on the association of wildfire smoke exposure on adverse pregnancy outcomes. A 2021 systematic review analyzed eight studies on wildfire smoke exposure and pregnancy outcomes, specifically birth weight, preterm birth, small-for-gestational-age infants, and infant mortality/fetal loss.¹ The authors found an association between decreased birth weight and wildfire smoke exposure, with the strongest correlation in second- and third-trimester exposures, but there was no substantial association with small-for-gestational-age infants.¹ There is low-quality evidence of an association between wildfire smoke exposure and preterm birth. A review of over 2 million charts of wildfire smoke exposure in pregnancy found no statistically significant increase in hypertensive disorders of pregnancy but increased odds of spontaneous preterm birth, which increased with each day of exposure.⁷ A 2019 study found an association between first-trimester wildfire smoke exposure and decreased birth weight, but no significant association in the second or third trimesters.⁴ This study also found an increase in gestational diabetes and gestational hypertension, especially with first-trimester exposure.⁴ Overall, per the 2021 systematic review, available evidence to date is of low to very low quality.¹

According to the Centers for Disease Control and Prevention, and the American College of Obstetricians and Gynecologists, the adverse effects of climate change, which include air pollution and wildfire smoke, disproportionately affect certain groups including children, the elderly, people of color, and individuals in lower socioeconomic groups.^{8,9} Factors that affect the vulnerability of some populations include systemic racism, housing quality, access to green space and tree cover, access to air filtration and high-quality masks, and exposure due to outdoor work environments.^{2,8,10} Given that I currently work in an ob/gyn clinic for an underserved population, most if not all of my patients are in a vulnerable category aside from their pregnancy status.

Based on the information available to me, I began counseling pregnant patients about potential adverse pregnancy effects and how they could reduce exposure to wildfire smoke. I explained the Air Quality Index (AQI) and how they could monitor levels at websites such as www.airnow.gov, which is the CDC recommended source for air quality information.¹² We discussed following instructions for “sensitive groups” when looking at the level of concern and AQI color. On days in the clinic when the AQI was greater than 100, I advised my patients to stay

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inside with doors and windows closed, and if feasible, update to high-efficiency air filters in home HVAC systems. We discussed investing in an air filtration system or portable air filter, as well as affordable high-quality masks, such as KN95s and KF94s, and accessing discounts by buying in bulk with family and friends. Further, the CDC website provides instructions from the United States Environmental Protection Agency on making a clean room in their home and how to make a low-cost air cleaner.¹¹⁻¹³ Patients should be counseled that they may need to seek shelter if their home becomes too hot or there is a power outage.¹³ If designated air shelters are not available, patients can consider temporary options during the day for no cost, such as public libraries.

More research is needed to establish an evidence base for the effects of wildfire smoke in pregnancy to properly counsel our patients in this new era in which the effects of climate change are intensifying and hitting closer to home. WHNPs need to advocate for an increase in public health initiatives to reduce the disparities for the most vulnerable populations, including high-quality home air filtration, air shelters, and increased access to high-quality masks. As climate change continues to affect our personal and professional lives, WHNPs must continue to educate themselves on the impact this has on patients’ lives and update our counseling to help improve patient outcomes. ■

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