Research Review of Air Pollution and Fetal Development

By: Kandyce Dunlap

What is air pollution?

Air pollution is the release of pollutants into the air that are harmful to human health and the environment. The Clean Air Act authorizes the Environmental Protection Agency (EPA) to protect public health by regulating the emissions of harmful air pollutants. The six most common air pollutants, referred to as criteria air pollutants, include particulate matter (PM2.5 and PM10), ozone, carbon monoxide, sulfur oxides, nitrogen oxides and lead. The EPA regulates emissions of the criteria air pollutants due to the harmful effects on human health and the environment.

Air pollution can be emitted from mobile sources, stationary sources and natural sources. Mobile sources travel from one area to another and can include cars, trucks, planes and trains. Stationary sources such as power plants, industrial facilities and oil refineries do not physically move, however wind can promote the travel of stationary source emissions from one area to another. Natural pollution sources include wildfires, volcanoes and wind-blown dust from agricultural fields.

Harm to Human Health

Air pollution is known to cause harm in adults, children and older adults. Health outcomes such as asthma, chronic obstructive pulmonary disease, chronic lower respiratory diseases, heart disease and diabetes are further compounded by air pollution (American Lung Association, 2018). More recently, research has suggested that the effects of air pollution can cross the mother-fetus blood barrier to hinder the development of unborn children and cause adverse pregnancy outcomes such as preterm birth, stillbirth, low birth weight and birth defects (Ha et al., 2018).
Effect on Fetal Development

Fetuses can experience lower weight, shorter length and smaller head circumferences from criteria air pollutants. Pollutants such as particulate matter and nitrogen oxides have been linked to lower birth weight, smaller head circumferences and shorter femur length – a measure of gestational length. Even in concentrations below the Clean Air Act criteria pollutant regulations, there is still an association between decreased fetal growth and air pollutants (Chen, Guo, Abramson, Williams, & Li, 2017; Malmqvist et al., 2016).

The length of pregnancy and risk of stillbirth have also been associated with certain air pollutants. Chronic exposure to high levels of ozone is associated with a 12 percent increased risk of pregnancy loss (Ha et al., 2018). Chronic exposure to high concentrations of fine particulate matter (PM2.5) is associated with a 13 percent increased risk of pregnancy loss (Ha et al., 2018). Preterm birth, delivery on or before 37 weeks of gestation, has been associated with air pollutants such as sulphur dioxide, ozone, nitrogen dioxide and coarse particulate matter (PM10) (Jacobs et al., 2017). Preterm birth can lead to underdevelopment of key organs such as the heart and lungs (Smith, Mckay, Van Asperen, Selvadurai, & Fitzgerald, 2009). Women exposed to sulphur dioxide during pregnancy were 1.1 times more likely to experience loss of pregnancy (Chen et al., 2017; Li, Guo, & Williams, 2016; Yang et al., 2018). Stillbirth is the birth of an infant that has died in the womb. Research suggests that exposure to certain pollutants such as PM2.5, PM10, nitrogen dioxide, sulphur dioxide and carbon monoxide have a significant association with increased risk of stillbirth, specifically with exposure to such pollutants in the third trimester of pregnancy (Yang et al., 2018).

Air pollution can affect the breathing and lungs of newborn babies. Infants born with respiratory complications are at a higher risk of developing asthma and other respiratory diseases during childhood (Korten, Ramsey, & Latzin, 2017; Latzin, Röösli, Huss, Kuehni, & Frey, 2009; Matera Veras, De, Alves, Fajersztajn, & Saldiva, 2017; Seeni et al., 2018). Transient tachypnea (TTN) is a condition where babies experience rapid, short breathing soon after being born and is an indication of poor lung development. Research has shown that exposure to PM2.5 and carbon monoxide over the whole pregnancy increased the risk of TTN by 17 percent and 10 percent, respectively (Seeni et al., 2018). Exposure to pollutants such as nitrogen oxides and ozone increased the risk of a baby being in respiratory distress upon birth by approximately 30 percent (Seeni et al., 2018).
Critical Stages of Pregnancy

Though pregnant women should be aware of air pollution during all stages of pregnancy, research indicates that the most critical stages for fetal development and exposure to air pollution are the second and third trimesters, weeks 13 through the end of pregnancy. (Carvalho et al., 2016; Clemens, Turner, & Dibben, 2017; Kumar Lamichhane et al., 2017; Malmqvist et al., 2016; Van Den Hooven et al., 2012; Wu et al., 2018). Pregnant women can check their air quality index (AQI) at AirNow.gov to understand their exposure and risk.

What is next?

Based on current research, we can conclude that maternal exposure to air pollution poses a threat to fetal development to include birth weight, length of pregnancy and overall fetal growth. We recommend that pregnant women pay particular attention to the AQI and limit outside exposure on days that the AQI reads orange and above. Precautionary measures to reducing air pollution exposure on poor air quality days can include limiting outside activities during summer months between 2 and 7 p.m. when ground level ozone is higher and ensuring that indoor air filters are changed every three months. On a broader scale, state and federal legislation can review current air quality emissions standards with special consideration given to pregnant women, children, those with respiratory diseases, older adults and other sensitive populations.

References


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