We have had hundreds of studies showing increased risk of just about every type of birth complication with air pollution, both PM2.5 and ozone; from minor to catastrophic; from premature birth to stillbirths. But this study below is the first we've seen that shows a connection also to risk of cerebral palsy.

It is in a highly respected journal, following 1.5 million pregnancies in Canada where the pollution levels are usually quite low. It found that for every 2.7 increase in PM2.5 exposure of the mother, the risk of cerebral palsy increased 12%. The new EPA annual standard is 9. That means air quality that meets that standard still increases the risk about 40%, and with a higher risk for baby boys than girls, typical of other environmental developmental neurotoxins.

Xinye Qiu, PhD[1]; Joel Schwartz, PhD[1,4]; Deshayne B. Fell, PhD[3,5,8,10]; Maryam Oskoui, MD, MSc[6,7]; Eric Lavigne, PhD[2,3,8]; Carmen Messerlian, PhD[1,4,9] *JAMA Netw Open.* 2024;7(7):e2420717. doi:10.1001/jamanetworkopen.2024.20717

Babies born within 3 km of an oil and gas drilling site had a lower birth weight than babies in the same area born before the drilling took place.

Willis M, et al. Associations between Residential Proximity to Oil and Gas Drilling and Term Birth Weight and Small-for-Gestational-Age Infants in Texas: A Difference-in-Differences Analysis. Environmental Health Perspectives, 2021; 129 (7): 077002 DOI: 10.1289/EHP7678

Wildfire smoke is associated with increased risk of low birth weight. 1 ug/m3 increase is associated with a 2.17 gram reduction in birth weight, and an increased risk of low birth weight of 3% and a 12% increased risk for very low birth weight.

Jiajianghui Li, Tianjia Guan, Qian Guo, Guannan Geng, Huiyu Wang, Fuyu Guo, Jiwei Li, Tao Xue. Exposure to landscape fire smoke reduced birthweight in low- and middle-income countries: findings from a siblings-matched case-control study. eLife, 2021; 10 DOI: 10.7554/eLife.69298

More evidence that air pollution increases the risk of preterm birth and miscarriage especially with exposure at the late stage of pregnancy.

Zhou W, et al. Association between Maternal Exposure to Ambient Air Pollution and the Risk of Preterm Birth: A Birth Cohort Study in Chongqing, China, 2015-2020. Int J Environ Res Public Health. 2022 Feb 15;19(4):2211. doi: 10.3390/ijerph19042211.

Yu Z, Zhang X, Zhang J, Feng Y, Zhang H, Wan Z, Xiao C, Zhang H, Wang Q, Huang C. Gestational exposure to ambient particulate matter and preterm birth: An updated systematic review and

meta-analysis. Environ Res. 2022 May 3:113381. doi: 10.1016/j.envres.2022.113381. Epub ahead of print. PMID: 35523275.

Zhou W, Ming X, Chen Q, Liu X, Yin P. The acute effect and lag effect analysis between exposures to ambient air pollutants and spontaneous abortion: a case-crossover study in China, 2017-2019. Environ Sci Pollut Res Int. 2022 May 6. doi: 10.1007/s11356-022-20379-8. Epub ahead of print. PMID: 35522417.

More evidence that air pollution causes systemic inflammation during pregnancy.

Zhang B, et al. Ambient PM2.5 exposures and systemic inflammation in women with early pregnancy.Sci Total Environ. 2022 Mar 14:154564. doi: 10.1016/j.scitotenv.2022.154564

Increased prenatal household air pollution exposure is associated with shorter telomere length at birth. Shorter TL at birth is associated with higher infant blood pressure. Pollution exposure in utero can affect cardiovascular health later in life.

Kaali S, et al. Prenatal Household Air Pollution Exposure, Cord Blood Mononuclear Cell Telomere Length and Age Four Blood Pressure: Evidence from a Ghanaian Pregnancy Cohort. Toxics. 2021 Jul 14;9(7):169. doi: 10.3390/toxics9070169. PMID: 34357912; PMCID: PMC8309911.

Sulfer dioxide, one of the component parts of air pollution in our valley, has been found to be associated with neural tube defects during the first month after conception.

Zhang JY, Dai HX, Wu QJ, Li J, Huang YH, Chen ZJ, Li LL, Chen YL, Liu S, Jiang CZ. Maternal exposure to ambient levels of sulfur dioxide and risk of neural tube defects in 14 cities in Liaoning province, China: a population-based case-control study. J Expo Sci Environ Epidemiol. 2020 Oct 1. doi: 10.1038/s41370-020-00273-6. Online ahead of print. PMID: 33005007

Exposure to traffic related air pollution during pregnancy increases the levels of pro-inflammatory chemicals like cytokines in cord blood, suggesting an impairment of immune function later in life.

García-Serna AM, et al. NELA Study Group. Cytokine profiles in cord blood in relation to prenatal traffic-related air pollution: The NELA cohort. Pediatr Allergy Immunol. 2022 Feb;33(2):e13732. doi: 10.1111/pai.13732. PMID: 35212052

In a first ever study, the prenatal/preconception pollution exposure of fathers was associated with lower birth weights.

Payne-Sturges DC, Puett R, Cory-Slechta DA. Both parents matter: a national-scale analysis of parental race/ethnicity, disparities in prenatal PM2.5 exposures and related impacts on birth outcomes. Environ Health. 2022 May 6;21(1):47. doi: 10.1186/s12940-022-00856-w. PMID: 35513869.

Another study that shows prenatal exposure affects lung disease vulnerability and rates of childhood asthma.

Wright R, et al. Prenatal Ambient Ultrafine Particle Exposure and Childhood Asthma in the Northeastern United States. American Journal of Respiratory and Critical Care Medicine, 2021; DOI: 10.1164/rccm.202010-3743OC

This is one of the first studies that shows prenatal exposure to air pollution critically impairs the production of thyroid hormones.

Irizar A, et al. Association between prenatal exposure to air pollutants and newborn thyroxine (T4) levels. Environmental Research, 2021; 197: 111132 DOI: 10.1016/j.envres.2021.111132

Several new studies add to the evidence that air pollution increases the risk of pregnancy complications and poor outcomes, and impaired fetal development

Tran K, et al. Residential Proximity to Oil and Gas Development and Birth Outcomes in California: A Retrospective Cohort Study of 2006–2015 Births. Environmental Health Perspectives, 2020; 128 (6): 067001 DOI: 10.1289/EHP5842

Sarizadeh R, Dastoorpoor M, Goudarzi G, Simbar M. The Association Between Air Pollution and Low Birth Weight and Preterm Labor in Ahvaz, Iran.

Int J Womens Health. 2020 May 4;12:313-325. doi: 10.2147/IJWH.S227049. eCollection 2020. PMID: 32440227 [Pub

Fong KC, Shi L, Papatheodorou S, Di Q, Just A, Kosheleva A, Messerlian C, Schwartz JD. Prenatal exposure to particulate air pollution and gestational age at delivery in Massachusetts neonates 2001-2015: A perspective of causal modeling and health disparities. Environ Epidemiol. 2020 Sep 14;4(5):e113. doi: 10.1097/EE9.0000000000000113. eCollection 2020 Oct.

PMID: 33154990 Free PMC article.

Zanini MJ, et al. Urban-Related Environmental Exposures during Pregnancy and Placental Development and Preeclampsia: a Review. Curr Hypertens Rep. 2020 Sep 3;22(10):81. doi: 10.1007/s11906-020-01088-4.

PMID: 32880755 Review

Air pollution exposure to a pregnant mother during the first trimester, PM2.5 of 6.5 ug/m3, was associated with a 17% increased risk of the baby having autism, but only in boys.

Jo H, et al. Sex-specific associations of autism spectrum disorder with residential air pollution exposure in a large Southern California pregnancy cohort. Environmental Pollution, Volume 254, Part A, November 2019, 113010

This study strengthens the evidence that air pollution is a significant risk factor for pre-term birth.

Zhang X, et al. Maternal PM_{2.5} exposure triggers preterm birth: a cross-sectional study in Wuhan, China. Glob Health Res Policy. 2020 May 1;5:17. doi: 10.1186/s41256-020-00144-5. eCollection 2020.

Prenatal air pollution increases the risk of reproductive birth defects.

Sun X, et al. Prenatal exposure to residential PM_{2.5} and anogenital distance in infants at birth: A birth cohort study from Shanghai, China. Environ Pollut. 2020 Apr 27;264:114684. doi: 10.1016/j.envpol.2020.114684. [Epub ahead of print]

This meta-analysis strengthens the evidence that PM2.5 is associated with hypertensive disorders of pregnancy.

Sun M, et al. The correlation between PM_{2.5} exposure and hypertensive disorders in pregnancy: A Meta-analysis. Sci Total Environ. 2019 Nov 2;703:134985. doi: 10.1016/j.scitotenv.2019.134985. [Epub ahead of print]

More evidence that ozone, once thought to be a weaker toxin than particulate pollution, is associated with preterm birth and stillbirth.

Smith RB, et al. Impacts of air pollution and noise on risk of preterm birth and stillbirth in London. Environ Int. 2019 Nov 26;134:105290. doi: 10.1016/j.envint.2019.105290. [Epub ahead of print]

Air pollution changes the physical development of the brain in utero, including reducing the size of certain parts of the brain. In this study, the corpus callosum, the bridge between both hemispheres, was decreased in volume with more air pollution exposure of the pregnant mother. This abnormality is associated with behavioral disorders.

Mortamais M, et al. Effects of prenatal exposure to particulate matter air pollution on corpus callosum and behavioral problems in children. Environ Res. 2019 Sep 7;178:108734. doi: 10.1016/j.envres.2019.108734. [Epub ahead of print]

More evidence that air pollution, prenatal or during infancy, is associated with increased risk of autism.

Jo H, et al. Sex-specific associations of autism spectrum disorder with residential air pollution exposure in a large Southern California pregnancy cohort. Environ Pollut. 2019 Nov;254(Pt A):113010. doi: 10.1016/j.envpol.2019.113010. Epub 2019 Aug 5.

Another study showing that air pollution impairs thyroid function in pregnant mothers, which can, in turn, impair fetal brain development

Ghassabian A, et al. Association of Exposure to Ambient Air Pollution With Thyroid Function During Pregnancy. JAMA Netw Open. 2019 Oct 2;2(10):e1912902. doi: 10.1001/jamanetworkopen.2019.12902.

Even newborns exposed to more air pollution have higher blood pressure.

Madhloum N. et al.
Neonatal blood pressure in association with prenatal air pollution exposure, traffic, and land use indicators: An ENVIRONAGE birth cohort study.
Environ Int. 2019 Jun 18;130:104853. doi: 10.1016/j.envint.2019.05.047.
[Epub ahead of print]

The length of telomeres is a marker of aging at the molecular level. Here is another study showing that air pollution exposure during pregnancy was associated with shorter telomeres measured at the age of eight.

Clemente DBP, et al. Prenatal and Childhood Traffic-Related Air Pollution Exposure and Telomere Length in European Children: The HELIX Project. Environ Health Perspect. 2019 Aug;127(8):87001. doi: 10.1289/EHP4148. Epub 2019 Aug 8.

We have known for several years that the success rate of in vitro fertilization is decreased with more air pollution. This study shows that can be offset by supplemental folic acid.

Gaskins AJ, et al.
Exposure to Traffic-Related Air Pollution, Supplemental Folate Intake, and Live Birth Among Women Undergoing Assisted Reproduction. Am J Epidemiol. 2019 Jun 26. pii: kwz151. doi: 10.1093/aje/kwz151. [Epub ahead of print]

We have seen numerous studies showing that air pollution exposure early in life (in utero and infancy) can have lasting impacts on health, like heart and lung function, that don't show up for decades. This study shows early life exposure is even associated with higher rates of arthritis in adulthood, especially rheumatoid arthritis.

Shepherd A, et al. Arthritis diagnosis and early-life exposure to air pollution. Environ Pollut. 2019 Oct;253:1030-1037. doi: 10.1016/j.envpol.2019.07.054. Epub 2019 Jul 13.

We have known for several years that air pollution can harm the developing fetus in utero. We have even had substantial evidence that air pollution affects DNA

and gene integrity. But an alarming new study in lab mice starkly shows what air pollution can do to future generations, even if they are never exposed. In mice, merely "pre-conception" exposure to air pollution, and no exposure after conception, at a level only slightly above the EPA's 24 hour standard for PM2.5, was enough to cause impaired heart function, decreased heart muscle mass, activated an oxidative stress response and triggered systemic inflammation through genetic changes, later on adulthood. The moral to this story is powerful. Even future generations are harmed by the air pollution breathed by future parents.

Tanwar V, et al. Preconception Exposure to Fine Particulate Matter Leads to Cardiac Dysfunction in Adult Male Offspring. Journal of the American Heart Association, 2018; 7 (24) DOI: 10.1161/JAHA.118.010797

Prenatal exposure to air pollution has profound effect on fetal development. In this case prenatal exposure to cooking stove emissions resulted in decreased lung function and increased risk of pneumonia in infants.

Lee AG, et al. Prenatal Household Air Pollution is Associated with Impaired Infant Lung Function with Sex-Specific Effects: Evidence from GRAPHS, a Cluster Randomized Cookstove Intervention Trial. Am J Respir Crit Care Med. 2018 Sep 26. doi: 10.1164/rccm.201804-0694OC. [Epub ahead of print]

Proximity to heavily trafficked roads at the time of birth is associated with DNA damage and impaired cognition measured later in childhood.

Peng C, et al. Residential Proximity to Major Roadways at Birth, DNA Methylation at Birth and Midchildhood, and Childhood Cognitive Test Scores: Project Viva(Massachusetts, USA) First Published:18 September 2018097006https://doi.org/10.1289/EHP2034

More evidence that air pollution threatens the integrity of fetal development. This study was done at the University of Utah and showed that over an eight year period, our air pollution increased the risk of miscarriage by 16%.

Leiser CL, et al. Acute effects of air pollutants on spontaneous pregnancy loss: a case-crossover study. Fertility and Sterility, 2018; DOI: 10.1016/j.fertnstert.2018.10.028

More detail on how early life air pollution exposure affects the micro anatomy of the brain, i.e. decreases the number of neurons, alters the blood brain barrier and increases microhemorrhages, all of which were associated with impaired brain function in animals.

Woodward NC, et al. Prenatal and early life exposure to air pollution induced hippocampal vascular leakage and impaired neurogenesis in association with behavioral deficits. Transl Psychiatry. 2018 Nov 29;8(1):261. doi: 10.1038/s41398-018-0317-1.

Multiple new studies showing air pollution causing adverse pregnancy outcomes, including closer proximity to industrial pollution sources associated with low birth weight newborns.

Gong X et al. Associations between maternal residential proximity to air emissions from industrial facilities and low birth weight in Texas, USA. Environ Int. 2018 Aug 7;120:181-198. doi: 10.1016/j.envint.2018.07.045. [Epub ahead of print]

Wang L, et al. Association between early prenatal exposure to ambient air pollution and birth defects: evidence from newborns in Xi'an, China. J Public Health (Oxf). 2018 Aug 18. doi: 10.1093/pubmed/fdy137. [Epub ahead of print]

He T, et al. Ambient air pollution, H19/DMR methylation in cord blood and newborn size: A pilot study in Zhengzhou City, China. Chemosphere. 2018 Aug 30;212:863-871. doi: 10.1016/j.chemosphere.2018.08.140. [Epub ahead of print]

Barn P, et al. The effect of portable HEPA filter air cleaner use during pregnancy on fetal growth: The UGAAR randomized controlled trial. Environ Int. 2018 Sep 10. pii: S0160-4120(18)31141-3. doi: 10.1016/j.envint.2018.08.036. [Epub ahead of print]

Wang Q, et al. Identifying windows of susceptibility for maternal exposure to ambient air pollution and preterm birth. Environ Int. 2018 Sep 18;121(Pt 1):317-324. doi: 10.1016/j.envint.2018.09.021. [Epub ahead of print]

Liu WY, et al. Association between ambient air pollutants and preterm birth in Ningbo, China: a time-series study. BMC Pediatr. 2018 Sep 20;18(1):305. doi: 10.1186/s12887-018-1282-9.

Air pollution during pregnancy is associated with increased rates of obesity in childhood.

Kim JS, et al. Longitudinal associations of in utero and early life near-roadway air pollution with trajectories of childhood body mass index. Environ Health. 2018 Sep 14;17(1):64. doi: 10.1186/s12940-018-0409-7.

Babies born to mothers living near fracking operations are more likely to born prematurely, have low birth weight, and worse APGAR scores. Fracking chemicals are toxic to fetal development.

Shale gas development and infant health: Evidence from Pennsylvania.J Health Econ. 2018 Aug 13;61:134-150. doi: 10.1016/j.jhealeco.2018.07.004. [Epub ahead of print]

Infant mortality increases with air pollution. This study from Africa shows the same relationship between infant mortality and air pollution, and adult mortality–a 1% increase for every 1 ug/m3 in PM2.5, or about 22% of infant deaths.

Heft-Neal S. et al. Robust relationship between air quality and infant mortality in AfricaNature volume 559, pages254–258 (2018)

More evidence that air pollution causes pregnancy complications like pre-term births, hypertension of pregnancy, and the most severe complications–miscarriage and still births.

Li X, et al. Analysis of short-term and sub-chronic effects of ambient air pollution on preterm birth in central China. Environ Sci Pollut Res Int. 2018 May 2. doi: 10.1007/s11356-018-2061-8. [Epub ahead of print]

Casey JA, et al. Coal and oil power plant retirements in California associated with reduced preterm birth among populations nearby. American Journal of Epidemiology, kwy110, https://doi.org/10.1093/aje/kwy110 Published: 16 May 2018

Xue T, et al. Association Between Hypertensive Disorders in Pregnancy and Particulate Matter in the Contiguous United States, 1999-2004. Hypertension. 2018 May 21. pii: HYPERTENSIONAHA.118.11080. doi: 10.1161/HYPERTENSIONAHA.118.11080. [Epub ahead of print].

Grippo A, et al. Air pollution exposure during pregnancy and spontaneous abortion and stillbirth. Rev Environ Health. 2018 Jul 5. pii: /j/reveh.ahead-of-print/reveh-2017-0033/reveh-2017-0033.xml. doi: 10.1515/reveh-2017-0033. [Epub ahead of print]

Another study showing that decreased pollution improved fertility rates.

Casey JA, et al. Increase in fertility following coal and oil power plant retirements in California. Environ Health. 2018 May 2;17(1):44. doi: 10.1186/s12940-018-0388-8.

More evidence that air pollution causes an increased risk for the pregnancy complication known as preeclampsia.

Wang Q, et al. Effects of prenatal exposure to air pollution on preeclampsia in Shenzhen, China. Environ Pollut. 2018 Feb 18;237:18-27. doi: 10.1016/j.envpol.2018.02.010. [Epub ahead of print]

Air pollution exposure during pregnancy increases the risk of asthma after birth during childhood.

Lavigne É, Bélair MA, Rodriguez Duque D, Do MT, Stieb DM, Hystad P, van Donkelaar A, Martin RV, Crouse DL, Crighton E, Chen H, Burnett RT, Weichenthal S, Villeneuve PJ, To T, Brook JR, Johnson M, Cakmak S, Yasseen AS 3rd, Walker M. Effect modification of perinatal exposure to air pollution and childhood asthma incidence. Eur Respir J. 2018 Feb 1. pii: 1701884. doi: 10.1183/13993003.01884-2017.

The association between air pollution and still births continue to mount.

Yang S, Tan Y, Mei H, Wang F, Li N, Zhao J, Zhang Y, Qian Z, Chang JJ, Syberg KM, Peng A, Mei H, Zhang D, Zhang Y, Xu S, Li Y, Zheng T, Zhang B. Ambient air pollution the risk of stillbirth: A prospective birth cohort study in Wuhan, China. Int J Hyg Environ Health. 2018 Feb 5. pii: S1438-4639(17)30531-X. doi: 10.1016/j.ijheh.2018.01.014. [Epub ahead of print] PMID: 29422441 [PubMed – as supplied by publisher]

More research showing the relationship between air pollution and adverse birth outcomes. In the case of the study below, an analysis of over 1.3 million births in China showed not only higher rates of pre-term births with more air pollution, but the correlation was stronger the more premature the birth.

Wang YY, et al. Association of Long-term Exposure to Airborne Particulate Matter of 1 μm or Less With Preterm Birth in China. JAMA Pediatr. 2018 Jan 2:e174872. doi: 10.1001/jamapediatrics.2017.4872. [Epub ahead of print]

Air pollution exposure during the first trimester was associated with decreased weight of a pregnant mother's placenta.

Ghasemi-Tehrani H, et al. Effect of Exposure to Air Pollution on Placental Weight in Isfahan-Iran. J Family Reprod Health. 2017 Jun;11(2):90-96.

Shutting down a coal power plant was followed by an increase in birth weight of newborns downwind from the plant.

Yang M, et al. The Impact of Environmental Regulation on Fetal Health: Evidence from the Shutdown of a Coal-Fired Power Plant Located Upwind of New Jersey. Journal of Environmental Economics and Management, 2017; DOI: 10.1016/j.jeem.2017.11.005

Multiple studies have shown air pollution affects male sperm. The studies below add to that data base, including one that shows it reduces the y/x chromosome ratio in sperm which would result in a decrease in percentage of male newborns compared to females.

Radwan M, et al. Air Pollution and Human Sperm Sex Ratio. Am J Mens Health. 2018 Jan 1:1557988317752608. doi: 10.1177/1557988317752608. [Epub ahead of print]

Zhou N, et al. Exposures to Atmospheric PM10 and PM10-2.5 Affect Male Semen Quality: Results of MARHCS Study.
Environ Sci Technol. 2018 Jan 11. doi: 10.1021/acs.est.7b05206. [Epub ahead of print]

Hundreds of studies have shown increased overall mortality from air pollution, most of that is assumed to occur in the vulnerable subsets of the adult population, especially the elderly. Far fewer studies have been done exploring possible increased rates of infant mortality. The study below adds significantly to the evidence that air pollution also contributes to infant mortality. Almost 500,000 infants were tracked for over 6 years. Researchers found a very strong association between small increases in PM2.5 and total infant deaths, respiratory deaths, and SIDS. Specifically 1.3 ug/m3 increases in PM2.5 increased the rate of these outcomes between 200% and 300%.

Son JY, et al. Pregnancy and Lifetime Exposure to Fine Particulate Matter and Infant Mortality in Massachusetts, 2001-2007. Am J Epidemiol. 2017 Nov 7:1-9. doi: 10.1093/aje/kwx015. [Epub ahead of print]

Numerous new studies showing air pollution's association with adverse pregnancy outcomes, especially low birth weight syndrome.

Wu H, et al. Exposure to fine particulate matter during pregnancy and risk of term low birth weight in Jinan, China, 2014-2016.
Int J Hyg Environ Health. 2017 Oct 28. pii: S1438-4639(17)30399-1. doi: 10.1016/j.ijheh.2017.10.013. [Epub ahead of print]

Ji Y, et al. Association between exposure to particulate matter during pregnancy and birthweight: a systematic review and a meta-analysis of birth cohort studies. J Biomed Res. 2017 Nov 1. doi: 10.7555/JBR.31.20170038. [Epub ahead of print]

Dutta A, et al. Household air pollution and chronic hypoxia in the placenta of pregnant Nigerian women: A randomized controlled ethanol Cookstove intervention. Sci Total Environ. 2017 Nov 14;619-620:212-220. doi: 10.1016/j.scitotenv.2017.11.091. [Epub ahead of print]

Smith R, et al. Impact of London's road traffic air and noise pollution on birth weight: retrospective population based cohort study. BMJ, 2017; j5299 DOI: 10.1136/bmj.j5299

Air pollution exposure of a mother, measured one month prior to conception and one month after shows higher rates of congenital malformations, especially of the heart.

Ren S, et al. Periconception Exposure to Air Pollution and Risk of Congenital Malformations. The Journal of Pediatrics, 2017; DOI: 10.1016/j.jpeds.2017.09.076

Evidence for a mechanism of how prenatal air pollution exposure may be associated with increased risk of childhood obesity.

Alderete TL, et al. Prenatal traffic-related air pollution exposures, cord blood adipokines and infant weight. Pediatr Obes. 2017 Nov 3. doi: 10.1111/ijpo.12248. [Epub ahead of print]

This study in animals shows impaired sperm production with air pollution exposure

Qiu L, et al. Exposure to Concentrated Ambient PM2.5 Compromises Spermatogenesis in a Mouse Model: Role of Suppression of Hypothalamus-Pituitary-Gonads Axis. Toxicol Sci. 2017 Nov 20. doi: 10.1093/toxsci/kfx261. [Epub ahead of print]

More evidence of the harm that air pollution provokes on fetal development, placental growth and pregnancy outcomes.

Blum J, et al. Exposure to Ambient Particulate Matter during Specific Gestational Periods Produces Adverse Obstetric Consequences in Mice. Environmental Health Perspectives, July 2017 DOI: 10.1289/EHP1029

Soto SF, et al. Exposure to fine particulate matter in the air alters placental structure and the renin-angiotensin system. PLoS One. 2017 Aug 18;12(8):e0183314. doi: 10.1371/journal.pone.0183314. eCollection 2017.

Reis MMD, et al. Air pollution and low birth weight in an industrialized city in Southeastern Brazil, 2003-2006. Rev Bras Epidemiol. 2017 Apr-Jun;20(2):189-199. doi: 10.1590/1980-5497201700020001.

Clemens T, et al. Maternal exposure to ambient air pollution and fetal growth in North-East Scotland: A population-based study using routine ultrasound scans. Environ Int. 2017 Oct;107:216-226. doi: 10.1016/j.envint.2017.07.018. Epub 2017 Jul 25.

Kingsley SL, et al. Maternal residential air pollution and placental imprinted gene expression. Environ Int. 2017 Sep 5;108:204-211. doi: 10.1016/j.envint.2017.08.022. [Epub ahead of print]

Wang L, et al. The association between cooking oil fume exposure during pregnancy and birth weight: A prospective mother-child cohort study. Sci Total Environ. 2017 Sep 4;612:822-830. doi: 10.1016/j.scitotenv.2017.08.031. [Epub ahead of print]

Both chronic and acute ozone exposure during pregnancy increase the risk of stillbirth, as much as 39% even at levels below the EPA's standards. Even the ozone levels in the week prior to delivery increase the risk. About 8,000 stillbirths a year occur nationally due to ozone. Extrapolating from that research to Utah indicates about 100 stillbirths a year occur in Utah due to our ozone, and that doesn't count the risk of PM2.5.

Mendola P, Ha S, Pollack AZ, Zhu Y, Seeni I, Kim SS, Sherman S, Liu D. Chronic and Acute Ozone Exposure in the Week Prior to Delivery Is Associated with the Risk of Stillbirth.Int J Environ Res Public Health. 2017 Jul 6;14(7). pii: E731. doi: 10.3390/ijerph14070731.

Air pollution exposure of a pregnant mother increases the likelihood of obesity later on in childhood.

Mao G, et al. Individual and Joint Effects of Early-Life Ambient PM2.5 Exposure and Maternal Prepregnancy Obesity on Childhood Overweight or Obesity. Environ Health Perspect; DOI:10.1289/EHP261

More evidence that air pollution increases the risk of intrauterine growth retardation, small for gestational weight babies, and premature births.

Basu R, et al. Association between PM2.5 and PM2.5 Constituents and Preterm Delivery in California, 2000-2006.
Paediatr Perinat Epidemiol. 2017 Jul 21. doi: 10.1111/ppe.12380. [Epub ahead of print]

Clemens T, Turner S, Dibben C. Maternal exposure to ambient air pollution and fetal growth in North-East Scotland: A population-based study using routine ultrasound scans. Environ Int. 2017 Jul 25;107:216-226. doi: 10.1016/j.envint.2017.07.018. [Epub ahead of print]

Liu C, et al. Different exposure levels of fine particulate matter and preterm birth: a meta-analysis based on cohort studies. Environ Sci Pollut Res Int. 2017 Jun 15. doi: 10.1007/s11356-017-9363-0. [Epub ahead of print]

Another study shows that air pollution impairs the vascular architecture of the placenta.

Hettfleisch, K, et al. Short-Term Exposure to Urban Air Pollution and Influences on Placental Vascularization Indexes. Environ Health Perspect; DOI:10.1289/EHP300

Evidence of air pollution's adverse effect on pregnancy is now overwhelming. In this study particulate pollution was associated with a decrease in fetal thyroid hormone (TSH) and decreased.

Janssen BG, et al. Fetal Thyroid Function, Birth Weight, and in Utero Exposure to Fine Particle Air Pollution: A Birth Cohort Study. Environ Health Perspect; DOI:10.1289/EHP508

Another study showing the connection between air pollution and another pregnancy complication–gestational hypertension.

Zhu Y, et al. Ambient air pollution and risk of gestational hypertension. Am J Epidemiol. 2017 May 4. doi: 10.1093/aje/kwx097. [Epub ahead of print]

Outdoor air pollution has been linked to 2.7 million preterm births per year, 18% of all pre-term births.

Christopher S. Malley, Johan C.I. Kuylenstierna, Harry W. Vallack, Daven K. Henze, Hannah Blencowe, Mike R. Ashmore. Preterm birth associated with maternal fine particulate matter exposure: A global, regional and national assessment. Environment International, 2017; DOI: 10.1016/j.envint.2017.01.023

The 9/11 dust cloud from the collapse of the Twin Towers in 2001, was shown to be associated with significantly higher rates of premature birth and low birth wt in the babies of pregnant women in Manhattan, nearest the site. The study's authors stated, "the impacts are especially pronounced for fetuses exposed in the first trimester, and for male fetuses. We estimate that in this group, exposure to the dust cloud more than doubled the probability of premature delivery and had similarly large effects on the probability of low birth weight." This is more evidence that even short term air pollution exposure can affect the developing fetus, and therefore life long health.

Currie J, et al. The 9/11 Dust Cloud and Pregnancy Outcomes: A Reconsideration
The Journal of Human Resources 51(4):805-831, DOI: 10.3368/jhr.51.4.0714-6533R

More research confirming the connection between air pollution and poor birth outcomes.

Balsa UI, et al. Exposures to Particulate Matter from the Eruptions of the Puyehue Volcano and Birth Outcomes in Montevideo. Environ Health Perspect; DOI:10.1289/EHP235

Exposure to NOx pollution had a significant association with the incidence of a serious pregnancy complication, placental abruption.

Michikawa T, et al. Air Pollutant Exposure within a Few Days of Delivery and Placental Abruption in Japan. Epidemiology. 2016 Dec 1. [Epub ahead of print]

Here is another study showing that air pollution during pregnancy precipitates the chemical markers of inflammation, a prelude to chronic disease vulnerability later in life for those babies.

Martens DS, et al. Neonatal Cord Blood Oxylipins and Exposure to Particulate Matter in the Early-Life Environment: An ENVIRONAGE Birth Cohort Study. Environ Health Perspect. 2016 Nov 4. [Epub ahead of print]

Changes in mitochondrial DNA (mtDNA) can serve as a marker of cumulative oxidative stress. Increased PM2.5 during the third trimester of pregnancy was associated with decreased mtDNA content suggesting heightened sensitivity to this kind biological damage in a fetus.

Rosa MJ, et al. Identifying sensitive windows for prenatal particulate air pollution exposure and mitochondrial DNA content in cord blood. Environ Int. 2016 Nov 11. pii: S0160-4120(16)30741-3. doi: 10.1016/j.envint.2016.11.007. [Epub ahead of print]

This study shows that ultra fine particulate pollution can affect development of the fetal brain by changing the expression of neuroprotective genes on nerve cells.

Solaimani P, Saffari A, Sioutas C, Bondy SC, Campbell A. Exposure to ambient ultrafine particulate matter alters the expression of genes in primary human neurons. Neurotoxicology. 2016 Nov 13. pii: S0161-813X(16)30225-X. doi: 10.1016/j.neuro.2016.11.001. [Epub ahead of print]

For every 10 ug/m3 of PM2.5, the risk of intrauterine inflammation (IUI) increased 240%. IUI contributes to, or is a mechanism for, multiple types of pregnancy complications.

Nachman R, et al. Intrauterine Inflammation and Maternal Exposure to Ambient PM2.5 during Preconception and Specific Periods of Pregnancy: The Boston Birth Cohort. Environ Health Perspect; DOI:10.1289/EHP243

Even one to two day episodes of air pollution may be enough to trigger premature births.

Li S, et al. Acute Impact of Hourly Ambient Air Pollution on Preterm Birth. Environ Health Perspect; DOI:10.1289/EHP200

This is a review article highlighting the evidence that air pollution exposure during pregnancy and even preconception can affect the fetal development of organs like the lungs.

Veras MM, et al. Before the first breath: prenatal exposures to air pollution and lung development. Cell Tissue Res. 2016 Oct 10. [Epub ahead of print]

This study showed that the Great London Smog event of 1952, was still impacting people's health 60 years later. Those who were infants or babies in utero when they were exposed to the event (which only lasted 5 days), showed higher rates of respiratory disease measured several decades later.

Bharadwaj P, et al. Early Life Exposure to the Great Smog of 1952 and the Development of Asthma. Am J Respir Crit Care Med. First published online 08 Jul 2016 as DOI: 10.1164/rccm.201603-0451OC

Impaired fetal growth, fetal loss, and neonatal deaths were significantly associated with heavy metals exposure during pregnancy.

Rahman A, Kumarathasan P, Gomes J. Infant and mother related outcomes from exposure to metals with endocrine disrupting properties during pregnancy. Sci Total Environ. 2016 Jul 1. pii: S0048-9697(16)31309-2. doi: 10.1016/j.scitotenv.2016.06.134. [Epub ahead of print]

This study demonstrated that the number of blood vessels in the placenta is decreased in the first trimester among women exposed to more NO2.

Hettfleisch K, et al. Short-Term Exposure to Urban Air Pollution and Influences on Placental Vascularization Indexes. Environ Health Perspect. 2016 Jul 6. [Epub ahead of print]

Particulate pollution is associated with higher rates of heart birth defects

Liu CB, et al. Effects of Prenatal PM10 Exposure on Fetal Cardiovascular Malformations in Fuzhou, China: A Retrospective Case-Control Study. Environ Health Perspect. 2016 Jul 6. [Epub ahead of print]

Vanadium is a heavy metal that has been recently recognized as a significant toxin, and is emitted as a byproduct of fossil fuel combustion, especially common in refinery emissions. The more vanadium in a mother's body, the higher the rate of low birthweight

Jiang M, et al. A nested case-control study of prenatal vanadium exposure and low birthweight. Hum Reprod. 2016 Jul 4. pii: dew176. [Epub ahead of print]

More evidence that toxic compounds in air pollution, from traffic and industrial sources, can cause cancer, in this case brain cancer in children with in utero, or infancy exposure.

von Ehrenstein O, et al. In Utero and Early-Life Exposure to Ambient Air Toxics and Childhood Brain Tumors: A Population-Based Case–Control Study in California, USA Environ Health Perspect; DOI:10.1289/ehp.1408582

Kawasaki Disease is an inflammation of the blood vessels that affects infants and young children. This study showed a statistical association between KD and ozone exposure. Air pollution certainly causes inflammation, so this is not a surprise.

Jung CR, et al. Ambient Air Pollutant Exposures and Hospitalization for Kawasaki Disease in Taiwan: A Case-Crossover Study (2000-2010) Environ Health Perspect; DOI:10.1289/EHP137

This is probably the best study to date showing that air pollution does indeed increase risk for still births. This meta-analysis showed a 2% increase for every 4 ug/m3 PM2.5. During a bad winter inversion and the height of the Uinta Basin drilling activity, at the one poorly placed monitor in Vernal, there was often PM2.5 of over 60. If that monitor had been placed in downtown Vernal, it would very likely have been much worse. Winter inversions in the Salt Lake Valley can reach PM2.5 levels of over 90. NOx, SO2, CO, and ozone were also shown to significantly correlate with stillbirths. Vernal has had the unique distinction of simultaneously high ozone, and high PM2.5.

Siddika N, Balogun HA, Amegah AK, Jaakkola JJ. Prenatal ambient air pollution exposure and the risk of stillbirth: systematic review and meta-analysis of the empirical evidence. Occup Environ Med. 2016 May 24. pii: oemed-2015-103086. doi: 10.1136/oemed-2015-103086. [Epub ahead of print] Review.

This study shows that hourly levels of air pollution at the time labor begins, show a significant correlation with rates of premature birth.

Li S, Guo Y, Williams G. Acute Impact of Hourly Ambient Air Pollution on Preterm Birth. Environ Health Perspect. 2016 Apr 29. [Epub ahead of print]

Another study showing air pollution changes the placental epigenetic profile, putting a newborn at risk for adverse health outcomes later in life.

Tsamou M, et al. Air pollution-induced placental epigenetic alterations in early life: a candidate miRNA approach. Epigenetics. 2016 Apr 22:0. [Epub ahead of print]

Exposure to traffic related pollution at birth was associated with a 500% increased risk for a certain type of childhood leukemia (AML).

Janitza AE, et al. Traffic-related air pollution and childhood acute leukemia in Oklahoma. Environmental Research. Volume 148, July 2016, Pages 102–111

Prenatal exposure to NOx is associated with increased risk for childhood obesity

Lavigne E, et al. Air Pollution Exposure During Pregnancy and Fetal Markers of Metabolic Function: The MIREC Study. Am J Epidemiol. 2016 Mar 29. pii: kwv256. [Epub ahead of print]

More evidence of air pollution's effect on pregnancy. Primary and secondary particulate matter, NOx, and ozone were all associated with higher incidences of preterm births.

Laurent O, et al. A Statewide Nested Case-Control Study of Preterm Birth and Air Pollution by Source and Composition: California, 2001-2008. Environ Health Perspect. 2016 Feb 19. [Epub ahead of print]

Habitual incense burning in the home is associated with decreased birth weight and small head circumference in term births. Boys are affected more than girls.

Chen LY, et al. Incense Burning during Pregnancy and Birth Weight and Head Circumference among Term Births: The Taiwan Birth Cohort Study. Environ Health Perspect. 2016 Mar 11. [Epub ahead of print]

PM2.5, and NOx are associated with higher rates of Low Birth Weight Syndrome.

Coker E, et al. Multi-pollutant exposure profiles associated with term low birth weight in Los Angeles County. Environ Int. 2016 Feb 15;91:1-13. doi: 10.1016/j.envint.2016.02.011. [Epub ahead of print]

Another meta-analysis showing the connection between air pollution and multiple types of adverse pregnancy outcomes.

Lamichhane DK, Leem JH, Lee JY1, Kim HC. A meta-analysis of exposure to particulate matter and adverse birth outcomes. Environ Health Toxicol. 2015 Nov 3;30:e2015011. doi: 10.5620/eht.e2015011. eCollection 2015.

A 32 study meta-analysis showing significant association between PM2.5 exposure during the second and third trimesters and lower overall birth weights, and higher rates of babies who qualify as having Low Birth Weight Syndrome. Heavy metals and PAHs likely increase the toxicity of PM2.5 in causing this outcome. The authors state, "These robust results further reveal the toxic effect of PM2.5 exposure during pregnancy on fetal growth. Air pollution is ubiquitous. All pregnant women are exposed to it at some level, and immature fetuses are more susceptible."

Sun X, Luo X, Zhao C, Zhang B, Tao J, Yang Z, Ma W, Liu T. The associations between birth weight and exposure to fine particulate matter (PM_{2.5}) and its chemical constituents during pregnancy: A meta-analysis. Environ Pollut. 2015 Dec 28;211:38-47. doi: 10.1016/j.envpol.2015.12.022. [Epub ahead of print]

More evidence that PM2.5 pollution is associated with increased risk for pre-term birth.

DeFranco E, et al. Exposure to airborne particulate matter during pregnancy is associated with preterm birth: a population-based cohort study. Environ Health. 2016 Jan 15;15(1):6. doi: 10.1186/s12940-016-0094-3.

Even more evidence that air pollution reduces the birth weight of infants. Babies born in Beijing, China during 2008 when significant reductions in pollution were achieved for the Olympics, babies born were larger than those born in the year before and the year after.

Rich D, et al. Differences in Birth Weight Associated with the 2008 Beijing Olympic Air Pollution Reduction: Results from a Natural Experiment. Environ Health Perspect; DOI:10.1289/ehp.1408795

Pregnant mothers exposed to more wood smoke, give birth to children that demonstrate worse neurologic scores including visuo-spatial integration, short-term memory, long-term memory, and fine motor skills when tested at ages 6-7.

Cooper L, Eskenazi B, Romero C, Balmes J, Smith KR. Neurodevelopmental performance among school age children in rural Guatemala is associated with prenatal and postnatal exposure to carbon monoxide, a marker for exposure to woodsmoke. Neurotoxicology. 2012 Mar;33(2):246-54. doi: 10.1016/j.neuro.2011.09.004. Epub 2011 Sep 24.

Air pollution is associated with higher rates of heart birth defects.

Girguisa M, et al. Maternal exposure to traffic-related air pollution and birth defects in Massachusetts. Environmental Research. Volume 146, April 2016, Pages 1–9

Air pollution exposure during fetal development and infancy can have life long consequences. This study showed decreased lung function measured at age 16 for those adolescents that were exposed to more air pollution during the first year of life. Additional pollution exposure after that, caused further reductions in lung function.

Schultz E, et al. "Early-Life Exposure to Traffic-related Air Pollution and Lung Function in Adolescence", American Journal of Respiratory and Critical Care Medicine, Vol. 193, No. 2 (2016), pp. 171-177.

Air pollution has an adverse effect on male reproductive health, damaging the DNA in sperm and reducing sperm quality.

Kumar S, Sharma A, Thaker R. Air pollutants and impairments of male reproductive health-an overview. Rev Environ Health. 2021 Jan 29. doi: 10.1515/reveh-2020-0136. Online ahead of print

Zhao Y, Zhu Q, Lin J, Cai J. Association of Exposure to Particulate Matter Air Pollution With Semen Quality Among Men in China. JAMA Netw Open. 2022 Feb 1;5(2):e2148684. doi: 10.1001/jamanetworkopen.2021.48684. PMID: 35175344

More evidence that air pollution increases the risk of birth anomalies like neural tube defects

Ravindra K, Chanana N, Mor S. Exposure to air pollutants and risk of congenital anomalies: A systematic review and metaanalysis. Sci Total Environ. 2020 Oct 7:142772. doi: 10.1016/j.scitotenv.2020.142772.

Zhang JY, et al. Maternal exposure to ambient levels of sulfur dioxide and risk of neural tube defects in 14 cities in Liaoning province, China: a population-based case-control study. J Expo Sci Environ Epidemiol. 2020 Oct 1. doi: 10.1038/s41370-020-00273-6. Online ahead of print.

PMID: 33005007

Prenatal air pollution exposure is associated with higher blood pressure in childhood.

Rosa MJ, et al. Identifying critical windows of prenatal particulate matter (PM2.5) exposure and early childhood blood pressure. Environ Res. 2019 Dec 23;182:109073. doi: 10.1016/j.envres.2019.109073. [Epub ahead of print]

Air pollution exposure at the time of conception is associated with an increase in a certain type of birth defect of the urethra.

Huang C, et al. Periconceptional exposure to air pollution and congenital hypospadias among full-term infants. Environ Res. 2020 Jan 17;183:109151. doi: 10.1016/j.envres.2020.109151. [Epub ahead of print]

More evidence that air pollution increases the risk of premature rupture of membranes, a disorder that puts both the baby and mother at risk for infection, and for premature birth.

Wang K, et al. Maternal exposure to ambient fine particulate matter and risk of premature rupture of membranes in Wuhan, Central China: a cohort study. Environ Health . 2019 Nov 14;18(1):96. doi: 10.1186/s12940-019-0534-y.

This is a meta-analysis that demonstrates the hard evidence that air pollution contributes to gestational diabetes.

Hu CY, et al. Human epidemiological evidence about the association between air pollution exposure and gestational diabetes mellitus: Systematic review and meta-analysis. Environ Res. 2019 Oct 21;180:108843. doi: 10.1016/j.envres.2019.108843. [Epub ahead of print]

Another study shows that air pollution changes the chemical environment of placental DNA, increasing the vulnerability of the unborn to chronic disease later in life.

Maghbooli Z, et al. Air pollution during pregnancy and placental adaptation in the levels of global DNA methylation. PLoS One. 2018 Jul 6;13(7):e0199772. doi: 10.1371/journal.pone.0199772. eCollection 2018.

People living near oil and gas drilling operations have a higher incidence of preterm birth.

Whitworth KW, et al. Drilling and Production Activity Related to Unconventional Gas Development and Severity of Preterm Birth. Environ Health Perspect; DOI:10.1289/EHP2622

Air pollution causes increased fragmentation of human sperm.

Bosco L, et al. Sperm DNA fragmentation: An early and reliable marker of air pollution. Environ Toxicol Pharmacol. 2018 Feb 7;58:243-249. doi: 10.1016/j.etap.2018.02.001. [Epub ahead of print]

Acceleration of the aging process is part of the clinical consequence of air pollution exposure. Telomere length is a marker of biological aging. This study showed that prenatal air pollution provokes shorter telomere length in the newborns, measured in the umbilical cord and placenta.

Martens DS, et al. Prenatal Air Pollution and Newborns' Predisposition to Accelerated Biological Aging. JAMA Pediatr. 2017 Oct 16. doi: 10.1001/jamapediatrics.2017.3024. [Epub ahead of print]

Yet another study showing increased incidence of premature birth with air pollution. The evidence is now overwhelming.

Liu C, et al. Different exposure levels of fine particulate matter and preterm birth: a meta-analysis based on cohort studies. Environ Sci Pollut Res Int. 2017 Jun 15. doi: 10.1007/s11356-017-9363-0. [Epub ahead of print]

This study suggests that the real culprit in particulate air pollution's adverse effect on pregnancy outcomes is PAHs which are often attached to air pollution particles, rather than the particles themselves. More evidence that not all air pollution is created equal, and we should be paying much more attention to those sources that create high levels of PAH pollution–wood smoke, and industrial pollution.

Jedrychowski WA, Majewska R, Spengler JD, Camann D, Roen EL, Perera FP. Prenatal exposure to fine particles and polycyclic aromatic hydrocarbons and birth outcomes: a two-pollutant approach. Int Arch Occup Environ Health. 2017 Feb 7. doi: 10.1007/s00420-016-1192-9. [Epub ahead of print]

This will likely be considered a landmark study. It shows that even air quality we label
"good," or "green", i.e. PM2.5 of about 10 ug/m3, doubles the incidence of "intrauterine inflammation" which is a strong predisposition for premature birth.

Furthermore, it shows that level of pollution even in the first three months prior to conception, increases the risk of intrauterine inflammation 52%.

Nachman RM, et al. Intrauterine Inflammation and Maternal Exposure to Ambient PM2.5 during Preconception and Specific Periods of Pregnancy: The Boston Birth Cohort. Environ Health Perspect. 2016 Apr 27. [Epub ahead of print]

Measuring PAH (polycyclic aromatic hydrocarbons)/DNA adducts from umbilical cord blood (as an indication of air pollution exposure), there was a significant correlation between prenatal air pollution exposure and anxiety, depression, aggressive behavior, and attention problems in children up to 11 years old.

Margolis AE, et al. Longitudinal effects of prenatal exposure to air pollutants on self-regulatory capacities and social competence. J Child Psychol Psychiatry. 2016 Mar 17. doi: 10.1111/jcpp.12548. [Epub ahead of print]

More evidence that air pollution causes poor pregnancy outcomes, especially pre-term births.

Sun X, et al. The association between fine particulate matter exposure during pregnancy and preterm birth: a meta-analysis. BMC Pregnancy Childbirth. 2015 Nov 18;15(1):300.

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Zhu X, et al. Maternal exposure to fine particulate matter (PM2.5) and pregnancy outcomes: a meta-analysis. Environ Sci Pollut Res Int. 2015 Mar;22(5):3383-96. doi: 10.1007/s11356-014-3458-7. Epub 2014 Aug 28.

Hazardous air pollutant exposure during prenatal life and early infancy are strongly associated with increased rates of certain types of childhood brain tumors.

von Ehrenstein O, et al. In Utero and Early-Life Exposure to Ambient Air Toxics and Childhood Brain Tumors: A Population-Based Case–Control Study in California, USA. Environ Health Perspect; DOI:10.1289/ehp.1408582

More evidence that pre-natal pollution harms brain function in children. In this case NOx exposure was calculated at birth, verbal IQ tests were done at age seven.

Porta D, Narduzzi S, Badaloni C, Bucci S, Cesaroni G, Colelli V, Davoli M, Sunyer J, Zirro E, Schwartz J, Forastiere F. Air pollution and cognitive development at age seven in a prospective Italian birth cohort. Epidemiology. 2015 Sep 30. [Epub ahead of print]

Pregnant mothers who live closest to fracking sites were 40% more likely to give birth prematurely than those who live farthest away. Premature birth predisposes a baby to a lifelong increase in vulnerability to a wide variety of poor health outcomes.

Casey JA, Savitz DA, Rasmussen SG, Ogburn EL, Pollak J, Mercer DG, Schwartz BS. Unconventional Natural Gas Development and Birth Outcomes in Pennsylvania, USA. Epidemiology. 2015 Sep 30. [Epub ahead of print]

Pregnant mothers more exposed to neurotoxins in air pollution, in this case styrene and chromium are more likely to give birth to children who are later diagnosed with autism. It is unclear, however, whether these chemicals are risk factors themselves or if they are just a reflection of the effect of a much larger mixture of toxic compounds.

Talbott EO, et al. Air toxics and the risk of autism spectrum disorder: the results of a population based case-control study in southwestern Pennsylvania. Environ Health. 2015 Oct 6;14:80. doi: 10.1186/s12940-015-0064-1.

Another study showing significantly increased risk for Autism Spectrum Disorder with prenatal, and post natal (up to two years after birth) exposure to PM2.5.

Talbott E, et al. Fine particulate matter and the risk of autism spectrum disorder. Environmental Research. Volume 140, July 2015, Pages 414–420

Interesting paper that showed decreased birth weight and smaller head circumference in babies born to white, British mothers exposed to more PM2.5, but not in Pakistani mothers. In contrast, more PM2.5 exposure increased adiposity of newborns in Pakistani mothers, but not in white British mothers. Not sure what to make of those findings.

Schembari A, de Hoogh K, Pedersen M, Dadvand P, Martinez D, Hoek G, Petherick ES, Wright J, Nieuwenhuijsen MJ. Ambient Air Pollution and Newborn Size and Adiposity at Birth: Differences by Maternal Ethnicity (the Born in Bradford Study Cohort). Environ Health Perspect. 2015 May 15. [Epub ahead of print]

In Beijing China, for about one month prior to the 2008 Olympics, many of their coal fired power plants were shut down, and traffic was forcibly reduced about 50%, all in an effort to reduce pollution. In a study of 84,000 births, mothers in their 8th month of pregnancy in 2008, compared to 2007 and 2009, gave birth to babies about 1% larger. This then is yet another study showing that air pollution reduces birth weight. 1% doesn't sound like much per baby, but it becomes a very large public health issue when thousands of babies are affected that way. Reduced birth weight is associated with an increased risk of numerous lifelong chronic diseases and impaired organ function.

Rich D, et al. Differences in Birth Weight Associated with the 2008 Beijing Olympic Air Pollution Reduction: Results from a Natural Experiment. Environ Health Perspect; DOI:10.1289/ehp.1408795

Prenatal exposure to pollution increases newborns' blood pressure.

van Rossem L, et al. Prenatal Air Pollution Exposure and Newborn Blood Pressure. Environ Health Perspect; DOI:10.1289/ehp.1307419

Pregnant mothers exposed to air pollution demonstrate shortened placental telomeres. Placental telomeres correlate with newborn's telomeres and telomeres are highly predictive of life expectancy. There is wide variability in the length of newborn's telomeres, and most of that variability is related to environmental exposures. Bottom line–Maternal exposure to air pollution programs her baby to a shorter life span.

Bijnens E, Zeegers MP, Gielen M, Kicinski M, Hageman GJ, Pachen D, Derom C, Vlietinck R, Nawrot TS. Lower placental telomere length may be attributed to maternal residential traffic exposure; a twin study. Environ Int. 2015 Mar 7;79:1-7. doi: 10.1016/j.envint.2015.02.008. [Epub ahead of print]

PAH exposure during pregnancy decreases levels of BDNF (Brain Derived Neurotrophic Factor), critical to brain development, and whose levels correlate inversely with brain dysfunction.

Tang D, Lee J, Muirhead L, Li TY, Qu L, Yu J, et al. 2014. Molecular and neurodevelopmental benefits to children of closure of a coal burning power plant in China. PLoS One 9:e91966.

Prenatal exposure to PAH air pollutants (in high concentrations in refinery emissions, cigarette smoke and wood smoke) damages fetal brain development, shrinking the volume of white matter primarily in the left hemisphere measured in early childhood, resulting in impaired cognition, ADHD and hyperactive behavior.

Peterson B, et al. Effects of Prenatal Exposure to Air Pollutants (Polycyclic Aromatic Hydrocarbons) on the Development of Brain White Matter, Cognition, and Behavior in Later Childhood. JAMA Psychiatry. Published online March 25, 2015.doi:10.1001/jamapsychiatry.2015.57

Large study, examining 350,000 births, at PM2.5 levels of slightly more than 16 ug/m3 in the third trimester, showed 42% increased risk of still births.

DeFranco E, et al. Air Pollution and Stillbirth Risk: Exposure to Airborne Particulate Matter during Pregnancy Is Associated with Fetal Death. PLoS One. 2015 Mar 20;10(3):e0120594. doi: 10.1371/journal.pone.0120594.

Previous studies have shown higher rates of virtually every type of adverse pregnancy outcome with air pollution. This study of 410, 000 pregnant women showed even higher rates of gestational diabetes with air pollution–20% increase for every 5 ug/m3 of PM2.5 and 18% increase for every 5 ppb of ozone.

Hu H, Ha S, Henderson BH, Warner TD, Roth J, Kan H, Xu X. Association of Atmospheric Particulate Matter and Ozone with Gestational Diabetes Mellitus. Environ Health Perspect. 2015 Mar 20. [Epub ahead of print]