Autism

More evidence connecting air pollution to autism

Kalkbrenner A, et al. Air Toxics in Relation to Autism Diagnosis, Phenotype, and Severity in a U.S. Family-Based Study. Environ Health Perspect; DOI:10.1289/EHP1867

Two more studies that show a connection between air pollution and autism. The first study showed that the effect could be mitigated by maternal extra consumption of folic acid.

Goodrich AJ, et al. Joint effects of prenatal air pollutant exposure and maternal folic acid supplementation on risk of autism spectrum disorder. Autism Res. 2017 Nov 9. doi: 10.1002/aur.1885. [Epub ahead of print]

Li K, et al. Early postnatal exposure to airborne fine particulate matter induces autism-like phenotypes in male rats. Toxicol Sci. 2017 Nov 7. doi: 10.1093/toxsci/kfx240. [Epub ahead of print]

More research showing the connection between environmental factors, air pollution in particular, and autism. Autism genes are affected by environmental pollutants.

Morales-Suárez-Varela M, et al. Systematic review of the association between particulate matter exposure and autism spectrum disorders. Environ Res. 2016 Dec 13;153:150-160. doi: 10.1016/j.envres.2016.11.022. [Epub ahead of print]

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Carter CJ, et al. Autism genes are selectively targeted by environmental pollutants including pesticides, heavy metals, bisphenol A, phthalates and many others in food, cosmetics or household products. Neurochem Int. 2016 Oct 27. pii: S0197-0186(16)30197-8. doi: 10.1016/j.neuint.2016.10.011. [Epub ahead of print]

This meta-analysis demonstrated an association between autism NOx and particulate pollution.

Flores-Pajot MC, Ofner M, Do MT, Lavigne E, Villeneuve PJ. Childhood autism spectrum disorders and exposure to nitrogen dioxide, and particulate matter air pollution: A review and meta-analysis. Environ Res. 2016 Aug 25. pii: S0013-9351(16)30317-6. doi: 10.1016/j.envres.2016.07.030. [Epub ahead of print]

Cancer

This Denmark study found more evidence that air pollution causes leukemia, this time in adults.

Taj T, et al. Exposure to PM2.5 constituents and risk of adult leukemia in Denmark: A population-based case-control study. Environ Res. 2020 Nov 3:110418. doi: 10.1016/j.envres.2020.110418. Online ahead of print. PMID: 33157111

The study provides more evidence that pollution decreases survival in cancer patients.

Ou JY, Kirchhoff AC, Hanson HA. Air Pollution across the Cancer Continuum: Extending Our Understanding of the Relationship between Environmental Exposures and Cancer. Cancer Epidemiol Biomarkers Prev. 2020 Oct;29(10):1876-1879. doi: 10.1158/1055-9965.EPI-19-1588.

PMID: 33004409

Air pollution from solid fuel combustion (wood and coal) increases the risk of breast and cervical cancer mortality.

Liu T, et al. Solid fuel use for heating and risks of breast and cervical cancer mortality in China. Environ Res. 2020 Apr 28;186:109578. doi: 10.1016/j.envres.2020.109578. [Epub ahead of print]

Air pollution is associated with gastric cancer. That is not surprising given that air pollution particles are not just inhaled, but also swallowed.

Yin J, et al. Impact of environmental factors on gastric cancer: A review of the scientific evidence, human prevention and adaptation. J Environ Sci (China). 2020 Mar;89:65-79. doi: 10.1016/j.jes.2019.09.025. Epub 2019 Nov 4.

More studies that show air pollution is associated with higher rates of lung, breast, and nasopharyngeal cancer.

White AJ, et al. Air Pollution, Clustering of Particulate Matter Components, and Breast Cancer in the Sister Study: A U.S.-Wide Cohort. Environ Health Perspect. 2019 Oct;127(10):107002. doi: 10.1289/EHP5131. Epub 2019 Oct 9.

Huang HC, et al. Association between coarse particulate matter (PM10-2.5) and nasopharyngeal carcinoma among Taiwanese men. J Investig Med. 2019 Oct 16. pii: jim-2019-001119. doi: 10.1136/jim-2019-001119. [Epub ahead of print]

Goldberg MS, et al. Associations between incident breast cancer and ambient concentrations of nitrogen dioxide from a national land use regression model in the Canadian National Breast Screening Study. Environ Int. 2019 Oct 21;133(Pt B):105182. doi: 10.1016/j.envint.2019.105182. [Epub ahead of print]

Zhang Z, et al. Association between particulate matter air pollution and lung cancer. Thorax. 2019 Nov 14. pii: thoraxjnl-2019-213722. doi: 10.1136/thoraxjnl-2019-213722. [Epub ahead of print]

Just about every type of cancer is provoked by air pollution. This study shows that even cancers thought to be exclusively associated with smoking are caused by air pollution, in this case nasopharyngeal cancer.

Fan HC, et al. Increased risk of incident nasopharyngeal carcinoma with exposure to air pollution. PLoS One. 2018 Sep 28;13(9):e0204568. doi: 10.1371/journal.pone.0204568. eCollection 2018.

Several new studies show air pollution's association with increased risk of cancer–childhood cancers, lung cancer, and cancers of the upper digestive tract and stomach.

Consonni D, et al. Outdoor particulate matter (PM10) exposure and lung cancer risk in the EAGLE study. PLoS One. 2018 Sep 14;13(9):e0203539. doi: 10.1371/journal.pone.0203539. eCollection 2018.

Weinmayr G, et al. Particulate matter air pollution components and incidence of cancers of the stomach and the upper aerodigestive tract in the European Study of Cohorts of Air Pollution Effects (ESCAPE). Environ Int. 2018 Aug 7;120:163-171. doi: 10.1016/j.envint.2018.07.030. [Epub ahead of print]

Ribeiro AG, et al. Incidence and mortality risk for respiratory tract cancer in the city of São Paulo, Brazil: Bayesian analysis of the association with traffic density. Cancer Epidemiol. 2018 Jul 23;56:53-59. doi: 10.1016/j.canep.2018.07.005. [Epub ahead of print]

Seifi M, et al. Exposure to ambient air pollution and risk of childhood cancers: A population-based study in Tehran, Iran. Sci Total Environ. 2018 Jul 24;646:105-110. doi: 10.1016/j.scitotenv.2018.07.219. [Epub ahead of print]

More evidence that air pollution increases the risk of stomach cancer, and other cancers of the upper GI tract.

Nagel G, et al. Air pollution and incidence of cancers of the stomach and the upper aerodigestive tract in the European Study of Cohorts for Air Pollution Effects (ESCAPE). Int J Cancer. 2018 Apr 26. doi: 10.1002/ijc.31564. [Epub ahead of print]

Benzene, SO2, and NOx were associated with increased rates of lung and bladder cancer, primarily in women over the age of 75.

Collarile P, et al. Residence in Proximity of a Coal-Oil-Fired Thermal Power Plant and Risk of Lung and Bladder Cancer in North-Eastern Italy. A Population-Based Study: 1995-2009.

Several recent studies strengthen the connection between air pollution and cancer, especially breast cancer.

Sifaki-Pistolla D, Lionis C, Koinis F, Georgoulias V, Tzanakis N; On behalf of the Cancer Registry of Crete (CRC). Lung cancer and annual mean exposure to outdoor air pollution in Crete, Greece. Eur J Cancer Prev. 2017 Jul 25. doi: 10.1097/CEJ.0000000000000407. [Epub ahead of print]

White AJ, et al. Indoor Wood-Burning Stove and Fireplace Use and Breast Cancer in a Prospective Cohort Study. Environ Health Perspect. 2017 Jul 18;125(7):077011. doi: 10.1289/EHP827.

Large C, Wei Y. Geographic variations in female breast cancer incidence in relation to ambient air emissions of polycyclic aromatic hydrocarbons. Environ Sci Pollut Res Int. 2017 Jun 14. doi: 10.1007/s11356-017-9395-5. [Epub ahead of print]

Goldberg MS, et al. The association between the incidence of postmenopausal breast cancer and concentrations at street-level of nitrogen dioxide and ultrafine particles. Environ Res. 2017 Jun 5;158:7-15. doi: 10.1016/j.envres.2017.05.038. [Epub ahead of print]

Air pollution reduces survival after the diagnosis of liver cancer

Deng H, et al. Particulate matter air pollution and liver cancer survival. Int J Cancer. 2017 Jun 7. doi: 10.1002/ijc.30779. [Epub ahead of print]

Air pollution found to reduce survival after diagnosis of liver cancer

Deng H, et al. Particulate matter air pollution and liver cancer survival. Int J Cancer. 2017 Jun 7. doi: 10.1002/ijc.30779. [Epub ahead of print]

Two more studies showing a relationship between air pollution and breast cancer.

Goldberg MS, et al. The association between the incidence of postmenopausal breast cancer and concentrations at street-level of nitrogen dioxide and ultrafine particles. Environ Res. 2017 Jun 5;158:7-15. doi: 10.1016/j.envres.2017.05.038. [Epub ahead of print]

Large C, Wei Y. Geographic variations in female breast cancer incidence in relation to ambient air emissions of polycyclic aromatic hydrocarbons. Environ Sci Pollut Res Int. 2017 Jun 14. doi: 10.1007/s11356-017-9395-5. [Epub ahead of print]

Another cancer associated with air pollution—liver cancer.

Pedersen M, et al. Ambient air pollution and primary liver cancer incidence in four European cohorts within the ESCAPE project. Environ Res. 2017 Jan 17;154:226-233. doi: 10.1016/j.envres.2017.01.006. [Epub ahead of print]

Air pollution has been classified as a "Class I carcinogen" by the World Health Organization. There has been a steady increase in the incidence of Acute Myeloid Leukemia (AML) over the past several decades, and other research implicates air pollution as a trigger for leukemia. This study showed that compared to healthy children, those who had AML had significantly higher levels of "particulate matter derived nanoparticles" aggregated with blood components. This demonstrates a plausible mechanism by which air pollution could trigger AML.

Visani G, et al. Environmental nanoparticles are significantly over-expressed in acute myeloid leukemia. Leuk Res. 2016 Nov;50:50-56.

Following almost 67,000 people, researchers found there is a strong correlation between chronic exposure to particulate pollution, and death due to all types of cancer. In particular for every 10 ug/m3 of PM2.5 (which is about the annual average for the Wasatch Front), there was an overall increase of 22% in death

from cancer, and even higher rates for lung and digestive system cancers, and an extraordinary increase of 80% in death rates for breast cancer, the most common cancer in women. Any of your loved ones have breast cancer? This should make the issue of air quality very personal to everyone.

Wong CM, et al. Cancer Mortality Risks from Long-term Exposure to Ambient Fine Particle. Cancer Epidemiol Biomarkers Prev; Published OnlineFirst April 29, 2016; doi 10.1158/1055-9965.EPI-15-0626

PM2.5 is associated with increased risk for liver cancer.

Pan W, et al. Fine Particle Pollution, Alanine Transaminase, and Liver Cancer: A Taiwanese Prospective Cohort Study (REVEAL-HBV). J Natl Cancer Inst. 2015 Nov 11;108(3). pii: djv341. doi: 10.1093/jnci/djv341. Print 2015 Mar.

Children

Air pollution exposure correlates with rates of anemia in children.

Bora K. Air Pollution as a Determinant of Undernutrition Prevalence among Under-Five Children in India: An Exploratory Study. J Trop Pediatr. 2021 Oct 6;67(5):fmab089. doi: 10.1093/tropej/fmab089

Two more studies showing that air pollution's impact of increasing blood pressure begins in childhood.

Huang M, et al. Effects of Ambient Air Pollution on Blood Pressure Among Children and Adolescents: A Systematic Review and Meta-Analysis. Journal of the American Heart Association, 2021; DOI: 10.1161/JAHA.120.017734

Prunicki M, et al. Air pollution exposure is linked with methylation of immunoregulatory genes, altered immune cell profiles, and increased blood pressure in children. Scientific Reports, 2021; 11 (1) DOI: 10.1038/s41598-021-83577-3

As early as childhood, air pollution exposure demonstrates anatomic changes in the brain, specifically reduced gray matter and cortical thickness.

Beckwith T, et al. Reduced gray matter volume and cortical thickness associated with traffic-related air pollution in a longitudinally studied pediatric cohort. PLOS ONE, 2020; 15 (1): e0228092 DOI: 10.1371/journal.pone.0228092

This fascinating study found that air pollution levels closer to the ground, at the height where a baby would sit in a stroller, are 44% higher than the levels a few feet higher, i.e. where the parents pushing the stroller would be inhaling.

Sharma A, et al. Quantification of air pollution exposure to in-pram babies and mitigation strategies. Environment International, 2020; 139: 105671 DOI: 10.1016/j.envint.2020.105671

Chronic exposure to more HAPs (hazardous air pollutants) was found to be associated with worse academic performance among school children in reading, math, and science through the third grade.

Grineski S, et al. Hazardous air pollutants are associated with worse performance in reading, math, and science among US primary schoolchildren. Environ Res. 2019 Nov 15:108925. doi: 10.1016/j.envres.2019.108925. [Epub ahead of print]

Air pollution is associated with increased rates of upper and lower respiratory and ear infections in children.

Kennedy CM, et al. Associations of mobile source air pollution during the first year of life with childhood pneumonia, bronchiolitis, and otitis media. Environ Epidemiol. 2018 Mar;2(1). pii: e007. doi: 10.1097/EE9.0000000000000007.

Air pollution and a more deprived social environment both contribute to lower intellectual scores in children.

Lett LA, et al. The Combined Influence of Air Pollution and Home Learning Environment on Early Cognitive Skills in Children. Int J Environ Res Public Health. 2017 Oct 26;14(11). pii: E1295. doi: 10.3390/ijerph14111295.

This study shows that attention span in school children is impaired by the air pollution they breathed on the way to school.

Sunyer J, et al. Traffic-related Air Pollution and Attention in Primary School Children: Short-term Association. Epidemiology: March 2017 – Volume 28 – Issue 2 – p 181–189. doi: 10.1097/EDE.0000000000000603

Telomeres are repeating sequences of DNA at the ends of chromosomes that keep the chromosomes from unraveling. Every time the cell divides it loses some telomere length. Telomere length is closely associated with longevity. Previous studies have shown air pollution is associated with shorter placental and fetal telomere length. This study shows that in children and adolescents, air pollution exposure is associated with reduced telomere length, and that means reduced life expectancy.

Lee E, et al. Traffic-Related Air Pollution and Telomere Length in Children and Adolescents Living in Fresno, CA. Journal of Occupational and Environmental Medicine, 2017; 59 (5): 446 DOI: 10.1097/JOM.0000000000000996

Children exposed to more traffic pollution short term, score worse on tests of ability to pay attention.

Sunyer J, et al. Traffic-related air pollution and attention in primary school children: short-term association. Epidemiology. 2016 Nov 29. [Epub ahead of print]

UPHE has been beating the drum on all the medical research showing how toxic air pollution is to the brain. Here is yet another study showing impairment of cognitive abilities and memory in eight year old school children.

Basagaña X, et al. Neurodevelopmental Deceleration by Urban Fine Particles from Different Emission Sources: A Longitudinal Observational Study. Environ Health Perspect. 2016 Apr 29;124(5). [Epub ahead of print]

Children exposed to more traffic related air pollution at home, have lower grade point averages, even when other known confounding variables are factored in.

Clark-Reyna SE, et al. Residential exposure to air toxics is linked to lower grade point averages among school children in El Paso, Texas, USA. Popul Environ. 2016 Mar;37(3):319-340. Epub 2015 Jul 17.

Yet another study showing prenatal air pollution exposure is associated with significantly worse neuropsychological development in children. For every 1 ug/m3 increase in PM2.5, motor scores were decreased 1.14 points, and every 1 ug/m3 increase in NO2 was associated with a 0.29 point decrease in mental scores. The Wasatch Front averages 38-57 ug/m3 for NO2.

Lertxundi A, et al. Exposure to fine particle matter, nitrogen dioxide and benzene during pregnancy and cognitive and psychomotor developments in children at 15months of age. Environ Int. 2015 Apr 10;80:33-40. doi: 10.1016/j.envint.2015.03.007. [Epub ahead of print]

March 5, 2015. Another study showing kids exposed to more traffic pollution demonstrate intellectual impairment compared to their non-exposed peers. In this study, similar to other studies, the cognitive loss was over 4%.

Sunnier J, et al. Association between Traffic-Related Air Pollution in Schools and Cognitive Development in Primary School Children: A Prospective Cohort Study. PLOS medicine. Published: March 3, 2015DOI: 10.1371/journal.pmed.1001792

COVID-19

Western wildfire smoke in 2020 was responsible for 19,000 cases of COVID and 700 deaths.

Xiaodan Zhou, Kevin Josey, Leila Kamareddine, Miah C. Caine, Tianjia Liu, Loretta J. Mickley, Matthew Cooper, Francesca Dominici. Excess of COVID-19 cases and deaths due to fine particulate matter exposure during the 2020 wildfires in the United

States. Science Advances, 2021; 7 (33): eabi8789 DOI: 10.1126/sciadv.abi8789

More evidence of the impact of air pollution on the risk of death from COVID

Bozack A, et al. Long-Term Air Pollution Exposure and COVID-19 Mortality: A Patient-Level Analysis from New York City. American Journal of Respiratory and Critical Care Medicine, 2021; DOI: 10.1164/rccm.202104-0845OC

Kogevinas M, et al. Ambient Air Pollution in Relation to SARS-CoV-2 Infection, Antibody Response, and COVID-19 Disease: A Cohort Study in Catalonia, Spain (COVICAT Study). Environmental Health Perspectives, 2021; 129 (11) DOI: 10.1289/EHP9726

Lavigne E, Ryti N, Gasparrini A, Sera F, Weichenthal S, Chen H, To T, Evans GJ, Sun L, Dheri A, Lemogo L, Kotchi SO, Stieb D. Short-term exposure to ambient air pollution and individual emergency department visits for COVID-19: a case-crossover study in Canada. Thorax. 2022 Mar 31:thoraxjnl-2021-217602. doi: 10.1136/thoraxjnl-2021-217602

Razzaq A, Cui Y, Irfan M, Maneengam A, Acevedo-Duque Á. Asymmetric effects of fine particulate matter and stringency policy on COVID-19 intensity. Int J Environ Health Res. 2022 Mar 31:1-13. doi: 10.1080/09603123.2022.2059452

This study looked at the ICU admissions for COVID 19 as a marker of pandemic transmission in the community. A positive correlation is found between PM2.5 concentration and cases, indicating that the pollution is facilitating the transmission.

Lolli S, Chen YC, Wang SH, Vivone G. Impact of meteorological conditions and air pollution on COVID-19 pandemic transmission in Italy. Sci Rep. 2020 Oct 1;10(1):16213. doi: 10.1038/s41598-020-73197-8. PMID: 33004925

Several papers have been published in the last few months showing that particulate pollution increases severity and lethality of COVID and its transmissibility from one person to another. Here are some of those studies and their conclusions. For example, across more than 3000 counties of the United States, an increase of 1 µg/m3 in PM(2.5) has been shown to increase mortality from COVID-19 by 8%, and in New York state alone, by 15%. *Conticini E, Frediani B, Caro D. Can atmospheric pollution be considered a co-factor in extremely high levels of SARS-CoV-2 lethality in Northern Italy? Environ Pollut. 2020 Apr 4:114465. doi: 10.1016/j.envpol.2020.114465.*

Karan A, Ali K, Teelucksingh S, Sakhamuri S. The impact of air pollution on the incidence and mortality of COVID-19. Glob Health Res Policy. 2020 Sep 1;5:39. doi: 10.1186/s41256-020-00167-y. eCollection 2020. PMID: 32879902 Free PMC article

Cazzolla Gatti R, Velichevskaya A, Tateo A, Amoroso N, Monaco A.Machine learning reveals that prolonged exposure to air pollution is associated with SARS-CoV-2 mortality and infectivity in Italy. Environ Pollut. 2020 Aug 21;267:115471. doi: 10.1016/j.envpol.2020.115471. PMID: 32882464

This study found that COVID-19 pandemic transmission is facilitated by dry and cool environmental conditions and polluted air.

Lolli S, Chen YC, Wang SH, Vivone G. Impact of meteorological conditions and air pollution on COVID-19 pandemic transmission in Italy. Sci Rep. 2020 Oct 1;10(1):16213. doi: 10.1038/s41598-020-73197-8.

This study has not yet been peer reviewed. But it's a nationwide study from researchers at the Harvard School of Public Health. It shows that just 1ug/m3 of PM2.5 increases the risk of death from COVID-19, 8%. Given that the annual PM2.5 standard is 12 ug/m3, that means that "acceptable" levels of air pollution would increase the risk of death from COVID-19 nearly 100%.

https://projects.iq.harvard.edu/covid-pm

Another study was done in Italy that showed 78% of the deaths from COVID-19 occurred in the parts of the country with the highest levels of NOx pollution.

Ogen Y. Assessing nitrogen dioxide (NO2) levels as a contributing factor to coronavirus (COVID-19) fatality. Science of The Total Environment. Volume 726, 15 July 2020, 138605

This study analyzed the air pollution reduction as a result of the contraction of economic activity in China and assessed how many lives might have been saved compared to the lives lost from COVID-19. The researchers concluded that the health benefits and reduced mortality secondary to less air pollution was greater than the number of deaths from the coronavirus.

Chen K, Wang M, Huang C, Kinney PL, Anastas PT. Air pollution reduction and mortality benefit during the COVID-19 outbreak in China [published online ahead of print, 2020 May 13]. Lancet Planet Health. 2020;doi:10.1016/S2542-5196(20)30107-8

Diabetes

Another study showing that air pollution increases the risk of type II diabetes

Elbarbary M, et al. Ambient air pollution exposure association with diabetes prevalence and glycosylated hemoglobin (HbA1c) levels in China. Cross-sectional analysis from the WHO study of AGEing and adult health wave. J Environ Sci Health A Tox Hazard Subst Environ Eng. 2020 Jul 2:1-14. doi:10.1080/10934529.2020.1787011

Published in one of the most prestigious medical journals, this study of 4.5 million US veterans found that 99% of the deaths related to air pollution occur in populations where the air pollution meets the EPA's standards. This puts a definitive stamp on the concept that there is no safe level of air pollution, and that those standards, which are supposed to be updated every 5 years, are far too lax. Also, nine causes of death related to air pollution were identified, including causes not previous connected to air pollution—kidney disease, dementia, and type II diabetes.

Bowe B, et al. Burden of Cause-Specific Mortality Associated With PM2.5 Air Pollution in the United States. JAMA Network Open. November 20, 2019

Short term exposure to PM2.5 and risk of hospital admission were found for several prevalent but rarely studied diseases, such as septicemia, fluid and electrolyte disorders, and acute and unspecified renal failure. Positive associations were also found between risk of hospital admission and cardiovascular and respiratory diseases, Parkinson's disease, diabetes, phlebitis, thrombophlebitis, and thromboembolism.

Mahase E. Study links air pollution to several new causes of hospital admissions.BMJ. 2019 Nov 28;367:l6741. doi: 10.1136/bmj.l6741.

More evidence that air pollution is associated with increased risk for metabolic disorders like type II diabetes

Holliday KM, et al. Air pollution-associated changes in biomarkers of diabetes risk. Environ Epidemiol. 2019 Aug 13;3(4):e059. doi: 10.1097/EE9.0000000000000059. eCollection 2019 Aug.

Hendryx M, et al. Exposure to heavy metals from point pollution sources and risk of incident type 2 diabetes among women: a prospective cohort analysis. Int J Environ Health Res. 2019 Sep 19:1-12. doi: 10.1080/09603123.2019.1668545. [Epub ahead of print]

Kim JS, et al. Associations of air pollution, obesity and cardiometabolic health in young adults: The Meta-AIR study. Environ Int. 2019 Oct 14;133(Pt A):105180. doi: 10.1016/j.envint.2019.105180. [Epub ahead of print]

Yang BY, et al. Ambient air pollution and diabetes: A systematic review and meta-analysis. Environ Res. 2019 Oct 12;180:108817. doi: 10.1016/j.envres.2019.108817. [Epub ahead of print]

Yu Y, et al. Air pollution, noise exposure, and metabolic syndrome - A cohort study in elderly Mexican-Americans in Sacramento area. Environ Int. 2019 Nov 25;134:105269. doi: 10.1016/j.envint.2019.105269. [Epub ahead of print]

More evidence connecting air pollution to obesity, diabetes, and metabolic syndrome

Matthiessen C, et al. Long-term exposure to airborne particulate matter and NO2 and prevalent and incident metabolic syndrome – Results from the Heinz Nixdorf Recall Study. Environ Int. 2018 Apr 10;116:74-82. doi: 10.1016/j.envint.2018.02.035. [Epub ahead of print]

Yang BY, et al. Ambient air pollution in relation to diabetes and glucose-homoeostasis markers in China: a cross-sectional study with findings from the 33 Communities Chinese Health Study. Lancet Planet Health. 2018 Feb;2(2):e64-e73. doi: 10.1016/S2542-5196(18)30001-9. Epub 2018 Feb 9.

Lucht SA, et al. Air Pollution and Glucose Metabolism: An Analysis in Non-Diabetic Participants of the Heinz Nixdorf Recall Study. Environ Health Perspect. 2018 Apr 3;126(4):047001. doi: 10.1289/EHP2561.

Wang M, et al. Association between Short-Term Exposure to Air Pollution and Dyslipidemias among Type 2 Diabetic Patients in Northwest China: A Population-Based Study. Int J Environ Res Public Health. 2018 Mar 30;15(4). pii: E631. doi: 10.3390/ijerph15040631.

More evidence of air pollution contributes to metabolic disorders, i.e. type II diabetes, insulin resistance, and interferes with glucose metabolism.

Chen M, et al. Prenatal Exposure to Diesel Exhaust PM2.5 Causes Offspring β Cell Dysfunction in Adulthood.
Am J Physiol Endocrinol Metab. 2017 Dec 26. doi: 10.1152/ajpendo.00336.2017. [Epub ahead of print]

Khafaie MA, et al. Particulate matter and markers of glycemic control and insulin resistance in type 2 diabetic patients: result from Wellcome Trust Genetic study. J Expo Sci Environ Epidemiol. 2017 Dec 21. doi: 10.1038/s41370-017-0001-1. [Epub ahead of print]

Dendup T, et al. Environmental Risk Factors for Developing Type 2 Diabetes Mellitus: A Systematic Review.
Int J Environ Res Public Health. 2018 Jan 5;15(1). pii: E78. doi: 10.3390/ijerph15010078.

Bai L, et al. Exposure to Ambient Ultrafine Particles and Nitrogen Dioxide and Incident Hypertension and Diabetes.
Epidemiology. 2018 Jan 9. doi: 10.1097/EDE.0000000000000798. [Epub ahead of print]

Tan C, et al. Long-term high air pollution exposure induced metabolic adaptations in traffic policemen. Environ Toxicol Pharmacol. 2018 Jan 5;58:156-162. doi: 10.1016/j.etap.2018.01.002. [Epub ahead of print]

More studies that strengthen the connection between air pollution and type II diabetes.

Mazidi M, et al. Ambient particulate air pollution (PM2.5) is associated with the ratio of type 2 diabetes to obesity. Sci Rep. 2017 Aug 22;7(1):9144. doi: 10.1038/s41598-017-08287-1.

Strak M, et al. Long-term exposure to particulate matter, NO2 and the oxidative potential of particulates and diabetes prevalence in a large national health survey. Environ Int. 2017 Sep 5;108:228-236. doi: 10.1016/j.envint.2017.08.017. [Epub ahead of print]

Numerous studies are showing a strong connection between pollution and type II diabetes. This study of newborns showed an increase in insulin levels, measured from cord blood, with more particulate pollution exposure. Specifically, for every 2.4 ug/m3 increase in PM2.5, insulin levels increased 13%. This suggests that pollution in utero can set the stage for type II diabetes later in life.

Madhloum N, et al. Cord plasma insulin and in utero exposure to ambient air pollution. Environ Int. 2017 May 22. pii: S0160-4120(16)30886-8. doi: 10.1016/j.envint.2017.05.012. [Epub ahead of print]

Numerous studies solidify the connection between air pollution and diabetes and impaired glucose metabolism.

Peng C, et al. Particulate Air Pollution and Fasting Blood Glucose in Nondiabetic Individuals: Associations and Epigenetic Mediation in the Normative Aging Study, 2000–2011. Environ Health Perspect; DOI:10.1289/EHP183

Lu MC, et al. Association of temporal distribution of fine particulate matter with glucose homeostasis during pregnancy in women of Chiayi City, Taiwan. Environ Res. 2016 Oct 13;152:81-87. doi: 10.1016/j.envres.2016.09.023. [Epub ahead of print

Toledo-Corral CM, et al. Effects of air pollution exposure on glucose metabolism in Los Angeles minority children. Pediatr Obes. 2016 Dec 6. doi: 10.1111/ijpo.12188. [Epub ahead of print]

Wallwork RS, Colicino E, Zhong J, Kloog I, Coull BA, Vokonas P, Schwartz JD, Baccarelli AA. Ambient Fine Particulate Matter, Outdoor Temperature, and Risk of Metabolic Syndrome. Am J Epidemiol. 2016 Dec 7. [Epub ahead of print]

A good review of the evidence that air pollution increases the risk of insulin resistance and type II diabetes.

Dang J, et al. Associations of Exposure to Air Pollution with Insulin Resistance: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2018 Nov 20;15(11). pii: E2593. doi: 10.3390/ijerph15112593.

More evidence that air pollution increases the risk for insulin resistance and type II diabetes.

Wolf K, Popp A, Schneider A, Breitner S, Hampel R, Rathmann W, Herder C, Roden M, Koenig W, Meisinger C, Peters A; Association Between Long-Term Exposure to Air Pollution and Biomarkers Related to Insulin Resistance, Subclinical Inflammation and Adipokines. Diabetes. 2016 Sep 7. pii: db151567. [Epub ahead of print]

Mounting evidence on the connection between type II diabetes and air pollution.

Eze IC, et al. Air pollution and diabetes association: Modification by type 2 diabetes genetic risk score. Environ Int. 2016 Jun 6;94:263-271. doi: 10.1016/j.envint.2016.04.032. [Epub ahead of print]

Goettems-Fiorin PB, et al. Fine particulate matter potentiates type 2 diabetes development in high-fat diet-treated mice: stress response and extracellular to intracellular HSP70 ratio analysis. J Physiol Biochem. 2016 Jun 29. [Epub ahead of print]

More evidence on the association between air pollution and type II diabetes. This study is from China, where the air pollution is particularly severe.

Liu C, et al. Associations between long-term exposure to ambient particulate air pollution and type 2 diabetes prevalence, blood glucose and glycosylated hemoglobin levels in China. Environ Int. 2016 May 2;92-93:416-421. doi: 10.1016/j.envint.2016.03.028. [Epub ahead of print]

More evidence that short-term exposure to PM2.5 promotes type II diabetes, by inducing vascular insulin resistance and inflammation triggered by a mechanism involving inflammation in the lungs.

Haberzettl P, O'Toole TE, Bhatnagar A, Conklin DJ. Exposure to Fine Particulate Air Pollution Causes Vascular Insulin Resistance by Inducing Pulmonary Oxidative Stress. Environ Health Perspect. 2016 Apr 29. [Epub ahead of print]

This study found a 24% increase in type II diabetes per increase in long term exposure to PM2.5 of 3.1 ug/m3 (less than a third of annual average on the Wasatch Front).

Hansen AB, et al. Long-term exposure to fine particulate matter and incidence of diabetes in the Danish Nurse Cohort. Environ Int. 2016 Mar 15;91:243-250. doi: 10.1016/j.envint.2016.02.036. [Epub ahead of print]

There is a growing body of research showing a significant connection between air pollution and Type II diabetes, i.e. decreased glucose tolerance, and insulin sensitivity. This study showed short term air pollution has these effects as well as increasing bad cholesterol (LDL) , and decreasing the good cholesterol (HDL).

Chen Z, et al. Ambient Air Pollutants Have Adverse Effects on Insulin and Glucose Homeostasis in Mexican Americans. Diabetes Care. 2016 Feb 11. pii: dc151795. [Epub ahead of print]

Numerous studies have shown that air pollution is significantly correlated with rates of Type II diabetes. This study shows the possible biologic mechanism–increased levels of circulating stress hormones and lipid metabolites with even brief exposure to high levels of ozone.

Miller D, et al. Ozone Exposure Increases Circulating Stress Hormones and Lipid Metabolites in Humans. Am J Respir Crit Care Med. 2016 Jan 8. [Epub ahead of print]

There are now several studies linking air pollution to Type I Diabetes. Two more have been published in the last two weeks.

Bodin J, Stene LC, Nygaard UC. Can Exposure to Environmental Chemicals Increase the Risk of Diabetes Type 1 Development? Biomed Res Int. 2015;2015:208947. Epub 2015 Mar 26.

Malmqvist E. Maternal exposure to air pollution and type 1 diabetes – Accounting for genetic factors. Environ Res. 2015 Apr 13;140:268-274. doi: 10.1016/j.envres.2015.03.024. [Epub ahead of print]

Mental Health

Nitrogen oxide exposure during childhood increases the risk of later on schizophrenia.

Horsdal H, et al. Association of Childhood Exposure to Nitrogen Dioxide and Polygenic Risk Score for Schizophrenia With the Risk of Developing Schizophrenia. JAMA Network Open, 2019; 2 (11): e1914401 DOI: 10.1001/jamanetworkopen.2019.14401

These studies showed that air pollution increased the rate of psychiatric emergency department visits for pediatric and adult patients.

Brokamp C, et al. Psychiatric Emergency Department Utilization and Fine Particulate Matter: A Case-Crossover Study. Environ Health Perspect. 2019 Sep;127(9):97006. doi: 10.1289/EHP4815. Epub 2019 Sep 25. PMID: 31553231 [PubMed - in process] Free Article

Bernardini F, et al. Air pollutants and daily number of admissions to psychiatric emergency services: evidence for detrimental mental health effects of ozone. Epidemiol Psychiatr Sci. 2019 Nov 6:1-7. doi: 10.1017/S2045796019000623. [Epub ahead of print] PMID: 31690359 [PubMed - as supplied by publisher]

Numerous studies have found a correlation between air pollution and behavioral disorders including unethical behavior. This study of over 86 million people found that correlation also exists for violent crime.

Burkhardt J, et al. The effect of pollution on crime: Evidence from data on particulate matter and ozone. Journal of Environmental Economics and Management, 2019; 102267 DOI: 10.1016/j.jeem.2019.102267

Another study shows a connection between air pollution and behavioral disorders like ADHD.

Ren Y, et al. Outdoor air pollution pregnancy exposures are associated with behavioral problems in China's preschoolers. Environ Sci Pollut Res Int. 2018 Nov 22. doi: 10.1007/s11356-018-3715-2. [Epub ahead of print]

This review article shows more evidence for the connection between air pollution and mental disorders, especially depression.

Buoli M, et al. Is there a link between air pollution and mental disorders?
Environ Int. 2018 Jun 4;118:154-168. doi: 10.1016/j.envint.2018.05.044. [Epub ahead of print]

More studies showing a significant connection between air pollution and suicide, substance abuse, and schizophrenia.

Lee H, et al. Ambient air pollution and completed suicide in 26 South Korean cities: Effect modification by demographic and socioeconomic factors. Sci Total Environ. 2018 Oct 15;639:944-951. doi: 10.1016/j.scitotenv.2018.05.210. Epub 2018 May 26.

Szyszkowicz M, et al. Ambient air pollution exposure and emergency department visits for substance abuse. PLoS One. 2018 Jun 29;13(6):e0199826. doi: 10.1371/journal.pone.0199826. eCollection 2018.

Duan J, et al. Is the serious ambient air pollution associated with increased admissions for schizophrenia? Sci Total Environ. 2018 Jul 2;644:14-19. doi: 10.1016/j.scitotenv.2018.06.218. [Epub ahead of print]

We know air pollution affects brain function, including increasing depression, suicidal tendencies, and impairing cognition. This study shows that air pollution is associated with criminal activity and unethical behavior.

Lu J, et al. Polluted Morality: Air Pollution Predicts Criminal Activity and Unethical Behavior. Psychological Science, 2018; 095679761773580 DOI: 10.1177/0956797617735807

Air pollution is associated with higher risk for developing and seeking treatment for mental disorders, and a much higher mortality risk for those with mental health and behavioral disorders, including suicide.

Ho HC, et al. Spatiotemporal influence of temperature, air quality, and urban environment on cause-specific mortality during hazy days. Environment International, Volume 112, March 2018, Pages 10-22

Jia Z, et al. Exposure to Ambient Air Particles Increases the Risk of Mental Disorder: Findings from a Natural Experiment in Beijing. Int J Environ Res Public Health. 2018 Jan 19;15(1). pii: E160. doi: 10.3390/ijerph15010160.

Oudin A, et al. The association between daily concentrations of air pollution and visits to a psychiatric emergency unit: a case-crossover study.Environ Health. 2018 Jan 10;17(1):4. doi:

10.1186/s12940-017-0348-8.Casas L, et al. Does air pollution trigger suicide? A case-crossover analysis of suicide deaths over the life span
European Journal of Epidemiology. November 2017, Volume 32, Issue 11, pp 973–981

This study shows that in healthy college age students, higher air pollution led to significant increases in stress hormones–cortisol, cortisone, epinephrine, and norepinephrine, higher blood pressure, insulin resistance, and biomarkers of oxidative stress and inflammation

Li H, et al. Particulate Matter Exposure and Stress Hormone Levels: A Randomized, Double-Blind, Crossover Trial of Air Purification. https://doi.org/10.1161/CIRCULATIONAHA.116.026796 Circulation. 2017;136:618-627

Another study showing air pollution impairs our mental health, i.e. is associated with higher rates of anxiety and depression.

Pun VC, et al. Association of Ambient Air Pollution with Depressive and Anxiety Symptoms in Older Adults: Results from the NSHAP Study. Environ Health Perspect; DOI:10.1289/EHP494

Air pollution's association with cognitive decline is now well established. This study shows that among older people who also experience socioeconomic stress and disadvantage, that association is even stronger.

Ailshire J, Karraker A, Clarke P. Neighborhood social stressors, fine particulate matter air pollution, and cognitive function among older U.S. adults. Soc Sci Med. 2016 Nov 14;172:56-63. doi: 10.1016/j.socscimed.2016.11.019. [Epub ahead of print]

Communities with higher air pollution see more prescription use of medications for psychiatric disorders.

Oudin, A., Bråbäck, L., Oudin Åström, D., Strömgren, M., Forsberg, B.: Association between neighbourhood air pollution concentrations and dispensed medication for psychiatric disorders in a large longitudinal cohort of Swedish children and adolescents. BMJ Open 2016;6:e010004 doi:10.1136/bmjopen-2015-010004

Another study showing air pollution is associated with depression–in this case PM2.5 of 10 ug/m3 is associated with about a 50% increase.

Kim KN, et al. Long-Term Fine Particulate Matter Exposure and Major Depressive Disorder in a Community-Based Urban Cohort. Environ Health Perspect. 2016 Apr 29. [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]

Decreased lung function in children postnatally exposed to pesticides.

Raanan R, Balmes JR, Harley KG, Gunier RB, Magzamen S, Bradman A, Eskenazi B. Decreased lung function in 7-year-old children with early-life organophosphate exposure. Thorax. 2015 Dec 3. pii: thoraxjnl-2014-206622. doi: 10.1136/thoraxjnl-2014-206622. [Epub ahead of print]

Mortality

Each week of wildfire smoke exposures from fires in the state of Washington were estimated to cause 91 deaths, including 20 cardiovascular disease deaths, and 10 respiratory disease deaths. As climate change gets worse, the negative impacts of smoke will plague the Wasatch front more and more.

Liu Y, Austin E, Xiang J, Gould T, Larson T, Seto E. Health Impact Assessment of PM 2.5 attributable mortality from the September 2020 Washington State Wildfire Smoke Episode. medRxiv. 2020 Sep 22:2020.09.19.20197921. doi: 10.1101/2020.09.19.20197921

In the state of Washington, each week of wildfire smoke exposures were estimated to cause 91 cases of increased all-cause mortality, 19.9 increased cardiovascular disease deaths, and 9.7 increased respiratory disease deaths. As climate change gets worse, the negative impacts of smoke will plague the Wasatch front more and more.

Liu Y, Austin E, Xiang J, Gould T, Larson T, Seto E. Health Impact Assessment of PM 2.5 attributable mortality from the September 2020 Washington State Wildfire Smoke Episode. medRxiv. 2020 Sep 22:2020.09.19.20197921. doi: 10.1101/2020.09.19.20197921. Preprint. PMID: 32995819 Free PMC article.

This study from 398 cities in 22 countries showed nitrogen oxides was a risk factor for death from cardiovascular and respiratory diseases, separate, and in addition to, particulate pollution and ozone. And like with the other components of pollution, there is no safe level.

Meng X, et al. Short term associations of ambient nitrogen dioxide with daily total, cardiovascular, and respiratory mortality: multilocation analysis in 398 cities. BMJ 2021; 372 doi: https://doi.org/10.1136/bmj.n534 (Published 24 March 2021)

More evidence that air pollution causes an increase in community deaths.

Wu X, et al. Evaluating the Impact of Long-term Exposure to Fine Particulate Matter on Mortality Among the Elderly. Science Advances, 2020 DOI: 10.1126/sciadv.aba5692

Yang J, et al. Fine particulate matter constituents and cause-specific mortality in China: A nationwide modelling study. Environ Int. 2020 Jun 30;143:105927. doi: 10.1016/j.envint.2020.105927. [Epub ahead of print]

Daellenbach, KR, et al. Sources of particulate-matter air pollution and its oxidative potential in Europe. Nature, 2020; 587 (7834): 414 DOI: 10.1038/s41586-020-2902-8

For patients that end up in the ICU, there is an increased risk of mortality with more air pollution. Specifically, the risk of death was increased 18% per increase of 10 ug/m3 of PM2.5.

Groves CP, et al. Intensive care admissions and outcomes associated with short-term exposure to ambient air pollution: a time series analysis. Intensive Care Med. 2020 Apr 30. doi: 10.1007/s00134-020-06052-z. [Epub ahead of print]

The authors of this study, from the prestigious journal, Chest, describe the impacts of air pollution in nearly the exact terms that UPHE has been using for several years. Air pollution is the world's fifth leading risk factor for death. Tissue damage may result directly from pollutant toxicity because fine and ultrafine particles can gain access to organs, or indirectly through systemic inflammatory processes. It can harm any organ in the body. Air pollution can harm everyone's health, but some are more susceptible than others, either because of genetics, socioeconomics, race, or ethnicity. Public health is damaged as levels below those previously considered to be safe.

Schraufnagel D, et al. Air Pollution and Noncommunicable Diseases. Chest. February 2019Volume 155, Issue 2, Pages 409–416

This is perhaps the most comprehensive analysis of the major studies exploring the relationship between PM2.5 and morality. It establishes again that increases of 1 ug/m3 of PM2.5 chronic exposure increase community deaths rates about 1%. Acute spikes of PM2.5 will add additional mortality, as will ozone. It is from data like this that UPHE states that between 1,000 and 2,000 people die prematurely every year in Utah because of our air pollution.

Pope CA, et al. Fine particulate air pollution and human mortality: 25+ years of cohort studies. Environmental Research. Available online 14 November 2019, 108924

A meta-analysis of studies showing air pollution causes shorter telomere length, a marker of accelerated aging, and predictor of premature death.

Zhao B, et al. Air pollution and telomere length: a systematic review of 12,058 subjects. Cardiovasc Diagn Ther. 2018 Aug;8(4):480-492. doi: 10.21037/cdt.2018.06.05.

Lead is usually thought of only as a neurotoxin, with focus primarily on what it does to the brain development of children. But lead exposure is also associated with a higher mortality rate among adults, contributing to over 400,000 deaths a year from heart disease.

Lanphear B, et al. Low-level lead exposure and mortality in US adults: a population-based cohort study. The Lancet Public Health, 2018 DOI: 10.1016/S2468-2667(18)30025-2

Another study showed increased rates of death with short term air pollution.

Huang J, Pan X, Guo X, Li G. Impacts of air pollution wave on years of life lost: A crucial way to communicate the health risks of air pollution to the public. Environ Int. 2018 Jan 29;113:42-49. doi: 10.1016/j.envint.2018.01.022. [Epub ahead of print] PMID: 29421406 [PubMed – as supplied by publisher]

Numerous new studies on the association between air pollution and premature death.

Kim SE, et al. Associations between mortality and prolonged exposure to elevated particulate matter concentrations in East Asia. Environ Int. 2017 Oct 30. pii: S0160-4120(17)30909-1. doi: 10.1016/j.envint.2017.10.010. [Epub ahead of print]

Fang X, et al. Relationship between fine particulate matter, weather condition and daily non-accidental mortality in Shanghai, China: A Bayesian approach. PLoS One. 2017 Nov 9;12(11):e0187933. doi: 10.1371/journal.pone.0187933. eCollection 2017.

Holnicki P, et al. Burden of Mortality and Disease Attributable to Multiple Air Pollutants in Warsaw, Poland. Int J Environ Res Public Health. 2017 Nov 8;14(11). pii: E1359. doi: 10.3390/ijerph14111359.

Cappellari M, et al. Association between short- and medium-term air pollution exposure and risk of mortality after intravenous thrombolysis for stroke. J Thromb Thrombolysis. 2017 Nov 28. doi: 10.1007/s11239-017-1589-7. [Epub ahead of print]

Corrigan AE, et al. Fine particulate matters: The impact of air quality standards on cardiovascular mortality. Environ Res. 2017 Nov 28;161:364-369. doi: 10.1016/j.envres.2017.11.025. [Epub ahead of print]

Parker JD, et al. Particulate Matter Air Pollution Exposure and Heart Disease Mortality Risks by Race and Ethnicity in the United States: 1997-2009 NHIS with Mortality Followup Through 2011. Circulation. 2017 Dec 13. pii: CIRCULATIONAHA.117.029376. doi: 10.1161/CIRCULATIONAHA.117.029376. [Epub ahead of print]

More evidence that air pollution shortens life expectancy and causes premature death.

Ebenstein A, et al. New evidence on the impact of sustained exposure to air pollution on life expectancy from China's Huai River Policy. Proceedings of the National Academy of Sciences, 2017; 201616784 DOI: 10.1073/pnas.1616784114

Huang C, et al. Potential Cardiovascular and Total Mortality Benefits of Air Pollution Control in Urban China. Circulation. 2017 Sep 7. pii: CIRCULATIONAHA.116.026487. doi: 10.1161/CIRCULATIONAHA.116.026487. [Epub ahead of print.

Malley C, et al. Updated Global Estimates of Respiratory Mortality in Adults ≥30 Years of Age Attributable to Long-Term Ozone Exposure. Environ Health Perspect; DOI:10.1289/EHP1390

Blount, R, et al. Traffic-Related Air Pollution and All-Cause Mortality during Tuberculosis Treatment in California. Environ Health Perspect; DOI:10.1289/EHP1699

This is a landmark study on air pollution and mortality, involving 61 million people from throughout the country. It is published in the most prestigious journal in the world, the New England Journal of Medicine. It significantly strengthens the association between premature death and PM2.5 and ozone. The key findings were that levels of both pollutants, well below the EPA's standards are still strongly associated with mortality. Specifically, for every 10 ug/m3 of chronic PM2.5 exposure mortality in 7.3%, or .73% for every 1 ug/m3. For ozone, for every 10 ppb, the mortality increased 1.1%. However, at lower concentrations, that association was even stronger. For those people exposed to levels of PM2.5 below 12 ug/m3 (the current EPA annual standard), and below 50 ppb ozone (the current EPA standard is 70 ppb), the risk of death increased to 1.36% for every 1 ug/m3 for PM2.5, and continued at the same rate for ozone, i.e. 1% for every 10 ppb.

This is the strongest research statement yet to establish that: 1. There is no safe level of air pollution. 2. Current EPA standards are inadequate and out of step with the science. 3. The health hazard per unit off exposure is actually greater at the lowest doses. That means public policy needs to address the problem even for those cities that have relatively clean air. 4. The current administration's attempt to delay or rollback standards will do even more harm than what has been previously calculated.

Di Q, et al. Air Pollution and Mortality in the Medicare Population. New England Journal of Medicine, 2017; 376 (26): 2513 DOI: 10.1056/NEJMoa1702747

We have known for several years that even low levels of particulate pollution (PM2.5) are associated with increased rates of daily death. Here is more evidence.

Schwartz J. et al. Estimating Causal Effects of Local Air Pollution on Daily Deaths: Effect of Low Levels. Environ Health Perspect; DOI:10.1289/EHP232

This MIT study is from 2013, and we don't know how we missed this at the time, but it certainly ramps up the relationship between pollution and mortality.

Epidemiologic evidence indicates that annually, 210,000 people in the US die prematurely due to particulate pollution and ozone. And the average premature death represents a loss of life of ten years!

PM2.5 generated from coal and diesel combustion are much more potent triggers of cardiovascular disease than PM2.5 from other sources.

Thurston GD, Burnett RT, Turner MC, Shi Y, Krewski D, Lall R, Ito K, Jerrett M, Gapstur SM, Diver WR, Pope CA 3rd. Ischemic Heart Disease Mortality and Long-Term Exposure to Source-Related Components of U.S. Fine Particle Air Pollution. Environ Health Perspect. 2015 Dec 2. [Epub ahead of print]

New methodology that solidifies the increase in mortality due to air pollution.

Schwartz J, Austin E, Bind MA, Zanobetti A, Koutrakis P. Estimating Causal Associations of Fine Particles With Daily Deaths in Boston. Am J Epidemiol. 2015 Sep 6. pii: kwv101. [Epub ahead of print]

More studies associate air pollution and risk of stroke and mortality from stroke.

Xue T, et al. A national case-crossover study on ambient ozone pollution and first-ever stroke among Chinese adults: Interpreting a weak association via differential susceptibility. Sci Total Environ. 2018 Nov 6;654:135-143. doi: 10.1016/j.scitotenv.2018.11.067. [Epub ahead of print]

Zhang R, et al. Acute Effects of Particulate Air Pollution on Ischemic Stroke and Hemorrhagic Stroke Mortality. Front Neurol. 2018 Oct 2;9:827. doi: 10.3389/fneur.2018.00827. eCollection 2018.

Tian Y, et al. Association between ambient air pollution and daily hospital admissions for ischemic stroke: A nationwide time-series analysis. PLoS Med. 2018 Oct 4;15(10):e1002668. doi: 10.1371/journal.pmed.1002668. eCollection 2018 Oct.

The American Thoracic Society has recommended lower national air quality standards than currently established by the EPA. The ATS recommend a PM2.5 standard of 11 ug/m3 instead of 12, and an ozone standard of 60 ppm instead of 70. This study calculates the increased mortality resulting from air pollution above the ATS suggestions.

Cromar KR, Gladson LA, Ghazipura M, Ewart G. ATS and Marron Institute Report: Estimated Excess Morbidity and Mortality Associated with Air Pollution above ATS-Recommended Standards, 2013-2015. Ann Am Thorac Soc. 2018 Feb 9. doi: 10.1513/AnnalsATS.201710-785EH. [Epub ahead of print] No abstract available.
PMID: 29425050 [PubMed – as supplied by publisher]

UPHE is adamantly opposed to the proposed project to dam the Bear River, reducing the flow to the Great Salt Lake, shrinking the lake, exposing thousands more acres of dry beach, and increasing the severity of dust storms. This study shows that dust storms in North America, like other forms of air pollution, increase mortality within a matter of days.

Crooks JL, et al. The Association between Dust Storms and Daily Non-Accidental Mortality in the United States, 1993–2005. Environ Health Perspect; DOI:10.1289/EHP216

It is well established that air pollution increases human mortality. Here is an interesting study that shows air pollution increases mortality in animals, in this case dairy cows.

Cox B, Gasparrini A, Catry B, Fierens F, Vangronsveld J, Nawrot TS. Ambient Air Pollution-Related Mortality in Dairy Cattle: Does It Corroborate Human Findings? Epidemiology. 2016 Jul 27. [Epub ahead of print]

Other

More evidence air pollution causes autoimmune diseases like rheumatoid arthritis, inflammatory bowel disease, and connective tissue disorders

Adami G, Pontalti M, Cattani G, et al Association between long-term exposure to air pollution and immune-mediated diseases: a population-based cohort study RMD Open 2022;8:e002055. doi: 10.1136/rmdopen-2021-002055

Ding S, Sun S, Ding R, Song S, Cao Y, Zhang L. Association between exposure to air pollutants and the risk of inflammatory bowel diseases visits. Environ Sci Pollut Res Int. 2021 Oct 20. doi: 10.1007/s11356-021-17009-0

Xie S, Zhang C, Zhao J, Li D, Chen J. Exposure to concentrated ambient PM2.5 (CAPM) induces intestinal disturbance via inflammation and alternation of gut microbiome. Environ Int. 2022 Feb 14;161:107138. doi: 10.1016/j.envint.2022.107138

Ozone is harmful to the skin, specifically on the statum corneum extracellular matrix of the skin.

Petracca B, Nădăban A, Eeman M, Gooris GS, Bouwstra JA. Effects of ozone on stratum corneum lipid integrity and assembly.

Chem Phys Lipids. 2021 Aug 2:105121. doi: 10.1016/j.chemphyslip.2021.105121. Epub ahead of print. PMID: 34352254.

Particulate pollution damages the cells of the cornea and conjunctiva of the eye.

Hyun SW, Song SJ, Park B, Lee TG, Kim CS. Toxicological effects of urban particulate matter on corneal and conjunctival epithelial cells. Toxicol Res. 2020 Feb 10;36(4):311-318. doi: 10.1007/s43188-019-00034-0. eCollection 2020 Oct. PMID: 33005590

Increasing air pollution increases income inequality and that general government public-health expenditures are an important transmission channel by which air pollution affects income inequality.

Wu J, Pu Y. Air pollution, general government public-health expenditures and income inequality: Empirical analysis based on the spatial Durbin model. PLoS One. 2020 Oct 1;15(10):e0240053. doi: 10.1371/journal.pone.0240053. eCollection 2020. PMID: 33002068 Free PMC article.

Particles "aged" in the atmosphere may be more toxic than "fresh" particulate pollution.

Offer S, et al. Effect of Atmospheric Aging on Soot Particle Toxicity in Lung Cell Models at the Air-Liquid Interface: Differential Toxicological Impacts of Biogenic and Anthropogenic Secondary Organic Aerosols (SOAs). Environ Health Perspect. 2022 Feb;130(2):27003. doi: 10.1289/EHP9413. Epub 2022 Feb 3. PMID: 35112925

Long term exposure to sulfur dioxide pollution, SOx, is associated with increased risk of osteoporosis related fractures.

Heo S, Kim H, Kim S, Choe SA, Byun G, Lee JT, Bell ML. Associations between Long-Term Air Pollution Exposure and Risk of Osteoporosis-Related Fracture in a Nationwide Cohort Study in South Korea. Int J Environ Res Public Health. 2022 Feb 19;19(4):2404. doi: 10.3390/ijerph19042404.PMID: 3520659

"Crosstalk" occurs between the respiratory and gastrointestinal tracts, commonly referred to as the gut-lung axis. Via microbial secretions, metabolites, immune mediators and lipid profiles, these two organ systems can influence each other. There is early evidence that probiotics, probiotics, and synbiotics may mitigate the negative effects of air pollution.

Keulers L, et al. Probiotics, prebiotics, and synbiotics to prevent or combat air pollution consequences: The gut-lung axis. Environ Pollut. 2022 Feb 28:119066. doi: 10.1016/j.envpol.2022.119066. Online ahead of print. PMID: 35240267 Review

Air filtration leads to increased protein synthesis and enhanced mitochondrial efficiency, resulting in a highly significant triggering of ATP synthesis and a reduction in oxidative damage.

Antuña E, Carlos Bermejo-Millo J, Caso-Onzain E, Caso-Peláez E, Potes Y, Coto-Montes A. Removal of Environmental Nanoparticles Increases Protein Synthesis and Energy Production in Healthy Humans. Front Bioeng Biotechnol. 2022 Feb 14;10:800011. doi: 10.3389/fbioe.2022.800011. eCollection 2022

Despite being a "criteria" pollutant, and regulated by the EPA, carbon monoxide has received little attention from researchers and from regulators. This large international study however showed that, like PM2.5 and ozone, carbon monoxide is deadly, even at low doses, there is no safe level of carbon monoxide, and that

the dose response curve is even steeper at low concentrations, below the EPA's standards.

Chen K, et al. Ambient carbon monoxide and daily mortality: a global time-series study in 337 cities. The Lancet Planetary Health, 2021; 5 (4): e191 DOI: 10.1016/S2542-5196(21)00026-7

More evidence of air pollution causing increases in hospitalizations, including at very low concentrations, and especially among the elderly.

Yazdi MD, et al. Long-Term Association of Air Pollution and Hospital Admissions Among Medicare Participants Using a Doubly Robust Additive Model. Circulation, 2021; DOI: 10.1161/CIRCULATIONAHA.120.050252

The smaller the pollution particles the more dangerous they are. This study confirmed that loss of life expectancy from inhalation of PM1 is greater than from PM2.5.

Zheng H, Yi W, Ding Z, Xu Z, Ho HC, Cheng J, Hossain MZ, Song J, Fan Y, Ni J, Wang Q, Xu Y, Wei J, Su H. Evaluation of life expectancy loss associated with submicron and fine particulate matter (PM1 and PM2.5) air pollution in Nanjing, China. Environ Sci Pollut Res Int. 2021 Jul 15. doi: 10.1007/s11356-021-15244-z. Epub ahead of print. PMID: 34268691.

Particulate pollution can simultaneously stimulate bone resorption and halt bone formation. More evidence that air pollution is associated with increased risk of developing osteoporosis

Adami G, Cattani G, Rossini M, Viapiana O, Olivi P, Orsolini G, Bertoldo E, Fracassi E, Gatti D, Fassio A. Association between exposure to fine particulate matter and osteoporosis: a population-based cohort study. Osteoporos Int. 2021 Jul 15. doi: 10.1007/s00198-021-06060-9. Epub ahead of print. PMID: 34268604.

In a heavily polluted city in Iran particulate pollution was associated with a loss of life expectancy of 3 years.

Moradi M, Hadei M, Yazdani M, Goudarzi M, Baboli Z, Tahmasebi Birgani Y, Neisi A, Goudarzi G. Effect of long-term exposure to PM2.5 on years of life lost in a populated Middle Eastern city. Environ Geochem Health. 2021 Feb 5. doi: 10.1007/s10653-021-00827-z. Epub ahead of print. PMID: 33544269.

Evidence is emerging that air pollution is also associated with the kidney. Here is one of the first studies to show that.

Li G, Huang J, Wang J, Zhao M, Liu Y, Guo X, Wu S, Zhang L. Long-Term Exposure to Ambient PM2.5 and Increased Risk of CKD Prevalence in China. J Am Soc Nephrol. 2021 Feb;32(2):448-458. doi: 10.1681/ASN.2020040517. Epub 2020 Dec 17. PMID: 33334736; PMCID: PMC8054885.

The incidence of metabolic syndrome dramatically increased in elderly males with exposure to particulate air pollution.

Zang ST, Luan J, Li L, Wu QJ, Chang Q, Dai HX, Zhao YH. Air pollution and metabolic syndrome risk: Evidence from nine observational studies. Environ Res. 2021 Jul 12:111546. doi: 10.1016/j.envres.2021.111546. Epub ahead of print. PMID: 34265350

New information on how air pollution injures the cells that line the blood vessels.

Li X, Haberzettl P, Conklin DJ, Bhatnagar A, Rouchka EC, Zhang M, O'Toole TE. Exposure to Fine Particulate Matter Air Pollution Alters mRNA and miRNA Expression in Bone Marrow-Derived Endothelial Progenitor Cells from Mice. Genes (Basel). 2021 Jul 10;12(7):1058. doi: 10.3390/genes12071058. PMID: 34356074; PMCID: PMC8307414.

Ozone and nitrogen oxide levels in an area with high rates of wood burning were associated with a decrease in the diameter of the microscopic blood vessels in the eye, as well as higher blood pressure in children who lived in an area of high exposure to wood smoke. This is a clear indicator of the adverse impact of air pollution (in this case wood smoke) on blood vessels, and it shows up as early as childhood.

Korsiak J, Perepeluk KL, Peterson NG, Kulka R, Weichenthal S. Air pollution and retinal vessel diameter and blood pressure in school-aged children in a region impacted by residential biomass burning. Sci Rep. 2021 Jun 17;11(1):12790. doi: 10.1038/s41598-021-92269-x. PMID: 34140605

This study draws a correlation between air pollution and “frailty" in the elderly. Paper says that when adjusted for age, sex, smoking, urbanity, frail and status changes were significantly associated with high PM 2.5 exposure.

*Lee WJ, Liu CY, Peng LN, Lin CH, Lin HP, Chen LK. PM2.5 air pollution contributes to the burden of frailty. Sci Rep. 2020 Sep 2;10(1):14478. doi: 10.1038/s41598-020-71408-w.*Air pollution in California fell with the COVID 19 lockdown. Authors found a sudden drop in air pollution when the shutdown started and uptick of air pollution when reopening occured. Ground-based observations around California show a 38%, 49%, and 31% drop in the concentration of NO2, carbon monoxide (CO) and particulate matter 2.5 (PM2.5) during the lockdown (March 19-May 7) compared to before (January 26-March 18) in 2020.

Liu Q, et al. Spatiotemporal impacts of COVID-19 on air pollution in California, USA. Sci Total Environ. 2020 Aug 10;750:141592. doi: 10.1016/j.scitotenv.2020.141592.

Air pollution causes disruption of corneal and conjunctival epithelium by decreasing cell viability, altering cell cycle, disrupting mucin, and regulating inflammatory mediators.

Hyun SW, Song SJ, Park B, Lee TG, Kim CS. Toxicological effects of urban particulate matter on corneal and conjunctival epithelial cells. Toxicol Res. 2020 Feb 10;36(4):311-318. doi: 10.1007/s43188-019-00034-0. eCollection 2020 Oct. PMID: 33005590

This study looks at the social impacts and public health consequences of poor air quality. Authors found that increasing air pollution increases income inequality

and that general government public-health expenditures are an important transmission channel by which air pollution affects income inequality.

Wu J, Pu Y. Air pollution, general government public-health expenditures and income inequality: Empirical analysis based on the spatial Durbin model. PLoS One. 2020 Oct 1;15(10):e0240053. doi: 10.1371/journal.pone.0240053. eCollection 2020.

PMID: 33002068

No surprise here. Ambulance dispatches increase during wildfire season.

Yao J, et al. Sub-Daily Exposure to Fine Particulate Matter and Ambulance Dispatches during Wildfire Seasons: A Case-Crossover Study in British Columbia, Canada. Environmental Health Perspectives, 2020; 128 (6): 067006 DOI: 10.1289/EHP5792

More evidence of air pollution's neurotoxic effect, in this case impairing episodic memory.

Petkus AJ, et al. Exposure to fine particulate matter and temporal dynamics of episodic memory and depressive symptoms in older women. Environ Int. 2019 Dec 24;135:105196. doi: 10.1016/j.envint.2019.105196. [Epub ahead of print]

Not only are NOx, SO2, and particulate pollution associated with increased risk of stroke, the relationship between ozone and stroke was "V" shaped, meaning that low concentrations of O3 had a greater association with stroke than moderate concentrations.

Wang Z, et al. Association between short-term exposure to air pollution and ischemic stroke onset: a time-stratified case-crossover analysis using a distributed lag nonlinear model in Shenzhen, China. Environ Health. 2020 Jan 2;19(1):1. doi: 10.1186/s12940-019-0557-4.

Another study showed a higher risk of arthritis with exposure to air pollution.

Yamamoto SS, et al. Household air pollution and arthritis in low-and middle-income countries: Cross-sectional evidence from the World Health Organization's study on Global Ageing and Adult Health.PLoS One. 2019 Dec 27;14(12):e0226738. doi: 10.1371/journal.pone.0226738. eCollection 2019.

Air pollution is associated with reduced bone mineral density, even in young people, increasing the risk of later on osteoporosis.

Ranzani OT, et al. Association of Ambient and Household Air Pollution With Bone Mineral Content Among Adults in Peri-urban South India. JAMA Netw Open. 2020 Jan 3;3(1):e1918504. doi: 10.1001/jamanetworkopen.2019.18504.

More evidence that air pollution is toxic to genes and decreases the length of telomeres.

Ma Y, et al. Effect of combustion-derived particles on genotoxicity and telomere length: a study on human cells and exposed populations. Toxicol Lett. 2020 Jan 7. pii: S0378-4274(20)30002-3. doi: 10.1016/j.toxlet.2020.01.002. [Epub ahead of print]

This study showed an increased effect of air pollution on cognition in elderly women compared with men of equal age.

Kim H, et al. Gender Difference in the Effects of Outdoor Air Pollution on Cognitive Function Among Elderly in Korea. Front Public Health. 2019 Dec 10;7:375. doi: 10.3389/fpubh.2019.00375. eCollection 2019.

Air pollution alters the composition and functional profile of the bacterial population of the GI tract. This is likely one explanation for the growing evidence that air pollution increases the risk of inflammatory bowel disease.

Fouladi F, et al. Air pollution exposure is associated with the gut microbiome as revealed by shotgun metagenomic sequencing. Environment International, 2020; 138: 105604 DOI: 10.1016/j.envint.2020.105604

Grande G, et al. Association Between Cardiovascular Disease and Long-term Exposure to Air Pollution With the Risk of Dementia. JAMA Neurology, 2020; DOI: 10.1001/jamaneurol.2019.4914

Chronic air pollution is associated with calcification of the coronary arteries in asymptomatic adults.

Huynh Q, et al. Long-term exposure to ambient air pollution is associated with coronary artery calcification among asymptomatic adults. Eur Heart J Cardiovasc Imaging. 2020 May 1. pii: jeaa073. doi: 10.1093/ehjci/jeaa073. [Epub ahead of print]

This study demonstrates that the benefits of cleaner air occur almost immediately. Respiratory symptoms, hospitalizations, school absenteeism, and mortality start to drop within a few weeks, although they may not drop back to normal. And there is an additional benefit to making already clean air even cleaner.

*Schraufnagel D, et al. Health Benefits of Air Pollution Reduction. Annals of the American Thoracic Society. Vol. 16, No. 12 | Dec 01, 2019*More evidence that air pollution related mortality is found at concentrations below the EPA's national standards.

Michael Brauer M, et al. Mortality–Air Pollution Associations in Low-Exposure Environments (MAPLE): Phase 1. Health Effects Institute. Research Report 203, November 2019

By promoting inflammation, particulate pollution was found to contribute to rheumatoid and osteoarthritis, higher levels of antibodies, severe bone density decrease, cartilage wear, and structure damages.

Peng K, et al. Particulate matter exposure aggravates osteoarthritis severity.Clin Sci (Lond). 2019 Oct 18. pii: CS20190458. doi: 10.1042/CS20190458. [Epub ahead of print]. PMID: 31696218 [PubMed - as supplied by publisher]

Alex AM, et al. Exposure to ambient air pollution and autoantibody status in rheumatoid arthritis. Clin Rheumatol. 2019 Nov 15. doi: 10.1007/s10067-019-04813-w. [Epub ahead of print]

More evidence that air pollution is associated with sleep disorders, including sleep apnea.

Tang M, et al. The association of short-term effects of air pollution and sleep disorders among elderly residents in China. Sci Total Environ. 2019 Nov 19:134846. doi: 10.1016/j.scitotenv.2019.134846. [Epub ahead of print]

Yu H, et al. The Association between Air Pollution and Sleep Duration: A Cohort Study of Freshmen at a University in Beijing, China. Int J Environ Res Public Health. 2019 Sep 11;16(18). pii: E3362. doi: 10.3390/ijerph16183362.

Inhalation of particulate pollution associated with Mountain Top Removal mining contributes to dramatically increased risk for dementia related mortality.

Salm AK, et al. Increased Dementia Mortality in West Virginia Counties with Mountaintop Removal Mining? Int J Environ Res Public Health. 2019 Nov 4;16(21). pii: E4278. doi: 10.3390/ijerph16214278. PMID: 31689936 [PubMed - in process]

Air pollution decreases stock market returns by decreasing mood and trading activity among brokers.

Wu Q, et al. Air pollution, stock returns, and trading activities in China. Pacific-Basin Finance Journal. Volume 51, October 2018, Pages 342-365

We have seen the emergence of studies showing that particulate matter is embedded in the critical organs of virtually all humans. Sixty-five people were studied at autopsy, the average age was 25, the youngest was only three years old. Researchers found between 2 billion and 22 billion nanoparticles of air pollution embedded in the heart tissue itself of all subjects. Those people who had lived in the highly polluted Mexico City had between 2 and 10 times as many pollution particles as those that lived less polluted environments.

Calderón-Garcidueñas L, et al. Combustion- and friction-derived magnetic air pollution nanoparticles in human hearts. Environmental Research Volume 176, September 2019, 108567

Thyroid function is critical to good health at any age, and especially critical for normal fetal development, including brain development. The impact of air pollution on thyroid function has only recently been studied. Two new studies show that air pollution impairs thyroid function in pregnant mothers and in turn

impairs fetal thyroid development, which may contribute to the well established connection between air pollution and low birth weight.

Howe CG, et al. Association of Prenatal Exposure to Ambient and Traffic-Related Air Pollution With Newborn Thyroid Function: Findings From the Children's Health Study. JAMA Network Open, 2018 DOI: 10.1001/jamanetworkopen.2018.2172

Wang X, et al. Evaluation of maternal exposure to PM2.5 and its components on maternal and neonatal thyroid function and birth weight: a cohort study. Thyroid. 2019 Jul 12. doi: 10.1089/thy.2018.0780. [Epub ahead of print]

Proximity to oil and gas drilling activity (think fracking), increases blood pressure, arterial stiffness, and the chemical markers of inflammation.

McKenziea LM, et al. Relationships between indicators of cardiovascular disease and intensity of oil and natural gas activity in Northeastern Colorado. Environmental Research, Volume 170, March 2019, Pages 56-64.

Air pollution is associated with other metabolic disorders like fatty liver disease and an adverse blood lipid profile.

Xu MX, et al. Prolonged PM2.5 exposure elevates risk of oxidative stress-driven nonalcoholic fatty liver disease by triggering increase of dyslipidemia. Free Radic Biol Med. 2018 Nov 19. pii: S0891-5849(18)31447-3. doi: 10.1016/j.freeradbiomed.2018.11.016. [Epub ahead of print]

A review article on all the evidence that air pollution shortens telomeres, which reduces life expectancy.

Miri M, et al. Air pollution and telomere length in adults: A systematic review and meta-analysis of observational studies. Environ Pollut. 2018 Oct 8;244:636-647. doi: 10.1016/j.envpol.2018.09.130. [Epub ahead of print]

Here's another study showing that air pollution is associated with kidney disease.

Chan TC, et al. Long-Term Exposure to Ambient Fine Particulate Matter and Chronic Kidney Disease: A Cohort Study. Published:15 October 2018CID: 107002https://doi.org/10.1289/EHP3304

Another study showing increases in hospital admissions for respiratory and cardiovascular diseases with more air pollution.

Phosri A, et al. Effects of ambient air pollution on daily hospital admissions for respiratory and cardiovascular diseases in Bangkok, Thailand. Sci Total Environ. 2019 Feb 15;651(Pt 1):1144-1153. doi: 10.1016/j.scitotenv.2018.09.183. Epub 2018 Sep 15.

More evidence that air pollution is associated with a worse blood lipid profile.

Yang BY, et al. Exposure to ambient air pollution and blood lipids in adults: The 33 Communities Chinese Health Study. Environ Int. 2018 Jul 23;119:485-492. doi: 10.1016/j.envint.2018.07.016. [Epub ahead of print]

More evidence that air pollution causes DNA damage and increases DNA repair activity.

Ledda C, et al. Mutagenic and DNA repair activity in traffic policemen: a case-crossover study.J Occup Med Toxicol. 2018 Aug 8;13:24. doi: 10.1186/s12995-018-0206-9. eCollection 2018.

Two new studies showing increased rates of appendicitis with more air pollution.

Aroui H, et al. The effect of environmental factors on the incidence of perforated appendicitis. Ann Ital Chir. 2018 Jul 23;7. pii: S0003469X18028014. [Epub ahead of print]

Chen CC, et al. Effects of ambient air pollution exposure on frequency of hospital admissions for appendicitis in Taipei, Taiwan.J Toxicol Environ Health A. 2018 Jul 26:1-7. doi:10.1080/15287394.2018.1498276. [Epub ahead of print]

Research continues to build that air pollution is associated with a broad range of neurologic diseases. This study breaks new ground in finding a connection between air pollution and Amyotrophic Lateral Sclerosis (ALS), i.e. Lou Gehrig's disease.

Povedano M, et al. Spatial Assessment of the Association between Long-Term Exposure to Environmental Factors and the Occurrence of Amyotrophic Lateral Sclerosis in Catalonia, Spain: A Population-Based Nested Case-Control Study. Neuroepidemiology. 2018 May 31;51(1-2):33-49. doi: 10.1159/000489664. [Epub ahead of print]

We are learning more and more about how air pollution may contribute to inflammatory bowel diseases. This study in mice shows that air pollution disrupts the components of bowel bacteria, leaving the bowel more vulnerable to inflammation.

Mutlu EA, et al. Inhalational exposure to particulate matter air pollution alters the composition of the gut microbiome. Environ Pollut. 2018 May 18;240:817-830. doi: 10.1016/j.envpol.2018.04.130. [Epub ahead of print]

Another study shows that air pollution increases the incidence of infections in general, in this case, ear infections.

Park M, et al. Air pollution influences the incidence of otitis media in children: A national population-based study. PLoS One. 2018 Jun 28;13(6):e0199296. doi: 10.1371/journal.pone.0199296. eCollection 2018.

We are often asked how bad does the air pollution have to get to make it more dangerous to your health than the benefits of the exercise itself? We still don't really know the answer, but this study suggests that with dirty air, the benefits of

the exercise are wiped out after 15 minutes, and that after 75 minutes, the air pollution is doing more damage than the benefits of the exercise.

Pasqua LA, et al. Exercising in Air Pollution: The Cleanest versus Dirtiest Cities Challenge. Int J Environ Res Public Health. 2018 Jul 17;15(7). pii: E1502. doi: 10.3390/ijerph15071502.

More evidence that air pollution changes the functioning of genes, one mechanism by which it provokes diseases of the heart, lungs, and endocrine systems.

Favé M-J, et al. Gene-by-environment interactions in urban populations modulate risk phenotypes. Nature Communications, 2018; 9 (1) DOI: 10.1038/s41467-018-03202-2

Plusquin M, et al. DNA methylome marks of exposure to particulate matter at three time points in early life. Environ Sci Technol. 2018 Mar 30. doi: 10.1021/acs.est.7b06447. [Epub ahead of print]

Jie Y, et al. Changes in gene expression in lungs of mice exposed to traffic-related air pollution. Mol Cell Probes. 2018 Apr 2. pii: S0890-8508(18)30034-3. doi: 10.1016/j.mcp.2018.03.005. [Epub ahead of print].

*Domingues ÉP, et al. Genotoxic effects following exposure to air pollution in street vendors from a high-traffic urban area. Env*iron Monit Assess. 2018 Mar 14;190(4):215. doi: 10.1007/s10661-018-6598-2.

Krauskopf J, Caiment F, van Veldhoven K, Chadeau-Hyam M, Sinharay R, Chung KF, Cullinan P, Collins P, Barratt B, Kelly FJ, Vermeulen R, Vineis P, de Kok TM, Kleinjans JC. The human circulating miRNome reflects multiple organ disease risks in association with short-term exposure to traffic-related air pollution. Environ Int. 2018 Jan 27;113:26-34. doi: 10.1016/j.envint.2018.01.014. [Epub ahead of print] PMID: 29421404 [PubMed – as supplied by publisher]

More evidence that air pollution contributes to the risk of strokes

Kulick ER, et al. Residential Proximity to Major Roadways and Risk of Incident Ischemic Stroke in NOMAS (The Northern Manhattan Study). Stroke. 2018 Mar 14. pii: STROKEAHA.117.019580. doi: 10.1161/STROKEAHA.117.019580. [Epub ahead of print]

Guan T, et al. Differential Susceptibility in Ambient Particle-Related First-Ever Stroke Onset Risk: Findings From a National Case-Crossover Study. Am J Epidemiol. 2018 Jan 17. doi: 10.1093/aje/kwy007. [Epub ahead of print]

Béjot Y, et al. A review of epidemiological research on stroke and dementia and exposure to air pollution. Int J Stroke. 2018 Jan 1:1747493018772800. doi: 10.1177/1747493018772800. [Epub ahead of print]

Air pollution is associated relapses in multiple sclerosis

Jeanjean M, Bind MA, Roux J, Ongagna JC, de Sèze J, Bard D, Leray E. Ozone, NO₂ and PM₁₀ are associated with the occurrence of multiple sclerosis relapses. Evidence from seasonal multi-pollutant analyses. Environ Res. 2018 Feb 6;163:43-52. doi: 10.1016/j.envres.2018.01.040. [Epub ahead of print] PMID: 29426027 [PubMed – as supplied by publisher]

Air pollution increases atherosclerosis in arteries in the brain and ameliorated by consuming omega three fatty acids.

Guan L, et al. PM2.5 inhalation induces intracranial atherosclerosis which may be ameliorated by omega 3 fatty acids. Oncotarget. 2017 Dec 16;9(3):3765-3778. doi: 10.18632/oncotarget.23347. eCollection 2018 Jan 9.

We highlight this paper first because one of our board members, Dr. Robert Paine, was one of the authors and the study was done here on the Wasatch Front. Investigators from the University of Utah and Intermountain Medical Center found that the risk of pneumonia and the severity of the illness (including ICU admission and need for critical care) was increased in response to a few days of increased PM2.5 levels. Like with so many other studies, these effects were seen even at levels below EPA standards.

Pirozzi CS, Jones BE, VanDerslice JA, Zhang Y, Paine R, Dean N. Short-Term Air Pollution and Incident Pneumonia: A Case-Crossover Study. Ann Am Thorac Soc. 2017 Dec 28. doi: 10.1513/AnnalsATS.201706-495OC. [Epub ahead of print]

More studies showing air pollution, including ozone, increases blood pressure, and the risk for hospitalization for high blood pressure

Zhang Z, et al. Long-Term Exposure to Fine Particulate Matter, Blood Pressure, and Incident Hypertension in Taiwanese Adults. Environ Health Perspect. 2018 Jan 18;126(1):017008. doi: 10.1289/EHP2466.

Chen CC, et al. Association between gaseous air pollution and hospital admissions for hypertension in Taipei, Taiwan.
J Toxicol Environ Health A. 2017 Dec 22:1-7. doi: 10.1080/15287394.2017.1395573. [Epub ahead of print]

This study in mice shows that an anti-oxidant in grapefruit reduces the DNA damage and oxidative stress in heart cells, and the tendency for blood clot formation caused by diesel exhaust. This is just one study, but there's no down side to eating more grapefruit.

Nemmar A, et al. Thrombosis, systemic and cardiac oxidative stress and DNA damage induced by pulmonary exposure to diesel exhaust particles, and the effect of nootkatone thereon. Am J Physiol Heart Circ Physiol. 2018 Jan 5. doi: 10.1152/ajpheart.00313.2017. [Epub ahead of print]

This is the first study we know of to show that air pollution affects menstruation, delaying the onset of menstrual regularity in exposed teenage girls.

Mahalingaiah S, et al. Perimenarchal air pollution exposure and menstrual disorders. Human Reproduction, 2018; DOI: 10.1093/humrep/dey005

Air pollution even of only a few days duration, increases the risk of bronchiolitis and otitis media in infants, especially those born prematurely

Girguis MS, et al. Exposure to acute air pollution and risk of bronchiolitis and otitis media for preterm and term infants.
J Expo Sci Environ Epidemiol. 2017 Dec 21. doi: 10.1038/s41370-017-0006-9. [Epub ahead of print]

Given that inflammation is the biological pathway through which air pollution causes many diseases, for this study to find an exacerbation of lupus with air pollution is not at all surprising.

Alves AGF, et al. Influence of air pollution on airway inflammation and disease activity in childhood-systemic lupus erythematosus. Clin Rheumatol. 2017 Nov 2. doi: 10.1007/s10067-017-3893-1. [Epub ahead of print]

This is the first study we know of to show that osteoporosis is associated with air pollution exposure.

Prada, D, Zhong, J, Colicino, E et al. Association of air particulate pollution with bone loss over time and bone fracture risk: analysis of data from two independent studies. Lancet Planet Health. 2017; 1: e337–e347

Air pollution degrades the inside lining of the nose.

Zhao R, et al. Nasal epithelial barrier disruption by particulate matter ≤2.5 μm via tight junction protein degradation.
J Appl Toxicol. 2017 Dec 13. doi: 10.1002/jat.3573. [Epub ahead of print]

In this rather elaborate study, the heart and lung benefits of exercise walking were offset by air pollution inhaled along a busy road.

Sinharay R, et al. Respiratory and cardiovascular responses to walking down a traffic-polluted road compared with walking in a traffic-free area in participants aged 60 years and older with chronic lung or heart disease and age-matched healthy controls: a randomised, crosso. The Lancet, 2017; DOI:

More evidence that air pollution increases blood pressure

Magalhaes S, et al. Impacts of exposure to black carbon, elemental carbon, and ultrafine particles from indoor and outdoor sources on blood pressure in adults: A review of epidemiological evidence. Environ Res. 2017 Nov 28;161:345-353. doi: 10.1016/j.envres.2017.11.030. [Epub ahead of print]

We have stated previously that air pollution harms all major organ systems. The evidence for an affect on kidneys has been sparse however. This new study shows evidence that air pollution has a significant association with impaired kidney function.

Bowe B, et al. Particulate Matter Air Pollution and the Risk of Incident CKD and Progression to ESRD. J Am Soc Nephrol. 2017 Sep 21. pii: ASN.2017030253. doi: 10.1681/ASN.2017030253. [Epub ahead of print]

Another study showing air pollution's connection to rates of strokes.

Guo P, et al. Ambient Air Pollution and Risk for Ischemic Stroke: A Short-Term Exposure Assessment in South China. Int J Environ Res Public Health. 2017 Sep 20;14(9). pii: E1091. doi: 10.3390/ijerph14091091.

More studies showing particulate pollution's alteration of the functioning of genes.

Huang Q, et al. Fine particulate matter 2.5 exerted its toxicological effect by regulating a new layer, long non-coding RNA. Sci Rep. 2017 Aug 24;7(1):9392. doi: 10.1038/s41598-017-09818-6.

de Oliveira A, et al. Biomass burning in the Amazon region causes DNA damage and cell death in human lung cells. Sci Rep. 2017 Sep 7;7(1):10937. doi: 10.1038/s41598-017-11024-3.

Inhalation of particles is different depending on the age of the person. Particle deposition highest in an infant, less in an older child, and lowest in an adult.

Deng Q, et al. Particle deposition in tracheobronchial airways of an infant, child and adult. Sci Total Environ. 2017 Aug 27;612:339-346. doi: 10.1016/j.scitotenv.2017.08.240. [Epub ahead of print]

Epigenetic changes have been found to play a role in the inflammation cascade triggered by air pollution.

Wang C, et al. Acute Inflammation Following Personal Exposure to Fine-particulate Air Pollution. Am J Epidemiol. 2017 Aug 17. doi: 10.1093/aje/kwx277. [Epub ahead of print

Even air pollution levels slightly above background levels are associated withe increased rates of hospitalization for all causes, and for respiratory and heart problems in particular. Like other studies on mortality, the rate of increase per unit of exposure, was even greater at PM 2.5 levels below 8 ug/m3. The current annual EPA standard is 12. Background levels of PM2.5 are about 5 ug/m3.

Makar M, Antonelli J, Di Q, Cutler D, Schwartz J, Dominici F. Estimating the Causal Effect of Low Levels of Fine Particulate Matter on Hospitalization. Epidemiology. 2017 Sep;28(5):627-634. doi: 10.1097/EDE.0000000000000690.

More evidence that air pollution is a risk factor for inflammatory bowel disease.

van der Sloot KWJ, Amini M, Peters V, Dijkstra G, Alizadeh BZ. Inflammatory Bowel Diseases: Review of Known Environmental Protective and Risk Factors Involved. Inflamm Bowel Dis. 2017 Aug 2. doi: 10.1097/MIB.0000000000001217. [Epub ahead of print]

Good review on the broad based health consequences of ozone. Think of it as slightly less toxic than particulate pollution.

Nuvolone D, Petri D, Voller F. The effects of ozone on human health. Environ Sci Pollut Res Int. 2017 May 25. doi: 10.1007/s11356-017-9239-3. [Epub ahead of print]

This paper gives us new insight into how particulate pollution causes vascular dysfunction, leading to such things as heart attacks and strokes. Inhaled nanoparticles were found to accumulate in the lining of blood vessels at sites of existing inflammation and atherosclerosis, aggravating that disease process. The particles appeared in the blood and urine of human subjects within as little as 15 minutes, and were still present three months later.

Miller MR, et al. Inhaled Nanoparticles Accumulate at Sites of Vascular Disease. ACS Nano. 2017 Apr 26. doi: 10.1021/acsnano.6b08551. [Epub ahead of print]

As the connection between air pollution and neurodegenerative diseases steadily grows, this is one we didn't anticipate–air pollution aggravating symptoms of Parkinson's disease.

Lee H, Myung W, Kim DK, Kim SE, Kim CT, Kim H. Short-term air pollution exposure aggravates Parkinson's disease in a population-based cohort. Sci Rep. 2017 Mar 16;7:44741. doi: 10.1038/srep44741.

Two more studies showing air pollution damages DNA by altering "epigenetics," the chemical bath that chromosomes sit in.

Lai CH, et al. Exposure to fine particulate matter causes oxidative and methylated DNA damage in young adults: A longitudinal study. Sci Total Environ. 2017 Apr 23;598:289-296. doi: 10.1016/j.scitotenv.2017.04.079. [Epub ahead of print]

Ding R, et al. Dose- and time- effect responses of DNA methylation and histone H3K9 acetylation changes induced by traffic-related air pollution. Sci Rep. 2017 Mar 3;7:43737. doi: 10.1038/srep43737.

The most toxic type of particulate pollution is the ultrafine category, i.e. less than 0.1 micron is size. Ultrafine pollution exposure is associated with accelerated atherosclerosis and increased rates of inflammatory bowel disease. This study reveals a likely mechanism. Ultrafines can be inhaled or ingested. This study shows that ingested ultrafine pollution altered the microbial make up of the bowel, and increased atherogenic lipid metabolites.

Li R, et al. Ambient Ultrafine Particle Ingestion Alters Gut Microbiota in Association with Increased Atherogenic Lipid Metabolites. Sci Rep. 2017 Feb 17;7:42906. doi: 10.1038/srep42906.

The closer you live to a major traffic corridor, the greater your chance of developing dementia. More evidence of the neurotoxicity of air pollution.

Chen H, et al. Living near major roads and the incidence of dementia, Parkinson's disease, and multiple sclerosis: a population-based cohort study. Published: 04 January 2017 DOI: http://dx.doi.org/10.1016/S0140-6736(16)32399-6

Ozone was associated with increased rates of hospitalization for dementia in a population in Spain.

Linares C, et al. Short-term association between environmental factors and hospital admissions due to dementia in Madrid. Environ Res. 2016 Oct 27;152:214-220. doi: 10.1016/j.envres.2016.10.020. [Epub ahead of print]

More evidence that PM 2.5 air pollution is associated with systemic autoimmune rheumatic diseases (SARDs), as well as an increased relative risk for juvenile idiopathic arthritis

Sun G, et al. Association between Air Pollution and the Development of Rheumatic Disease: A Systematic Review. Int J Rheumatol. 2016;2016:5356307. Epub 2016 Oct 25.

Some of the first research showing that air pollution reduces kidney function, even at levels significantly below the national EPA standards.

Raaschou-Nielsen O, et al. Outdoor air pollution and risk for kidney parenchyma cancer in 14 European cohorts. Int J Cancer. 2016 Dec 22. doi: 10.1002/ijc.30587. [Epub ahead of print]

Another study showing that exposure to particulate matter is associated with the thickness of atherosclerosis in the body's arteries.

Aguilera I, et al. Particulate Matter and Subclinical Atherosclerosis: Associations between Different Particle Sizes and Sources with Carotid Intima-Media Thickness in the SAPALDIA Study. Environ Health Perspect; DOI:10.1289/EHP161

This study shows that a 2.1 ug/m3 increase in chronic PM2.5 exposure was associated with a decrease in kidney function equivalent to what would be expected from 2 yrs of aging. Bear in mind that the Wasatch Front averages a PM2.5 of about 10. So that would be a decrease in kidney function equivalent to ten years of aging.

Mehta A, et al. Long-Term Exposure to Ambient Fine Particulate Matter and Renal Function in Older Men: The Veterans Administration Normative Aging StudyEnviron Health Perspect. 2016 Sep; 124(9): 1353–1360.

More evidence that episodic air pollution, typical of Utah's inversions, provokes damage to the lining of blood vessels, which can contribute to acceleration of age

related vascular disease, and ultimately strokes, heart attacks, sudden death, and poor pregnancy outcomes. The subjects studied were young healthy adults.

Pope CA, Bhatnagar A, McCracken J, Abplanalp WT, Conklin DJ, O'Toole TE. Exposure to Fine Particulate Air Pollution Is Associated with Endothelial Injury and Systemic Inflammation. Circ Res. 2016 Oct 25. pii: CIRCRESAHA.116.309279.

Air pollution accelerates the aging process, at least in part by shortening the length of telomeres. Life expectancy is proportional to telomere length, and the initial length of telomeres at birth is largely the result of environmental factors. Telomeres can be considered the cellular memories of exposure to oxidative stress and inflammation throughout a life time.

Martens DS, Nawrot TS. Air Pollution Stress and the Aging Phenotype: The Telomere Connection. Curr Environ Health Rep. 2016 Jun 29. [Epub ahead of print]

Air pollution is associated with a loss of the sense of smell (which incidentally is one of the first signs of Alzheimer's).

Ajmani GS, et al. Effects of Ambient Air Pollution Exposure on Olfaction: A Review. Environ Health Perspect. 2016 Jun 10. [Epub ahead of print]

The study below showed that the multi-faceted operations of the Canadian Tar Sands are a major source of air pollution in North America. The authors state this has implications for other sources of "heavy oil" extraction. That would include the heavy black wax crude in the Uinta Basin. These two studies certainly reinforce our concern about air pollution as the most likely explanation for the spike in infant deaths in Vernal.

Leggy J, et al. Oil sands operations as a large source of secondary organic aerosols Nature (2016) doi:10.1038/nature17646

This is a landmark study showing chronic PM 2.5 levels of as little as 5 ug/m3 correlate with a 20% increase in development of coronary artery calcification over ten years. The EPA's annual standard is 12.5 ug. So based on the metric from this study, what the EPA considers "safe" or acceptable, will increase the "hardening" of your arteries over 70 yrs, by 360%. Doesn't sound very safe does it?

Kaufman, J, et al. Association between air pollution and coronary artery calcification within six metropolitan areas in the USA (the Multi-Ethnic Study of Atherosclerosis and Air Pollution): a longitudinal cohort study. DOI: http://dx.doi.org/10.1016/S0140-6736(16)00378-0

The risk of an ischemic stroke with air pollution is well established. This study shows that particulate pollution and ozone are significantly correlated with hemorrhagic stroke as well.

Han M, et al. Association between hemorrhagic stroke occurrence and meteorological factors and pollutants. BMC Neurol. 2016 May 4;16(1):59. doi: 10.1186/s12883-016-0579-2.

The evidence for air pollution's neurotoxicity continues to mount. For every 3 ug/m3 increase in NO2, considered a marker of traffic pollution, rates of Parkinson's Disease increased 9%. Wasatch Front averages around 25 ug/m3. This study suggests that Wasatch Front pollution is associated with an increase in Parkinson's of 72%.

Ritz B, et al. Traffic-Related Air Pollution and Parkinson's Disease in Denmark: A Case–Control Study. Environ Health Perspect; DOI:10.1289/ehp.1409313

Long term exposure to traffic pollution strongly associated with Alzheimer's and vascular causes dementia.

Oudin, A, et al. Traffic-Related Air Pollution and Dementia Incidence in Northern Sweden: A Longitudinal Study. Environ Health Perspect; DOI:10.1289/ehp.1408322

The evidence on how air pollution damages the brain continues to mount. This study followed almost 100,000 people's chronic air pollution exposure, and found an extraordinary 211% risk of Alzheimer's per increase of 10.91 ppb in O3, a 138% risk of increase of AD per increase of 4.34 µg/m3 in PM2.5. Ozone can reach 70-80 ppb in the summer, and PM2.5 70-90 ug/m3 in the winter.

Jung CR, Lin YT, Hwang BF. Ozone, particulate matter, and newly diagnosed Alzheimer's disease: a population-based cohort study in Taiwan. J Alzheimers Dis. 2015;44(2):573-84. doi: 10.3233/JAD-140855.

This fascinating study demonstrates that the increased mortality affect of air pollution persists for decades. The air pollution you breathed in the 1970s is still increasing your mortality risk.

Hansell A, et al. Historic air pollution exposure and long-term mortality risks in England and Wales: prospective longitudinal cohort study. Thorax 2015;0:1–9. doi:10.1136/thoraxjnl-2015-207111

The body of research revealing the neurotoxicity of air pollution, especially polycyclic aromatic hydrocarbons (PAHs) continues to grow. This study in people over 60 yrs. old, showed this correlation between metabolites of PAHs measured in urine and cognitive testing: a 1% increase in PAHs resulted in approximately a 1.8% poorer performance.

Best EA, Juarez-Colunga E, James K, LeBlanc WG, Serdar B (2016) Biomarkers of Exposure to Polycyclic Aromatic Hydrocarbons and Cognitive Function among Elderly in the United States (National

Health and Nutrition Examination Survey: 2001-2002). PLoS ONE 11(2): e0147632. doi:10.1371/journal.pone.0147632

The bulk of the evidence suggests that people benefit from exercise, even during pollution situations. But what is the threshold at which someone does themselves more harm than good is not known. Aerobic exercise augments the overall inhaled air pollution dose, potentiates the diffusion of pollutants into circulating blood, augments oxidative stress and inflammation, raises blood pressure, impairs vascular function, and unfavorably affects autonomic balance.

Giorgini P, Rubenfire M, Bard RL, Jackson EA, Ferri C, Brook RD. Air Pollution and Exercise: A REVIEW OF THE CARDIOVASCULAR IMPLICATIONS FOR HEALTH CARE PROFESSIONALS. J Cardiopulm Rehabil Prev. 2015 Sep 16. [Epub ahead of print]

More research strengthens the connection between air pollution and Alzheimer's and dementia. Rates increased about 40% for the most exposed group, compared to the least.

Oudin A, Forsberg B, Nordin Adolfsson A, Lind N, Modig L, Nordin M, Nordin S, Adolfsson R, Nilsson LG. Traffic-Related Air Pollution and Dementia Incidence in Northern Sweden: A Longitudinal Study. Environ Health Perspect. 2015 Jul 31. [Epub ahead of print]

This paper followed 10 million people, and measured the time to first admission for any of three neurodegenerative diseases–dementia, Alzheimer's, or Parkinson's. They found an 8-15% increase in diagnosis of these disorders per 1 ug/m3 increase in long PM2.5 exposure. That's a remarkably strong correlation.

Kioumourtzoglou MA, Schwartz JD, Weisskopf MG, Melly SJ, Wang Y, Dominici F, Zanobetti A. Long-term PM2.5 Exposure and Neurological Hospital Admissions in the Northeastern United States. Environ Health Perspect. 2015 May 15. [Epub ahead of print]

Large meta-analysis of 94 studies showed even short term spikes in ozone, carbon monoxide, SO2, NOx, and PM2.5 are associated with significant increases in rates of strokes. The greatest association was for the same day of exposure, although PM2.5 showed a lingering effect.

Shah A, et al. Short term exposure to air pollution and stroke: systematic review and meta-analysis. BMJ 2015;350:h1295