Utah Physicians for a Healthy Environment

2016 Year-End Report on Air Pollution and Health Research

Research on air pollution's effect on public health was strengthened and expanded significantly in 2016. Some of the most remarkable research centered on how air pollution contributes to pregnancy complications and impaired fetal development.[1-9] Authors of one of these studies stated, "These robust results further reveal the toxic effect of PM2.5 exposure during pregnancy on fetal growth. Air pollution is ubiquitous. All pregnant women are exposed to it at some level, and immature fetuses are more susceptible."[5]

A common denominator for air pollution's connection to multiple diseases is the triggering of inflammation, affecting arteries and blood supply throughout the body. Intrauterine inflammation is known to be a pathway for multiple types of pregnancy complications. Air pollution at the level of the Wasatch Front's annual average increases the risk of intrauterine inflammation by 240%.[10] Much higher pollution levels, typical of our winter inversions will undoubtedly increase that risk much more.

Even short-term exposure is associated with higher rates of pregnancy complications. Episodes lasting only one to two days can be enough to trigger premature births. The 9/11 dust cloud from the collapse of the Twin Towers in 2001, was shown to be associated with significantly higher rates of premature birth and low birth weight.[69] The study's authors stated, "the impacts are especially pronounced for fetuses exposed in the first trimester, and for male fetuses. We estimate that in this group, exposure to the dust cloud more than doubled the probability of premature delivery and had similarly large effects on the probability of low birth weight."

Even hourly air pollution levels at the time labor begins is associated with higher rates of premature birth.[11] Other studies strengthened the connection between air pollution and placental malformations, still births and birth defects.[12 -14] More research was added to the science on how air pollution during pregnancy or even in the months prior to conception can irreversibly affect fetal development of multiple organs, genetic and epigenetic integrity and life-long health.[15-19]

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

respiratory disease measured several decades later.[20]

Air pollution's connection to cancer was greatly enhanced [21-23] with studies showing that children who had leukemia had significantly higher levels of pollution nanoparticles in their blood,[24] and that rates of death from multiple types of cancer, especially breast cancer, is significantly increased with long-term levels of pollution comparable to those of the Wasatch Front.[25]

We learned a great deal more about how air pollution is toxic to the human brain throughout the age spectrum. The connection between pollution and neurodegenerative diseases, like Alzheimer's and Parkinson's Disease, impaired memory and cognition, behavioral disorders, mental illnesses and autism was strengthened.[26-43]

A remarkable study was published proving that air pollution particles called "magnetites" end up inside the brain, in astonishing concentrations-- millions of particles per gram of brain tissue.[44] People with higher concentrations of these metallic nanoparticles are known to be at higher risk for Alzheimer's, and the kind of brain damage these particles can cause is consistent with the disease. Researchers seldom use alarming language to describe the conclusions from their investigations, but the lead author of this study said the results are "dreadfully shocking."

The connection between air pollution and metabolic disorders, like obesity and type II diabetes is now substantial, and was further solidified by numerous studies published in 2016.[45-56]

And finally, we learned more about the mechanisms and the magnitude of how air pollution causes strokes, heart attacks, increased death rates, increases blood pressure, changes heart rhythms, worsens cholesterol profile,[57-58] shortens life expectancy, accelerates the aging process, and inflames the arterial system, even when limited to short term episodes, even in young healthy adults, and even at levels below the EPA's national standards.[59- 67] The increase in mortality risk can persist for decades after exposure. Air pollution breathed in the 1970s is still increasing a person's mortality risk today.[68]

This large and multi-faceted body of research only adds to the thousands of studies published in previous years. Protecting public health and safety is the first responsibility of any government. This new research should compel Utah lawmakers to address these health hazards with meaningful legislation, going far beyond those of previous years. UPHE calls on the Utah Legislature and the Governor's office to make 2017 the year for cleaning up our air.

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References:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

22. 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]

23. Poulsen AH, et al. Air pollution from traffic and risk for brain tumors: a nationwide study in Denmark. Cancer Causes Control. 2016 Feb 18. [Epub ahead of print]

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

25. 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

26. Tzivian L, et al. Long-Term Air Pollution and Traffic Noise Exposures and Mild Cognitive Impairment in Older Adults: A Cross-Sectional Analysis of the Heinz Nixdorf Recall Study. Environ Health Perspect; DOI:10.1289/ehp.1509824

27. 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]

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

29. 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

30. 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]

31. 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]

32. 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.

33. 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]

34. 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

35. 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

36. 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.

37. 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

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

39. Chen JC, et al. Ambient Air Pollution and Neurotoxicity on Brain Structure: Evidence From Women's Health Initiative Memory Study. ANN NEUROL 2015;78:466–476

40. 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]

41. 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]

42. 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]

43. 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]

44. Maher, B, et al. Magnetite pollution nanoparticles in the human brain. PNAS 2016 ; published ahead of print September 6, 2016, doi:10.1073/pnas.1605941113

45. 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]

46. 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]

47. 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]

48. 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]

49. 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]

50. 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]

51. 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]

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

53. 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]

54. 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]

55. 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]

56. 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

57. Bind MA, et al. Quantile Regression Analysis of the Distributional Effects of Air Pollution on
58. Blood Pressure, Heart Rate Variability, Blood Lipids, and Biomarkers of Inflammation in Elderly American Men: The Normative Aging Study. Environ Health Perspect. 2016 Mar 11. [Epub ahead of print]

59. Collart P, et al. Short-term effects of air pollution on hospitalization for acute myocardial infarction: age effect on lag pattern. Int J Environ Health Res. 2017 Feb;27(1):68-81. doi: 10.1080/09603123.2016.1268678.

60. 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

61. 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

62. 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

63. Baccarelli AA, et al. Particulate Air Pollution, Exceptional Aging, and Rates of Centenarians: A Nationwide Analysis of the United States, 1980–2010. Environ Health Perspect; DOI:10.1289/EHP197

64. 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]

65. 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

66. 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.

67. Stafoggia M, et al. Association between short-term exposure to ultrafine particles and mortality in eight European urban areas. Epidemiology. 2016 Nov 29. [Epub ahead of print]

68. 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

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