

**A new study has found that compared to eight years ago, following the increase in global production, the amount of plastic contamination of our organs has increased about 50%. The amount of plastic in our brains is up to 30 times higher than other organs, and amounts to about the weight of a plastic spoon, i.e. seven grams. The plastic is in the form of ominous looking tiny flakes (see the picture).**

**Research on what the health consequences are is still in the early stages. But as expected, so far, indications are that, just like the other dangerous particles of air pollution, plastic nanoparticles create an immune/inflammatory response that harms individual cells, entire organs, and ultimately your overall health.**

*[Nihart, A.J., Garcia, M.A., El Hayek, E. et al. Bioaccumulation of microplastics in decedent human brains. Nat Med \(2025\). https://doi.org/10.1038/s41591-024-03453-1](https://doi.org/10.1038/s41591-024-03453-1)*

**A new, large study of 1.2 million people validates that claim and more. The study found a dramatic increase in the risk of dementia over three years with exposure to wildfire smoke, more than 20 times the risk from other types of air pollution.**

**And the likely reasons are extremely small particles, ultrafine PM, are produced by wildfires, they are saturated with toxic chemicals and heavy metals, and they can bypass the lungs and the brain's normal microanatomic defenses (blood/brain barrier), allowing direct access to the brain by being absorbed through the lining of the nose.**

**We encourage everyone to avoid wood smoke as much as possible. Don't burn wood yourself, don't patronize restaurants that use a wood stove, and the US Forest Service's love affair with "forest management"--logging, thinning, slash pile burning and prescribed burns is malpractice. In most cases it doesn't help prevent wildfires from happening, it's often actually counter productive, because it makes the forest canopy hotter, drier, and windier, the three main risk factors for spreading wildfires.**

[Article on the study.](#)

**Hundreds of studies have documented the toxic effect of air pollution on acute and chronic brain function, neurodegenerative other neurologic diseases, and brain development in children. Two new studies extend that evidence to include air pollution exposure of pregnant mothers and the risk of cerebral palsy to their newborns, and confirm the exceptional risk of wildfire smoke in causing and/or accelerating dementia.**

**In a study of nearly 1.6 million pregnant mothers in Canada, an increase of 2.7 ug/m<sup>3</sup> in PM<sub>2.5</sub> exposure during the pregnancy increased the risk of the baby having cerebral palsy by 12%, more if the baby is male.**

Zhang Y, Hu Y, Talarico R, et al. Prenatal Exposure to Ambient Air Pollution and Cerebral Palsy. *JAMA Netw Open*. 2024;7(7):e2420717. doi:10.1001/jamanetworkopen.2024.20717

**In this study from Iran, examining children in three different areas of the country with different levels of pollution, children living in the most polluted areas had IQs that were more than 16 points lower than children with the lowest amount of pollution.**

Seifi M, Yunesian M, Naddafi K, Nabizadeh R, Dobaradaran S, Ziyarati MT, Nazmara S, Yekaninejad MS, Mahvi AH. Exposure to ambient air pollution and socio-economic status on intelligence quotient among schoolchildren in a developing country. *Environ Sci Pollut Res Int*. 2021 Aug 6. doi: 10.1007/s11356-021-15827-w. Epub ahead of print. PMID: 34355328.

**Just 1 ug/m3 increase in PM2.5 corresponded to a 16% increase chance of Alzheimer's**

Shaffer R, et al. Fine Particulate Matter and Dementia Incidence in the Adult Changes in Thought Study. *Environmental Health Perspectives*, 2021; 129 (8): 087001 DOI: 10.1289/EHP9018

**Indoor PM2.5 levels in offices associated with impaired cognition, attention span, response time, and productivity.**

Jose Guillermo Cedeño Laurent, Piers MacNaughton, Emily Jones, Anna S Young, Maya Bliss, Skye Flanigan, Jose Vallarino, Ling Jyh Chen, Xiaodong Cao, Joseph G Allen. Associations between acute exposures to PM2.5 and carbon dioxide indoors and cognitive function in office workers: a multicountry longitudinal prospective observational study. *Environmental Research Letters*, 2021; 16 (9): 094047 DOI: 10.1088/1748-9326/ac1bd8

**Air pollution is associated with increased criminal behavior.**

Herrnstadt, Evan, Anthony Heyes, Erich Muehlegger, and Soodeh Saberian. 2021. "Air Pollution and Criminal Activity: Microgeographic Evidence from Chicago." *American Economic Journal: Applied Economics*, 13 (4): 70-100. DOI: 10.1257/app.20190091

**Vigorous physical activity in air pollution increases brain white matter hyperintensity lesions, and air pollution attenuates the beneficial associations of physical activity with these lesions.**

Melissa A. Furlong, Gene E. Alexander, Yann C. Klimentidis, David A. Raichlen. Association of Air Pollution and Physical Activity With Brain Volumes. *Neurology*, 2021; 10.1212/WNL.0000000000013031 DOI: 10.1212/WNL.0000000000013031

### **Reducing air pollution reduces the risk of dementia in older women.**

Wang X, et al. Association of improved air quality with lower dementia risk in older women *Proceedings of the National Academy of Sciences* Jan 2022, 119 (2) e2107833119; DOI: 10.1073/pnas.2107833119

### **Air pollution causes inflammation and cell death of the olfactory system.**

Wei S, Xu T, Jiang T, Yin D. Chemosensory Dysfunction Induced by Environmental Pollutants and Its Potential As a Novel Neurotoxicological Indicator: A Review. *Environ Sci Technol*. 2021 Aug 17;55(16):10911-10922. doi: 10.1021/acs.est.1c02048. Epub 2021 Aug 6. PMID: 34355568.

Kim BY, Park JY, Cho KJ, Bae JH. Effects of Urban Particulate Matter on the Olfactory System in a Mouse Model. *Am J Rhinol Allergy*. 2021 Jul 8:19458924211026416. doi: 10.1177/19458924211026416. Epub ahead of print. PMID: 34236242.

### **Older adults living in areas with higher PM2.5 concentrations had worse cognitive function even after adjustment for community- and individual-level social and economic characteristics.**

Ailshire J, Crimmins E. Fine particulate matter air pollution and cognitive function among older US adults *Am J Epidemiol*. 2014 Aug 15;180(4):359-66. doi: 10.1093/aje/kwu155. Epub 2014 Jun 24.

### **Proximity to sources of airborne lead reduces brain function of children.**

Gatzke-Kopp LM, Warkentien S, Willoughby M, Fowler C, Folch DC, Blair C. Proximity to sources of airborne lead is associated with reductions in Children's executive function in the first four years of life. *Health Place*. 2021 Feb 2;68:102517. doi: 10.1016/j.healthplace.2021.102517

### **More evidence that rates of Alzheimers Dementia, including rates of mortality and hospital admission risks for AD, correlate with air pollution exposure.**

Rhew SH, Kravchenko J, Lyerly HK. Exposure to low-dose ambient fine particulate matter PM2.5 and Alzheimer's disease, non-Alzheimer's dementia, and Parkinson's disease in North Carolina. *PLoS One*. 2021;16(7):e0253253. Published 2021 Jul 9. doi:10.1371/journal.pone.0253253

### **Another study showed accelerated cognitive decline in the elderly exposed to more air pollution.**

Duchesne J, et al. Exposure to ambient air pollution and cognitive decline: Results of the prospective Three-City cohort study. *Environ Int.* 2022 Feb 3;161:107118. doi: 10.1016/j.envint.2022.107118

### **Improvement in air quality was associated with less cognitive decline in the elderly**

Younan D, Wang X, Millstein J, Petkus AJ, Beavers DP, Espeland MA, Chui HC, Resnick SM, Gatz M, Kaufman JD, Wellenius GA, Whitsel EA, Manson JE, Rapp SR, Chen JC. Air quality improvement and cognitive decline in community-dwelling older women in the United States: A longitudinal cohort study. *PLoS Med.* 2022 Feb 3;19(2):e1003893. doi: 10.1371/journal.pmed.1003893. eCollection 2022 Feb. PMID: 35113870

Letellier N, et al. Air quality improvement and incident dementia: Effects of observed and hypothetical reductions in air pollutants using parametric g-computation. *Alzheimers Dement.* 2022 Feb 9. doi: 10.1002/alz.12606

### **Higher exposure of pregnant mothers to PAHs in the third trimester delays and impairs emotional and behavioral development in infants.**

Liu R, DeSerisy M, Fox NA, Herbstman JB, Rauh VA, Beebe B, Margolis AE. Prenatal exposure to air pollution and maternal stress predict infant individual differences in reactivity and regulation and socioemotional development. *J Child Psychol Psychiatry.* 2022 Feb 17. doi: 10.1111/jcpp.13581

### **In this animal study, evidence of the neurotoxicity and inflammatory effects of air pollution was confirmed with prolonged exposure to diesel exhaust causing impaired memory and learning, and triggered depressive-like responses.**

Ehsanifar M, Yavari Z, Rafati M. Exposure to urban air pollution particulate matter: neurobehavioral alteration and hippocampal inflammation. *Environ Sci Pollut Res Int.* 2022 Mar 3. doi: 10.1007/s11356-022-19367-9

### **More evidence that air pollution exposure early in life increases the risk of neurodevelopmental disorders, especially attention deficit disorders, overall intelligence, and executive functioning.**

Castagna A, Mascheron E, Fustinin S, Montiross R. Air pollution and neurodevelopmental skills in preschool- and school-aged children: A systematic review. *Neurosci Biobehav Rev.* 2022 Mar 21:104623. doi: 10.1016/j.neubiorev.2022.104623

### **Indoor levels of PM2.5 and CO2 were inversely associated with cognitive function in a prospective, longitudinal study that included working age subjects from six different countries.**

Laurent JGC, MacNaughton P, Jones E, Young AS, Bliss M, Flanigan S, Vallarino J, Chen LJ, Cao X, Allen JG. Associations between Acute Exposures to PM2.5 and Carbon Dioxide Indoors and Cognitive Function in Office Workers: A Multicountry Longitudinal Prospective Observational Study. *Environ Res Lett.* 2021 Sep;16(9):094047. doi: 10.1088/1748-9326/ac1bd8. Epub 2021 Sep 9

### **Carbon monoxide exposure increases the risk of seizures in epileptic patients.**

Chen Z, et al. Ambient air pollution and epileptic seizures: a panel study in Australia. *Epilepsia.* 2022 Apr 8. doi: 10.1111/epi.17253

### **More evidence that air pollution is toxic to the brain and is associated with neurologic diseases like Alzheimer's and Parkinson's Disease.**

Patten K, et al. The Effects of Chronic Exposure to Ambient Traffic-Related Air Pollution on Alzheimer's Disease Phenotypes in Wildtype and Genetically Predisposed Male and Female Rats. *Environmental Health Perspectives*, 2021; 129 (5) DOI: 10.1289/EHP8905

Jo S, Kim Y, Park KW, et al. Association of NO2 and Other Air Pollution Exposures With the Risk of Parkinson Disease. *JAMA Neurol.* Published online May 17, 2021. doi:10.1001/jamaneurol.2021.1335

### **Another study shows that even short-term air pollution exposure is associated with impaired cognition.**

Gao X, et al. Short-term air pollution, cognitive performance and nonsteroidal anti-inflammatory drug use in the Veterans Affairs Normative Aging Study. *Nature Aging*, 2021; DOI: 10.1038/s43587-021-00060-4

### **Two new studies showing that prenatal and childhood air pollution exposure has lasting consequences to adolescent and adult behavior and academic performance.**

Reuben A, et al. Association Of Air Pollution Exposure in Childhood and Adolescence With Psychopathology at the Transition To Adulthood. *JAMA Network Open*, 2021 DOI: 10.1001/jamanetworkopen.2021.7508

Margolis A, et al. Prenatal exposure to air pollution is associated with childhood inhibitory control and adolescent academic achievement. *Environmental Research*, 2021; 111570 DOI: 10.1016/j.envres.2021.111570

### **Closer proximity to sources of lead pollution is associated with loss of cognitive abilities and executive functioning in young children.**

Gatzke-Kopp LM, Warkentien S, Willoughby M, Fowler C, Folch DC, Blair C. Proximity to sources of airborne lead is associated with reductions in Children's executive function in the first four years of life. *Health Place*. 2021 Mar;68:102517. doi: 10.1016/j.healthplace.2021.102517. Epub 2021 Feb 2. PMID: 33540187; PMCID: PMC7965333

**This study was done in Salt Lake County and found that our frequent spikes in particulate pollution are associated with worse math and english scores in grade school students. This is consistent with other studies showing acutely impaired memory and cognition with air pollution. But perhaps the most interesting finding was that the impact was worse among those students of greater socio-economic advantage.**

Mullen C, et al. Effects of PM2.5 on Third Grade Students' Proficiency in Math and English Language Arts. *Int. J. Environ. Res. Public Health* 2020, 17(18), 6931; <https://doi.org/10.3390/ijerph17186931>

**More evidence that even short-term increase in PM2.5, PM10, NO2, SO2 and O3 concentrations was significantly associated with exacerbation of mental disorders, impaired brain development and other manifestations of neurotoxicity**

Lu P, Zhang Y, Xia G, Zhang W, Xu R, Wang C, Guo Y, Li S. Attributable risks associated with hospital outpatient visits for mental disorders due to air pollution: A multi-city study in China. *Environ Int*. 2020 Jun 30;143:105906. doi: 10.1016/j.envint.2020.105906. [Epub ahead of print]

Lu P, et al. Attributable risks associated with hospital outpatient visits for mental disorders due to air pollution: A multi-city study in China. *Environ Int*. 2020 Jun 30;143:105906. doi: 10.1016/j.envint.2020.105906. [Epub ahead of print]

Zhao T, et al. Depression and Anxiety With Exposure to Ozone and Particulate Matter: An Epidemiological Claims Data Analysis. *J Hyg Environ Health*. 2020 May 19;228:113562. doi: 10.1016/j.ijheh.2020.113562. Online ahead of print.

Bronstein J, et al. Diesel exhaust extract exposure induces neuronal toxicity by disrupting autophagy. *Toxicological Sciences*, 2020; DOI: 10.1093/toxsci/kfaa055

Patten K, et al. Effects of early life exposure to traffic-related air pollution on brain development in juvenile Sprague-Dawley rats. *Translational Psychiatry*, 2020; 10 (1) DOI: 10.1038/s41398-020-0845-3

**Another study that shows metallic air pollution nanoparticles are embedded in the brain even in children, adolescents, and young adults.**

Caldero n-Garciduen~L, et al. Quadruple abnormal protein aggregates in brainstem pathology and exogenous metal-rich magnetic nanoparticles (and engineered Ti-rich nanorods). The substantia nigrae is a very early target in young urbanites and the gastrointestinal tract a key brainstem portal. *Environmental Research* 191 (2020) 110139 More evidence that air pollution is associated with the pathologic hallmarks

of Alzheimer's.

Iaccarino L, et al. Association Between Ambient Air Pollution and Amyloid Positron Emission Tomography Positivity in Older Adults With Cognitive Impairment. *JAMA Neurol*. Published online November 30, 2020. doi:10.1001/jamaneurol.2020.3962

**More evidence of air pollution's impact on brain function. For every 2.81 µg/m<sup>3</sup> of PM<sub>2.5</sub>, the annual decline rate in a certain type of memory capability was accelerated by 19.3%.**

Younan D, et al. Particulate matter and episodic memory decline mediated by early neuroanatomic biomarkers of Alzheimer's disease. *Brain*, awz348, <https://doi.org/10.1093/brain/awz348>. Published: 20 November 2019

**Numerous studies have shown the toxicity of air pollution to brain function and development, even changing brain architecture. This study show that a critical area of the brain for memory, the hippocampus, is smaller in size in adults exposed to more air pollution.**

Hedges DW, et al. Association between Exposure to Air Pollution and Hippocampal Volume in Adults in the UK Biobank. *Neurotoxicology*. 2019 Jun 17. pii: S0161-813X(19)30053-1. doi: 10.1016/j.neuro.2019.06.005. [Epub ahead of print]

**Another study showing that air pollution harms brain development in children, in this case through chemical changes in DNA.**

Peng C, et al. Residential Proximity to Major Roadways at Birth, DNA Methylation at Birth and Midchildhood, and Childhood Cognitive Test Scores: Project Viva(Massachusetts, USA) Published: 18 September 2018, DOI: <https://doi.org/10.1289/EHP2034>

**Another study that suggests a connection between air pollution and brain cancer, and this one reveals a likely mechanism.**

Ljubimova, JY, et al. Coarse particulate matter (PM<sub>2.5-10</sub>) in Los Angeles Basin air induces expression of inflammation and cancer biomarkers in rat brains. *Scientific Reports*, 2018; 8 (1) DOI: 10.1038/s41598-018-23885-3

**We have become increasingly alarmed at the body of research showing how harmful air pollution is to the brain, including the presence of air pollution particles penetrating brain tissue itself.**

**The latest research examined the brains of 203 people, ranging in age from less than one year old to 40 years old. At autopsy (causes of death were usually trauma), every single brain but one showed the abnormal proteins that are the microbiologic hallmarks of Alzheimer's, even in an 11 month old. And the amount of these abnormal proteins was proportional to the amount of air pollution where**

**the subjects lived. The principle author, probably the world's expert on this type of research said,**

**“Alzheimer’s disease hallmarks start in childhood in polluted environments, and we must implement effective preventative measures early. It is useless to take reactive actions decades later.”**

*Calderón-Garcidueñas L, et al. Hallmarks of Alzheimer disease are evolving relentlessly in Metropolitan Mexico City infants, children and young adults. APOE4 carriers have higher suicide risk and higher odds of reaching NFT stage V at ≤ 40 years of age. Environmental Research, 2018; 164: 475 DOI: 10.1016/j.envres.2018.03.023*

**This study was done evaluating a large patient population of over 100,000 right here on Utah’s Wasatch Front. It showed that serious lower respiratory infections in every age group were increased with more air pollution, even short term exposure lasting only several days.**

*Horne BD, et al. Short-term Elevation of Fine Particulate Matter Air Pollution and Acute Lower Respiratory Infection. Am J Respir Crit Care Med. 2018 Apr 13. doi: 10.1164/rccm.201709-1883OC. [Epub ahead of print]*

**More air pollution exposure is associated with smaller volumes of brain grey matter.**

*Power MC, et al. The Association of Long-Term Exposure to Particulate Matter Air Pollution with Brain MRI Findings: The ARIC Study. Environ Health Perspect. 2018 Feb 16;126(2):027009. doi: 10.1289/EHP2152.*

**A good review article on how environmental contaminants like air pollution affect the brain in males much more than females**

*Kern JK, et al. Developmental neurotoxicants and the vulnerable male brain: a systematic review of suspected neurotoxicants that disproportionately affect males. Acta Neurobiol Exp (Wars). 2017;77(4):269-296.*

**Air pollution affects the brain in multiple ways. This shows that it increases the delinquent behavior of adolescents, much like lead does.**

*Younan D, et al. Longitudinal Analysis of Particulate Air Pollutants and Adolescent Delinquent Behavior in Southern California. Journal of Abnormal Child Psychology, 2017; DOI: 10.1007/s10802-017-0367-5*

**Air pollution is associated with brain diseases and dysfunction. This study adds to the evidence that air pollution contributes to depression.**

*Lin H, et al. Exposure to air pollution and tobacco smoking and their combined effects on depression in six low- and middle-income countries. Br J Psychiatry. 2017 Aug 10. pii: bjp.bp.117.202325. doi: 10.1192/bjp.bp.117.202325. [Epub ahead of print]*

**Another study shows that air pollution impairs cognitive abilities of children. In particular these studies measured the amount of air pollution that children breathed on the way to school, which correlated with decreased memory.**



Forns J, et al. Longitudinal association between air pollution exposure at school and cognitive development in school children over a period of 3.5 years. *Environ Res.* 2017 Aug 28;159:416-421. doi: 10.1016/j.envres.2017.08.031. [Epub ahead of print]

Alvarez-Pedrerol M, et al. Impact of commuting exposure to traffic-related air pollution on cognitive development in children walking to school. *Environmental Pollution*, 2017; 231: 837 DOI: 10.1016/j.envpol.2017.08.075

## **Another study that shows a connection between air pollution and malignant brain tumors**

Andersen Z, et al. Long-term Exposure to Ambient Air Pollution and Incidence of Brain Tumor: the European Study of Cohorts for Air Pollution Effects (ESCAPE). *Neuro Oncol.* 2017 Aug 31. doi: 10.1093/neuonc/nox163. [Epub ahead of print]

**Air pollution accelerates brain aging, increases the deposition of amyloid beta particles in the brain, and can almost double the risk of Alzheimer's in elderly women. Put another way, air pollution appears to be responsible for 20% of Alzheimer's. A critical Alzheimer risk gene, magnifies the risk further, especially in women, and interacts with air pollution to accelerate brain aging.**

Cacciottolo M, et al. Particulate air pollutants, APOE alleles and their contributions to cognitive impairment in older women and to amyloidogenesis in experimental models. *Translational Psychiatry* (2017) 7, e1022; doi:10.1038/tp.2016.280 Published online 31 January 2017

**This study documents that toxic, nano-sized particles called “magnetites” found in air pollution end up in our brains. People with higher concentrations of the metallic nanoparticles are known to be at higher risk for Alzheimer's, and the kind of brain damage these “magnetites” can cause are consistent with the disease.**

**At 150 nanometers or less in diameter, these particles, including iron oxide, platinum, nickel, and cobalt, whose origin can be industrial, vehicle or other sources of pollution, are small enough to be inhaled through the nose and enter the brain through the olfactory nerve system. The researchers found millions of these particles per gram of brain tissue after studying numerous autopsies. The lead study author said these results are “dreadfully shocking”.**

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

**More evidence that particulate air pollution harms the brain, in this case, decreases cognition in people 50-80 yrs old.**

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

**High levels of traffic air pollution are associated with significantly higher rates of brain cancer.**

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]

**Chronic exposure to PM2.5 is associated with loss of brain white matter in elderly women. For every 3.49 ug/m<sup>3</sup> PM2.5 annual average, the loss of white matter was about what would be seen from 1-2 years of aging. With Salt Lake City averaging about 10 ug/m<sup>3</sup>, that means there is an acceleration of brain aging of 3-6 yrs.**

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

### **More evidence of the neurotoxicity of air pollution**

Costa LG, et al. NEUROTOXICITY OF TRAFFIC-RELATED AIR POLLUTION. *Neurotoxicology*. 2015 Nov 20. pii: S0161-813X(15)30024-3. doi: 10.1016/j.neuro.2015.11.008. [Epub ahead of print]

### **The risk of benign brain tumors is increased with air pollution.**

Chang KH, Teng CJ, Hsu YC, Tsai SC, Lin HJ, Hsieh TL, Muo CH, Hsu CY, Chou RH. Long-Term Exposure to Air Pollution Associates the Risk of Benign Brain Tumor: A Nationwide, Population-Based, Cohort Study in Taiwan. *Toxics*. 2022 Apr 2;10(4):176. doi: 10.3390/toxics10040176.PMID: 35448437

**More evidence of the penetration of pollution nanoparticles (NP) into human brains. Early life NP exposures pose high risk to brains for development of lethal neurologic outcomes.**

Calderón-Garcidueñas L, González-Maciel A, Reynoso-Robles R, Silva-Pereyra HG, Torres-Jardón R, Brito-Aguilar R, Ayala A, Stommel EW, Delgado-Chávez R. Environmentally Toxic Solid Nanoparticles in Noradrenergic and Dopaminergic Nuclei and Cerebellum of Metropolitan Mexico City Children and Young Adults with Neural Quadruple Misfolded Protein Pathologies and High Exposures to Nano Particulate Matter. *Toxics*. 2022 Mar 29;10(4):164. doi: 10.3390/toxics10040164.PMID: 35448425

### **More evidence that air pollution impairs cognitive performance.**

Yu X, et al. Exposure to air pollution and cognitive impairment risk: a meta-analysis of longitudinal cohort studies with dose-response analysis. *J Glob Health*. 2020 Jun;10(1):010417. doi: 10.7189/jogh.10.010417.

**More evidence that air pollution, in this case black carbon and the metal nickel (by products of fossil fuel combustion), impairs cognitive function, specifically, verbal memory, recognition, mental processing speed, and executive function, which all focused in frontal and pre- frontal lobe areas.**

Wurth R, et al. Fine Particle Sources and Cognitive Function in An Older Puerto Rican Cohort in Greater Boston. *Environ Epidemiol*. 2018 Sep;2(3). pii: e022. doi: 10.1097/EE9.000000000000022.

**Exposure to air pollution is associated with lower verbal scores, white matter is more affected than gray matter, and the effect increases with the duration of exposure. Less well educated men over age 60 are the most vulnerable to this effect.**

Zhang X, et al. *The impact of exposure to air pollution on cognitive performance. PNAS* September 11, 2018 115 (37) 9193-9197; published ahead of print August 27, 2018

## **More studies showing air pollution's strong association with Alzheimer's, dementia, and the anatomic changes in the brain associated with these disorders**

Hullmann M, et al. *Diesel engine exhaust accelerates plaque formation in a mouse model of Alzheimer's disease. Part Fibre Toxicol.* 2017 Aug 30;14(1):35. doi: 10.1186/s12989-017-0213-5.

Chen H, et al. *Exposure to ambient air pollution and the incidence of dementia: A population-based cohort study. Environment International.* Volume 108, November 2017, Pages 271-277

**The subjects in this study below were children, teenagers, and young adults in Mexico City where the particulate pollution is still quite high, despite many public policy changes to address it. This is the second study to show that these tiny pollution nanoparticles from fossil fuel combustion end up inside our brains. Once there they can cause brain damage, disrupting cellular and intracellular architecture. This undoubtedly contributes to the many clinical studies that show impaired brain function, loss of memory, loss of intellectual abilities, behavior problems, and more degenerative brain diseases in people exposed to more air pollution.**

**We should be just as concerned about the air our children breathe as we are about lead in the water they drink.**

González-Maciel A, Reynoso-Robles R, Torres-Jardón R, Mukherjee PS, Calderón-Garcidueñas L. *Combustion-Derived Nanoparticles in Key Brain Target Cells and Organelles in Young Urbanites: Culprit Hidden in Plain Sight in Alzheimer's Disease Development. J Alzheimers Dis.* 2017 Jun 3. doi: 10.3233/JAD-170012. [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]

**More and more studies are showing how toxic air pollution is to the brain. Previous studies have shown loss of white matter volume in children exposed to air pollution in the womb, and in animals exposed shortly after birth. The study below, examining adults 60 yrs old and older, shows a loss of total brain volume (an indicator of dementia and brain atrophy) with even small increments of PM2.5. For every 2 ug/m<sup>3</sup> increase in PM2.5, brain volume decreased 0.32% and the odds of covert brain infarcts (mini-strokes) increased 46%. Given that the EPA has recently lowered the annual PM2.5 standard to 12 ug/m<sup>3</sup>, that means air quality can meet the national standard, and still be responsible for a 2% decrease in your brain matter, and a 280% increased likelihood of provoking mini-strokes.**

*Wilker E, et al. Long-Term Exposure to Fine Particulate Matter, Residential Proximity to Major Roads and Measures of Brain Structure. doi: 10.1161/STROKEAHA.114.008348. Published online before print April 23, 2015,*