SPD BUNDESTAGS FRAKTION

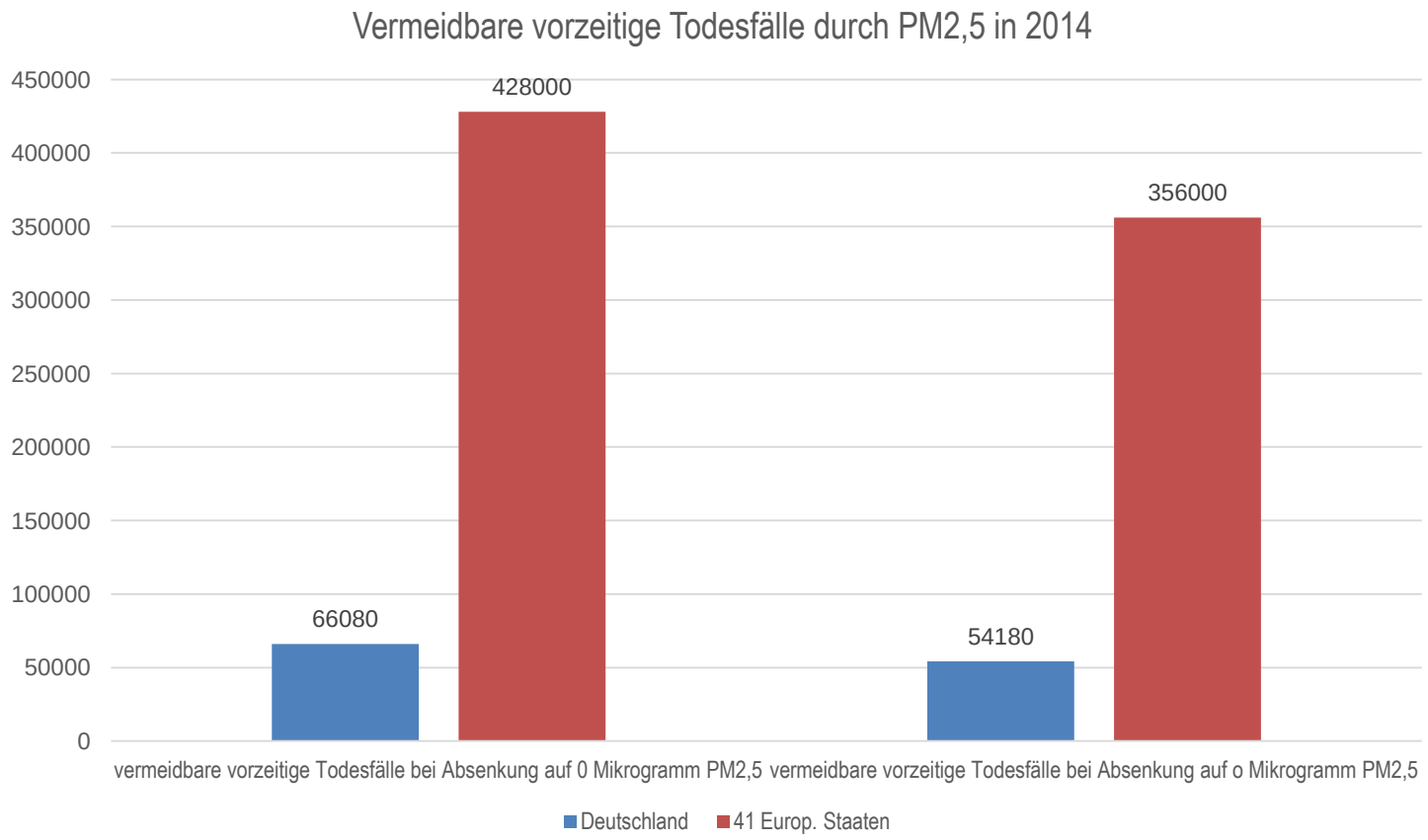
GESUNDE.STADT
Mülheim.Leverkusen

Welche Bedeutung hat Feinstaub für die Gesundheit?
Schwerpunkt Kinder und ältere Menschen
13.11.2017

Welche Gesundheitsrisiken birgt Feinstaub?

WHO:
Feinstaubbelastung ist das größte umweltbezogene Gesundheitsrisiko und für jährlich 3 Millionen vorzeitige Todesfälle verantwortlich.

Vermeidbare Todesfälle durch Feinstaub



Quelle: European Environment Agency: Air quality in Europe — 2017 report

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Überblick über die Studie

“Air Pollution and Mortality in the Medicare Population”

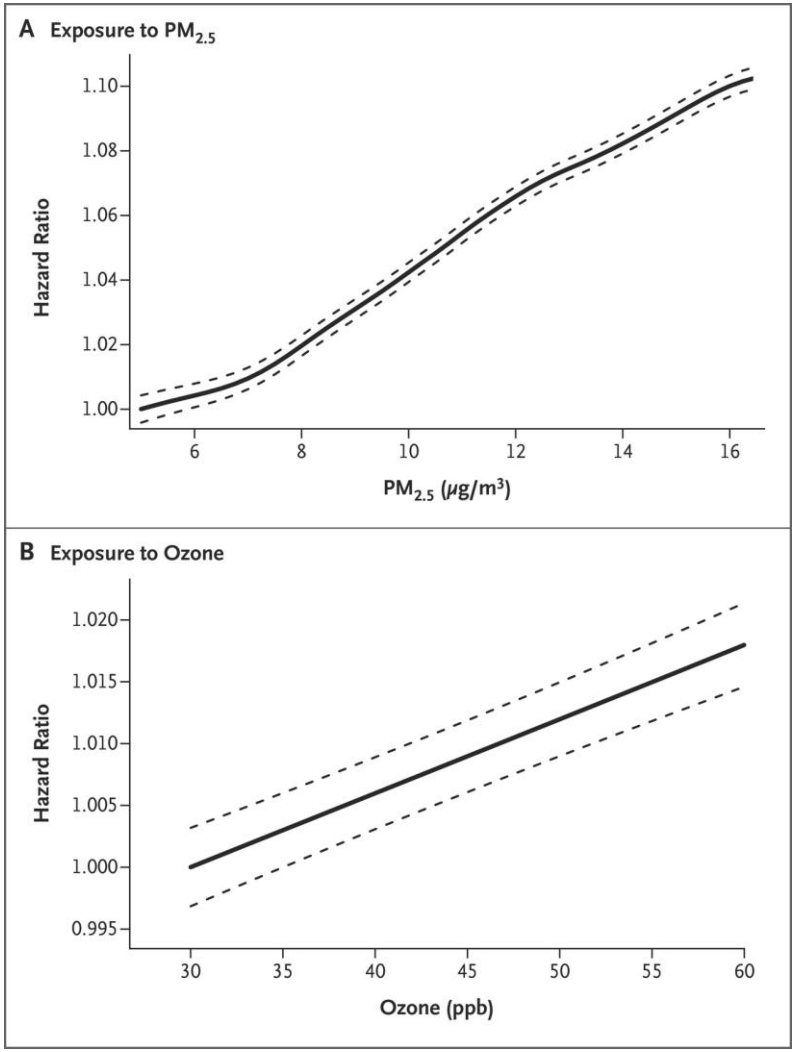
Qian Di, M.S., Yan Wang, M.S., Antonella Zanobetti, Ph.D., Yun Wang, Ph.D., Petros Koutrakis, Ph.D., Christine Choirat, Ph.D., Francesca Dominici, Ph.D., and Joel D. Schwartz, Ph.D.

From the Departments of Environmental Health and Biostatistics,
Harvard T.H. Chan School of Public Health, Boston.

- Die Studie umfasst mehr als 60 Mio Menschen in den USA im Zeitraum von 2000 bis 2012 bei mehr als 22 Mio Todesfällen
- Untersucht wurde die Frage, ob es einen dosisabhängigen Anstieg der Gesamtsterblichkeit bei Feinstaub und Ozon gibt.

Quelle: N Engl J Med Volume 376(26):2513-2522, June 29, 2017

Concentration–Response Function of the Joint Effects of Exposure to $PM_{2.5}$ and Ozone on All-Cause Mortality.



Quelle: N Engl J Med Volume 376(26):2513-2522, June 29, 2017

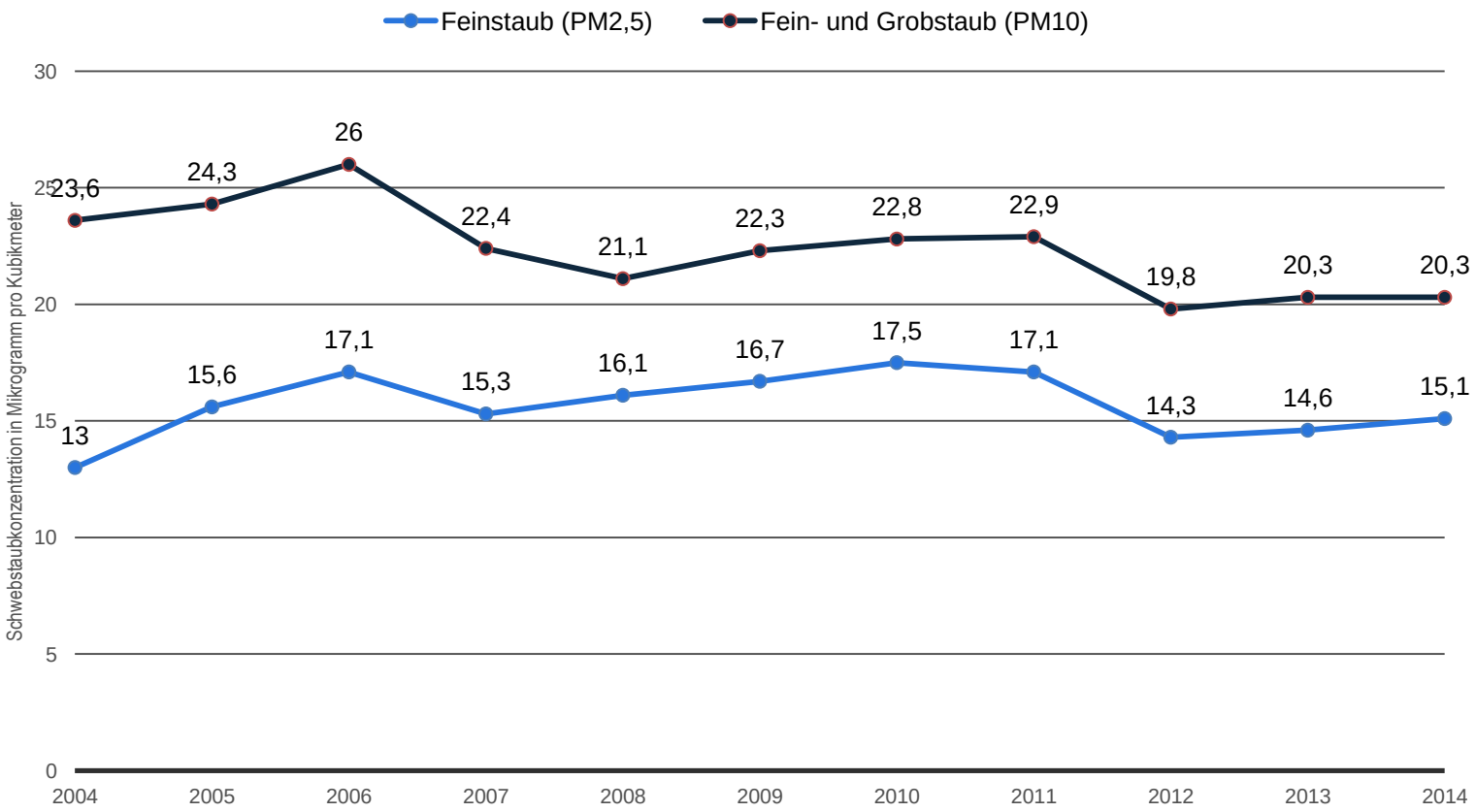
Bedeutung für Leverkusen

Bei 1800 Sterbefällen pro Jahr in Leverkusen sind 140 bis 200 Sterbefälle vermeidbar wenn die Feinstaubbelastung um 10 Mikrogramm pro Kubikmeter verringert wird

Im Durchschnitt verliert jeder an Feinstaub Verstorbene zehn Lebensjahre

Quelle: Eigene Berechnungen, Mikael Skou Andersen: Co-benefits of climate mitigation: Counting statistical lives or life-years?, Ecological Indicators 79 (2017) 11–18

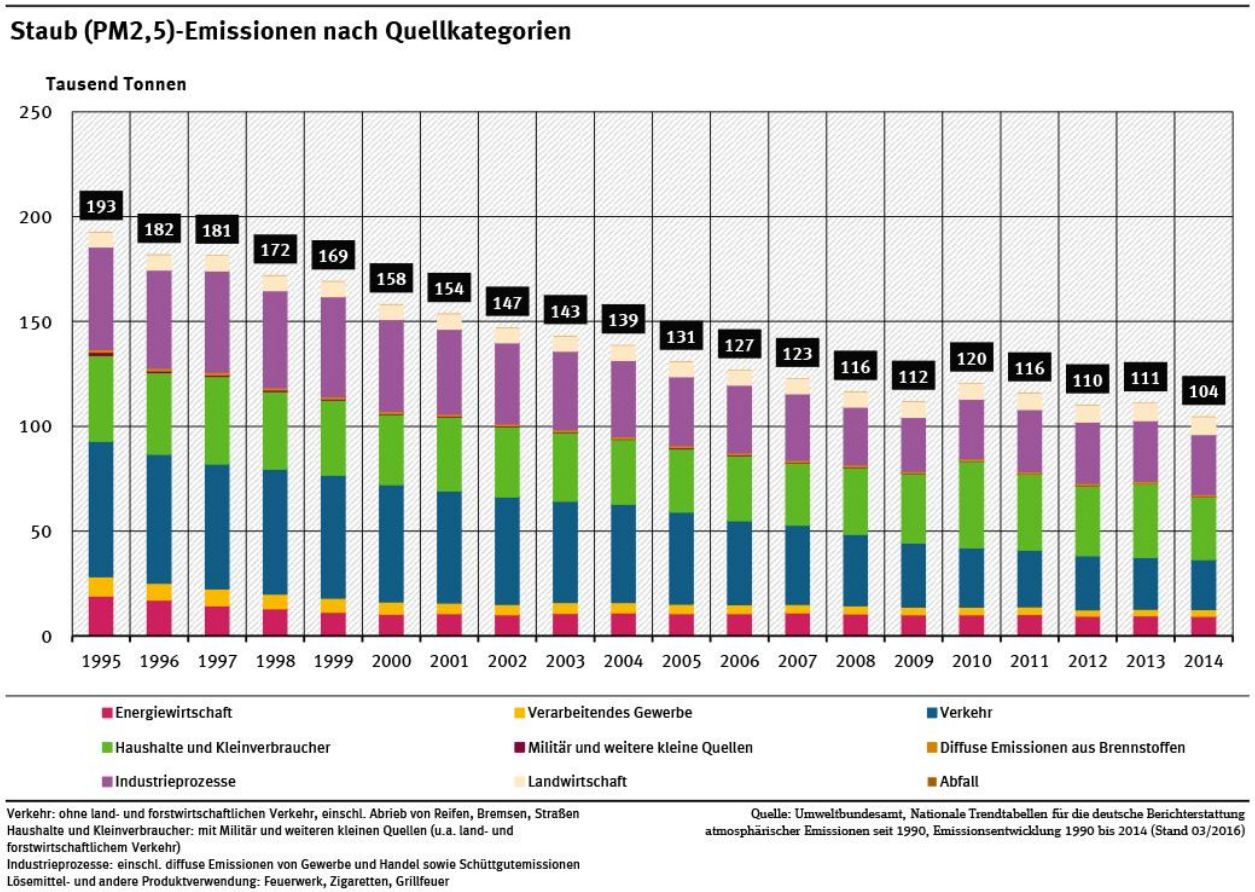
Belastung der städtischen Bevölkerung in Deutschland durch Luftverschmutzung mit Schwebstaub* (Feinstaub und Grobstaub) von 2004 bis 2014 (in Mikrogramm pro Kubikmeter)



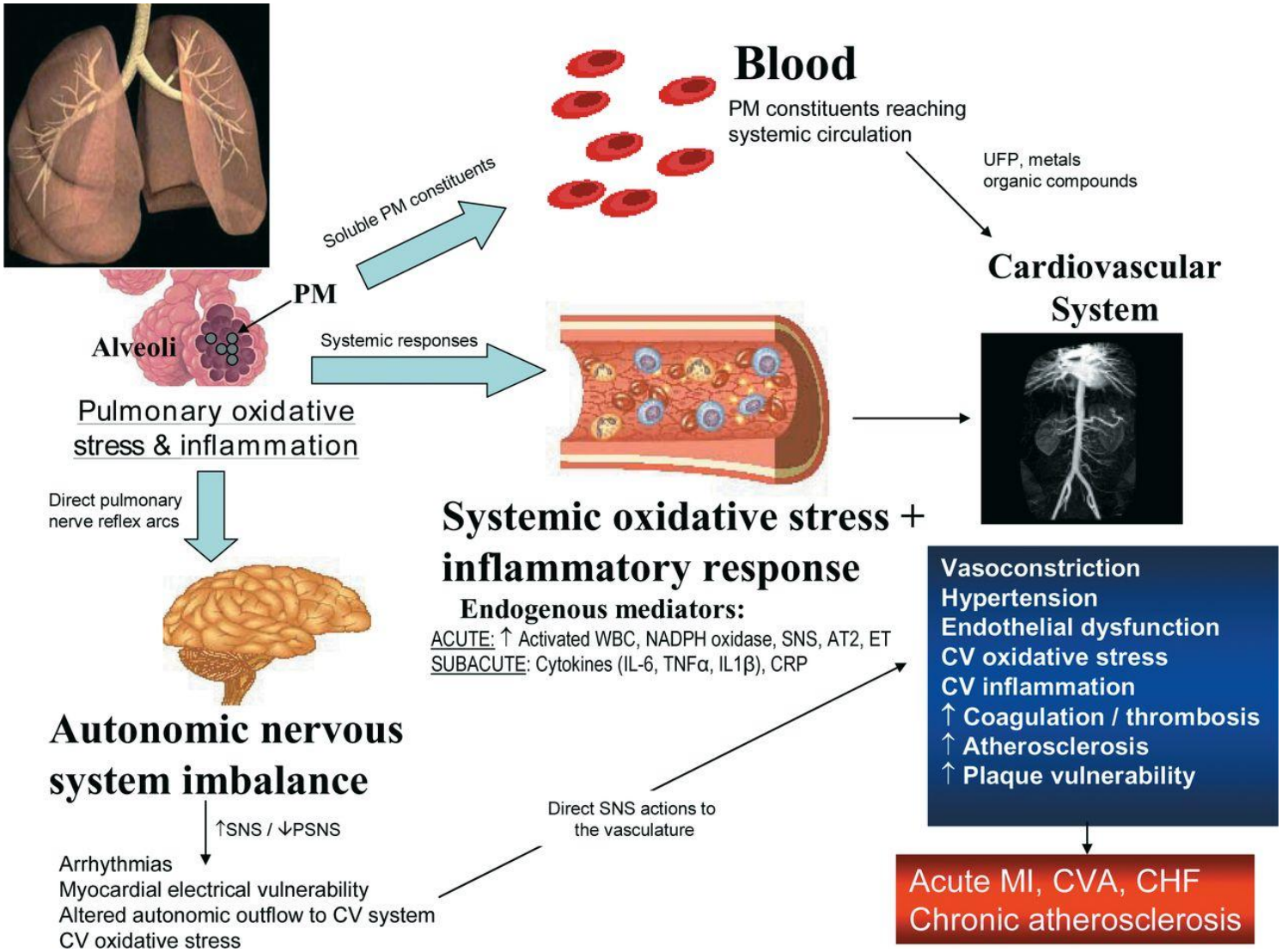
* Dieser Indikator zeigt die nach Bevölkerungszahl gewichtete PM10- und PM2,5-Konzentration, der die städtische Bevölkerung potenziell ausgesetzt ist.

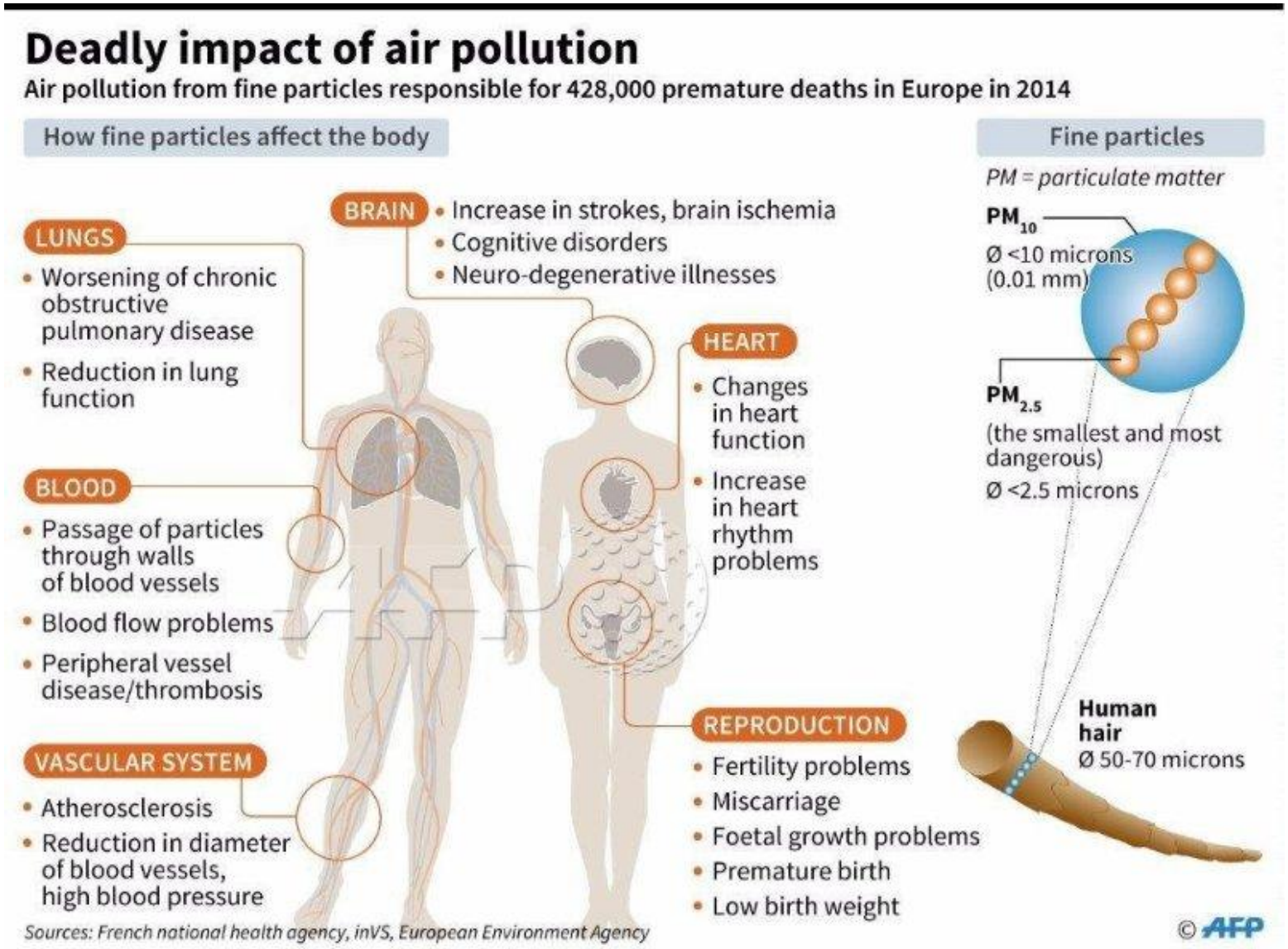
Quelle: Eurostat, Statista

Woher kommt Feinstaub?



Quelle: Umweltbundesamt


Blood
PM constituents reaching systemic circulation
Soluble PM constituents
UFP, metals organic compounds
Cardiovascular System
PM
Alveoli
Systemic responses
Pulmonary oxidative stress & inflammation
Direct pulmonary nerve reflex arcs
Systemic oxidative stress + inflammatory response
Endogenous mediators:
ACUTE: ↑ Activated WBC, NADPH oxidase, SNS, AT2, ET
SUBACUTE: Cytokines (IL-6, TNFα, IL1β), CRP
Vasoconstriction
Hypertension
Endothelial dysfunction
CV oxidative stress
CV inflammation
↑ Coagulation / thrombosis
↑ Atherosclerosis
↑ Plaque vulnerability
Autonomic nervous system imbalance
↑SNS / ↓PSNS
Arrhythmias
Myocardial electrical vulnerability
Altered autonomic outflow to CV system
CV oxidative stress
Direct SNS actions to the vasculature
Acute MI, CVA, CHF
Chronic atherosclerosis


Deadly impact of air pollution
Air pollution from fine particles responsible for 428,000 premature deaths in Europe in 2014
How fine particles affect the body
LUNGS
• Worsening of chronic obstructive pulmonary disease
• Reduction in lung function
BRAIN
• Increase in strokes, brain ischemia
• Cognitive disorders
• Neuro-degenerative illnesses
HEART
• Changes in heart function
• Increase in heart rhythm problems
BLOOD
• Passage of particles through walls of blood vessels
• Blood flow problems
• Peripheral vessel disease/thrombosis
VASCULAR SYSTEM
• Atherosclerosis
• Reduction in diameter of blood vessels, high blood pressure
REPRODUCTION
• Fertility problems
• Miscarriage
• Foetal growth problems
• Premature birth
• Low birth weight
Fine particles
PM = particulate matter
PM10
Ø <10 microns (0.01 mm)
PM2.5
(the smallest and most dangerous)
Ø <2.5 microns
Human hair
Ø 50-70 microns
Sources: French national health agency, inVS, European Environment Agency
© AFP

Auswirkungen des Feinstaubs auf die Lunge

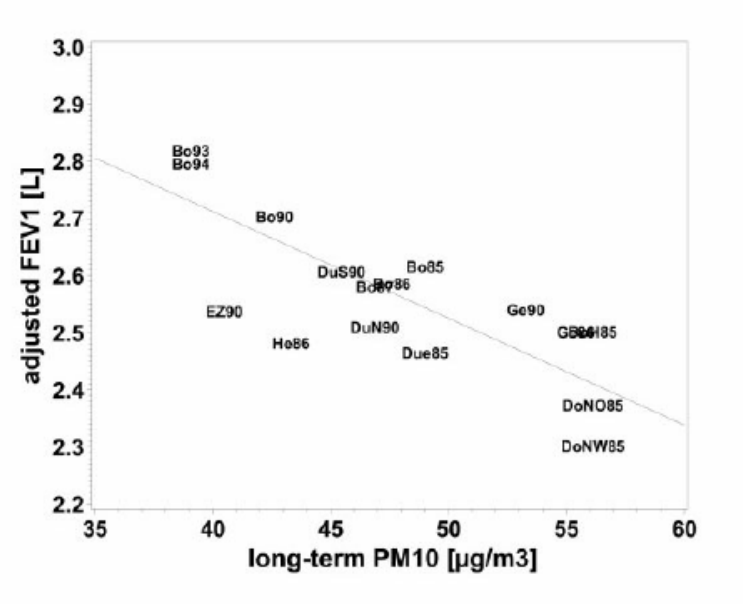


Figure 1
Association between FEV_1 and long-term PM_{10} exposure (five-year mean), adjusted for age, height, BMI, SES, heating with fossil fuels, occupational exposure (Dust/ temperature) and smoking for women who lived at least five years at their place of residence. Means of each place and year of study: Bo = Borken, DoH = Dortmund Hörde, DoNO = Dortmund North-East, Due = Dülmen, DuS = Duisburg South, DuN = Duisburg North, EZ = Essen Centre, Ge = Gelsenkirchen, He = Herne

Quelle Tamara Schikowski et al.: Long-term air pollution exposure and living close to busy roads are associated with COPD in women, *Respiratory Research* 2005, **6**:152

“Protection against fine particle-induced pulmonary and systemic inflammation by omega-3 polyunsaturated fatty acids”

Xiang-Yong Li, Lei Hao, Ying-Hua Liu, Chih-Yu Chen, Victor J. Pai, Jing X. Kang, Harvard Medical School, Institute of Biochemistry and Molecular Biology, Guangdong Medical University
Biochemica et Biophysica Acta 1861 (2017) 577–584

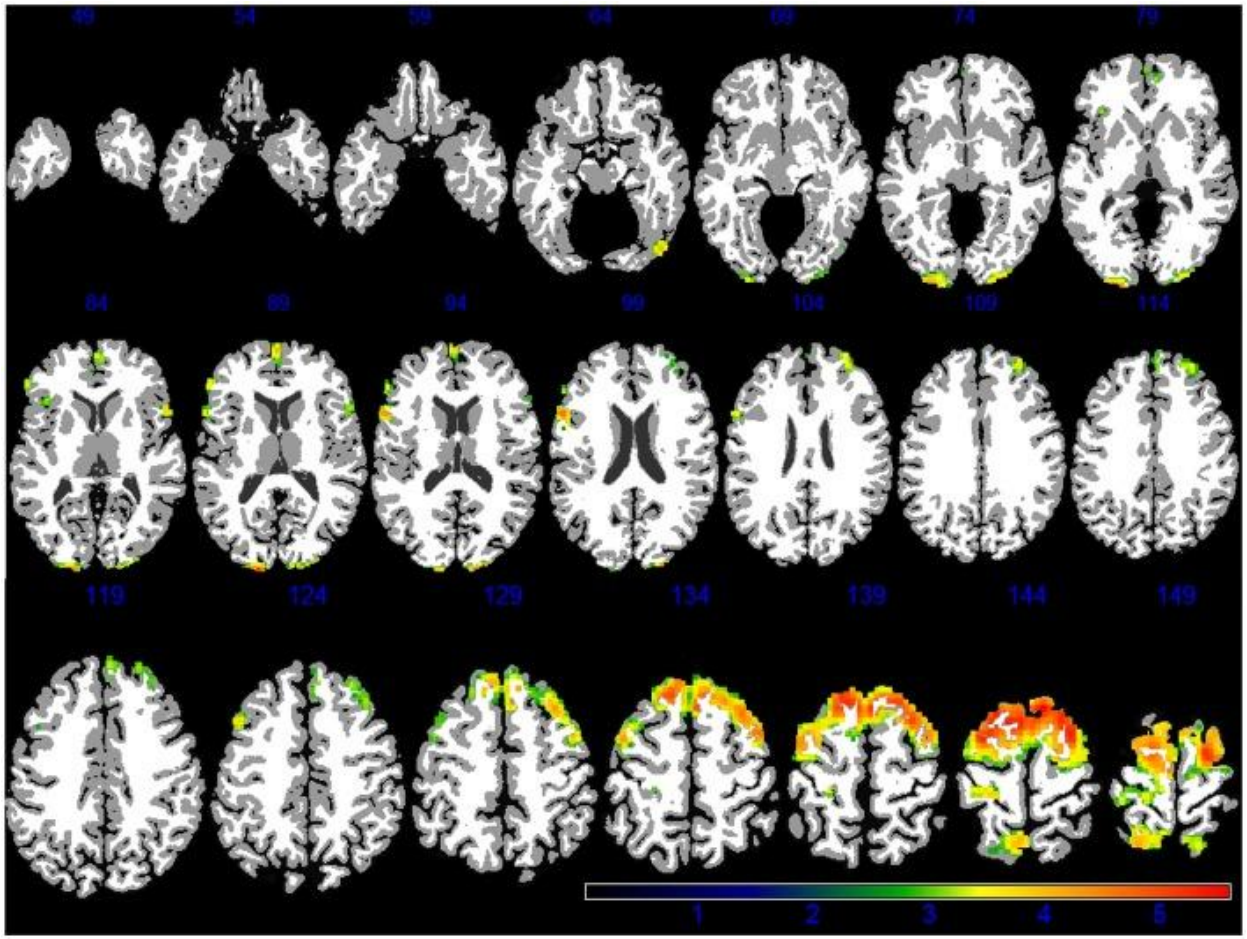
“A Voxel-Based Morphometry Study Reveals Local Brain Structural Alterations Associated with Ambient Fine Particles in Older Women ”

Ramon Casanova, Xinhui Wang, Jeanette Reyes, Yasuyuki Akita, Marc L. Serre, William Vizuete, Helena C. Chui, Ira Driscoll, Susan M. Resnick, Mark A. Espeland, Jiu-Chiuan Chen for the WHIMS-MRI Study

Department of Biostatistical Sciences, Wake Forest School of Medicine, Winston-Salem, NC, USA, Department of Preventive Medicine, University of Southern California, Los Angeles, CA, USA, University of North Carolina, Chapel Hill, NC, USA, Department of Neurology, University of Southern California, Los Angeles, CA, USA, Department of Psychology, University of Wisconsin-Milwaukee, Milwaukee, WI, USA, Laboratory of Behavioral Neuroscience, Intramural Research Program, National Institute on Aging, National Institutes of Health, Baltimore, MD, USA

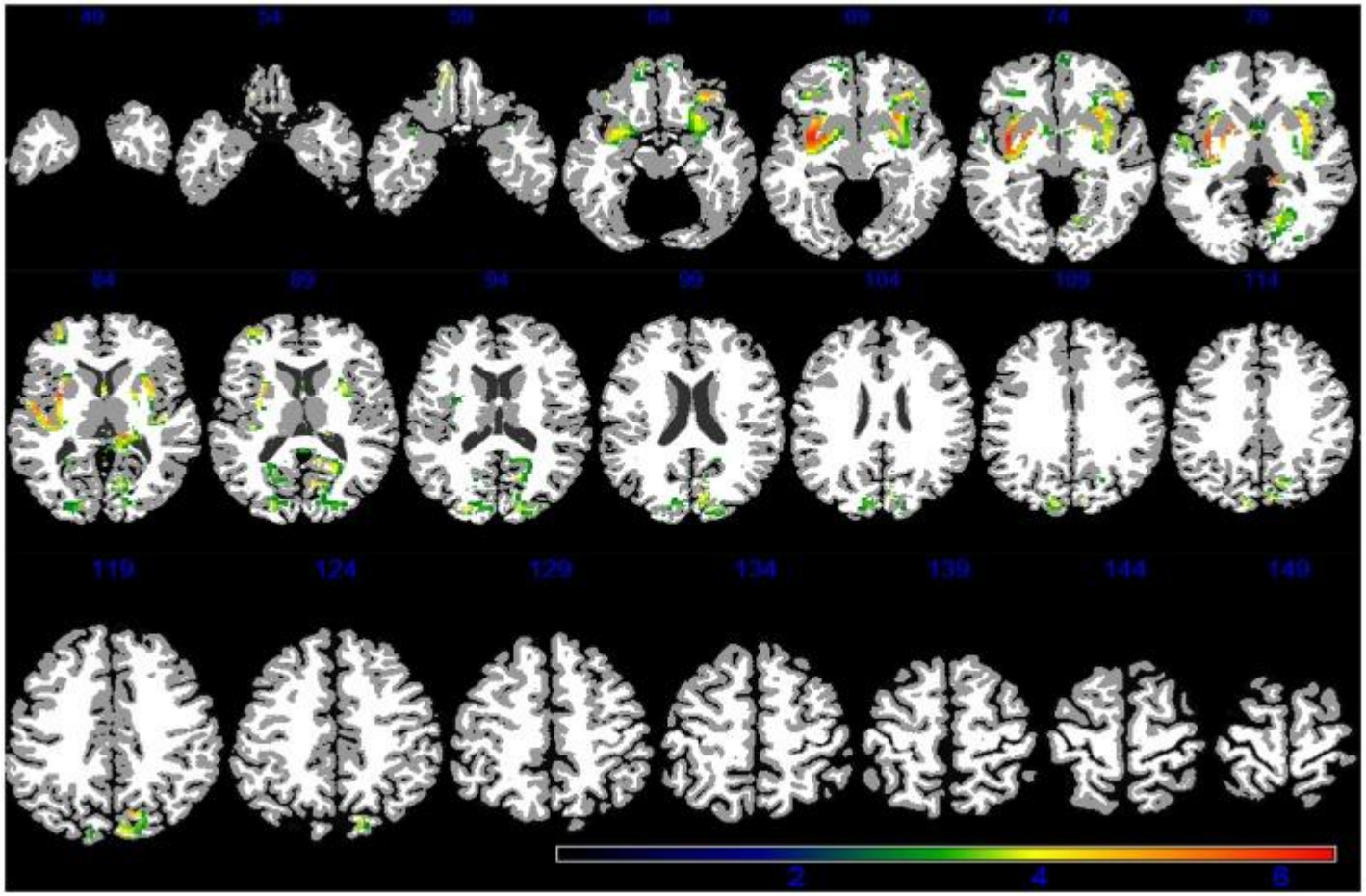
Front. Hum. Neurosci. 10:495. (2016)

“A Voxel-Based Morphometry Study Reveals Local Brain Structural Alterations Associated with Ambient Fine Particles in Older Women ”



GM areas negatively associated to $PM_{2.5}$ exposure ($q < 0.05$ FDR corrected) in the VBM linear regression models are presented in color. Images are oriented according to the neurological convention.

“A Voxel-Based Morphometry Study Reveals Local Brain Structural Alterations Associated with Ambient Fine Particles in Older Women ”



WM areas with decreased volumes associated to increased $PM_{2.5}$ exposure ($q < 0.05$ FDR corrected) in the VBM linear regression models are presented in color. Images are oriented according to the neurological convention..

“Traffic-Related Air Pollution and Cognitive Function in a Cohort of Older Men”

Melinda C. Power,1,2 Marc G. Weisskopf,1,2 Stacey E. Alexeeff,1 Brent A. Coull,3
Avron Spiro III,4,5 and Joel Schwartz1,2

1Department of Environmental Health,
2Department of Epidemiology, and
3Department of Biostatistics, Harvard School of Public Health, Boston, Massachusetts, USA;
4Veterans Affairs Boston Healthcare System, Boston, Massachusetts, USA;
5Department of Epidemiology, Boston University School of Public Health, Boston, Massachusetts, USA
Environ Health Perspect 119:682–687 (2011)

Studie an 680 Männern zwischen 1996 und 2007.

Verkehrsbedingte Feinstaubbelastung führt zu kognitiver Einschränkung bei Männern.

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“Ozone, particulate matter, and newly diagnosed Alzheimer's disease: a population-based cohort study in Taiwan.”

Jung CR[1], Lin YT[1], Hwang BF[2]

1
Department of Public Health, College of Public Health, China Medical University, Taichung, Taiwan Department of Occupational Safety and Health, College of Public Health, China Medical University, Taichung, Taiwan.
2
Department of Occupational Safety and Health, College of Public Health, China Medical University, Taichung, Taiwan.
J Alzheimers Dis. 2015;44(2):573-84

Studie an 95,690 Personen, Alter ≥ 65, während 2001-2010

“No exercise-induced increase in serum BDNF after cycling near a major traffic road.”

I.Bos[ab] L.Jacobs[c] T.S.Nawrot[cd] B.de Geus[a] R.Torfs[b] L.Int Panis[ae] B.Degraeuwe[b] R.Meeusen[a]

[a] Department of Human Physiology & Sports Medicine, Vrije Universiteit Brussel, Brussels, Belgium

[b] Flemish Institute for Technological Research (VITO), Mol, Belgium

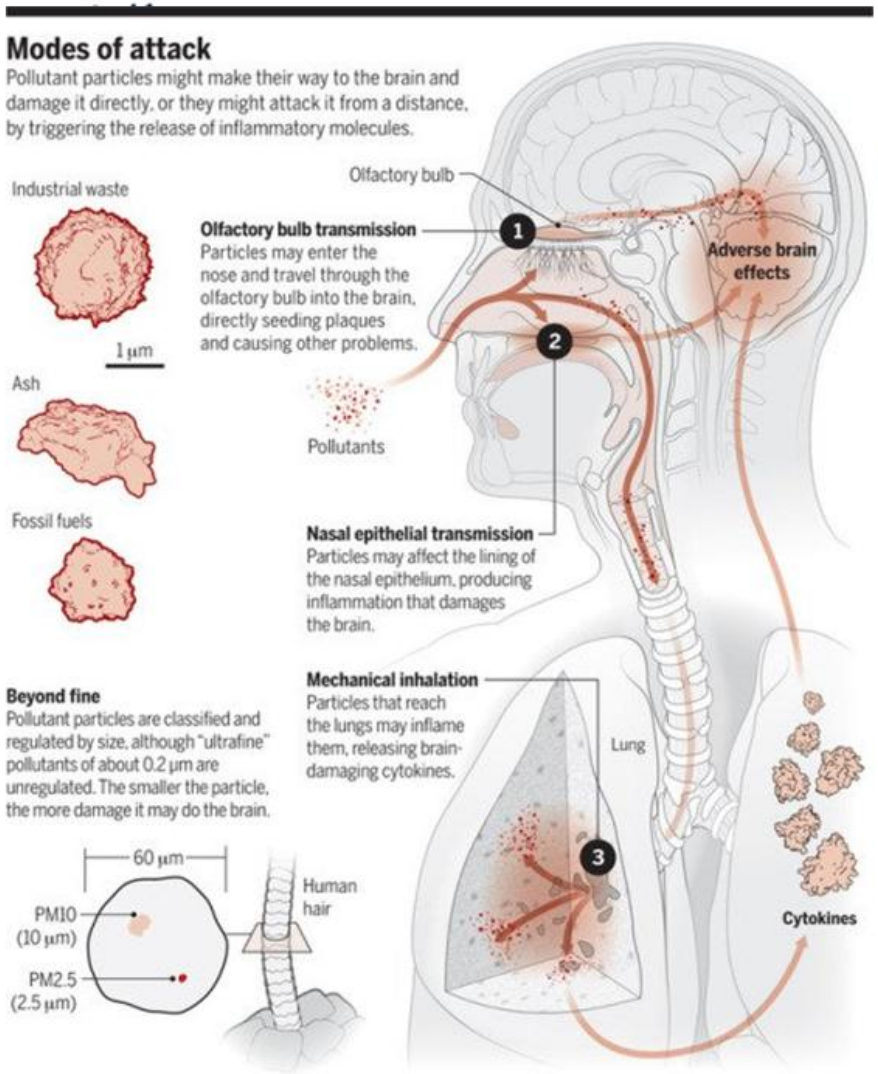
[c] School of Public Health, Occupational and Environmental Medicine, Unit of Lung Toxicology, K.U. Leuven, Leuven, Belgium

[d] Centre for Environmental studies, Hasselt University, Diepenbeek, Belgium

[e] Transportation Research Institute (IMOB), Hasselt University, Diepenbeek, Belgium

Neurosci Lett. 2011 Aug 15;500(2):129-32

Bei hoher Feinstaubbelastung schützt Sport das Gehirn nicht.



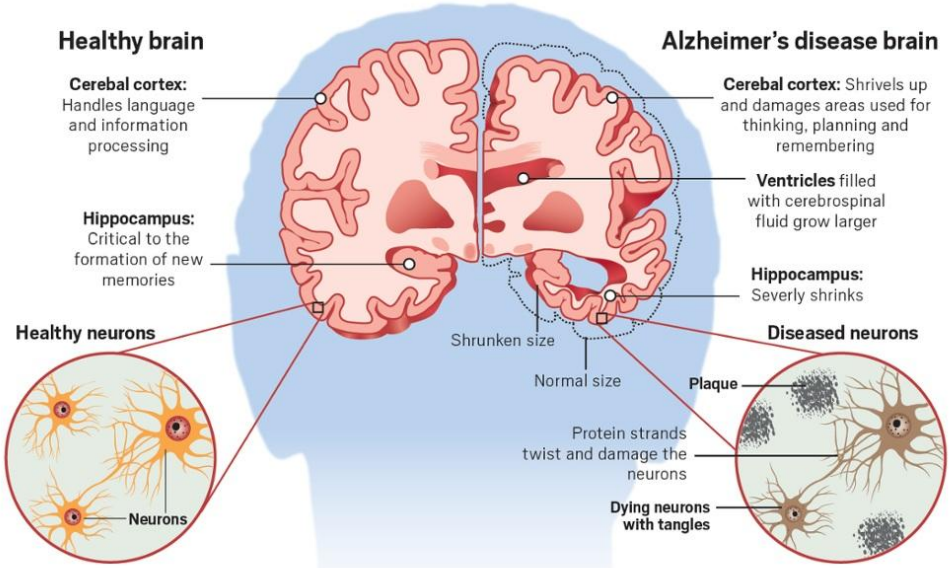
Impacts on the brain?

"Some of the health risks of inhaling fine and ultrafine pollutant particles are well-established, such as asthma, lung cancer, and, most recently, heart disease. But a growing body of evidence suggests that such exposure can also **harm the brain, accelerating cognitive aging**, and may even increase risk of Alzheimer's disease and other forms of dementia."

The polluted brain
Emily Underwood*
+ See all authors and affiliations
Science 27 Jan 2017:
Vol. 355, Issue 6323, pp. 342-345
DOI: 10.1126/science.355.6323.342 7

Environmental risk

A new study led by USC scientist links fine particle air pollution, such as diesel soot, to increased risk for Alzheimer's disease.



The three stages of the progressive brain disease

Early stage
Plaque and protein tangles form in the areas of the brain used for learning, memory, thinking and planning.

Mild to moderate stage
plaques and tangles spread to brain areas involved in speaking, understanding speech, and the sense of where the body is in relation to other objects.

Advanced stage
The brain shrinks dramatically due to widespread cell death. Patients lose their ability to communicate, to recognize family and loved ones and to care for themselves.

Source: Alzheimer's Association

STAFF GRAPHIC

Air Pollution and Brain Damage

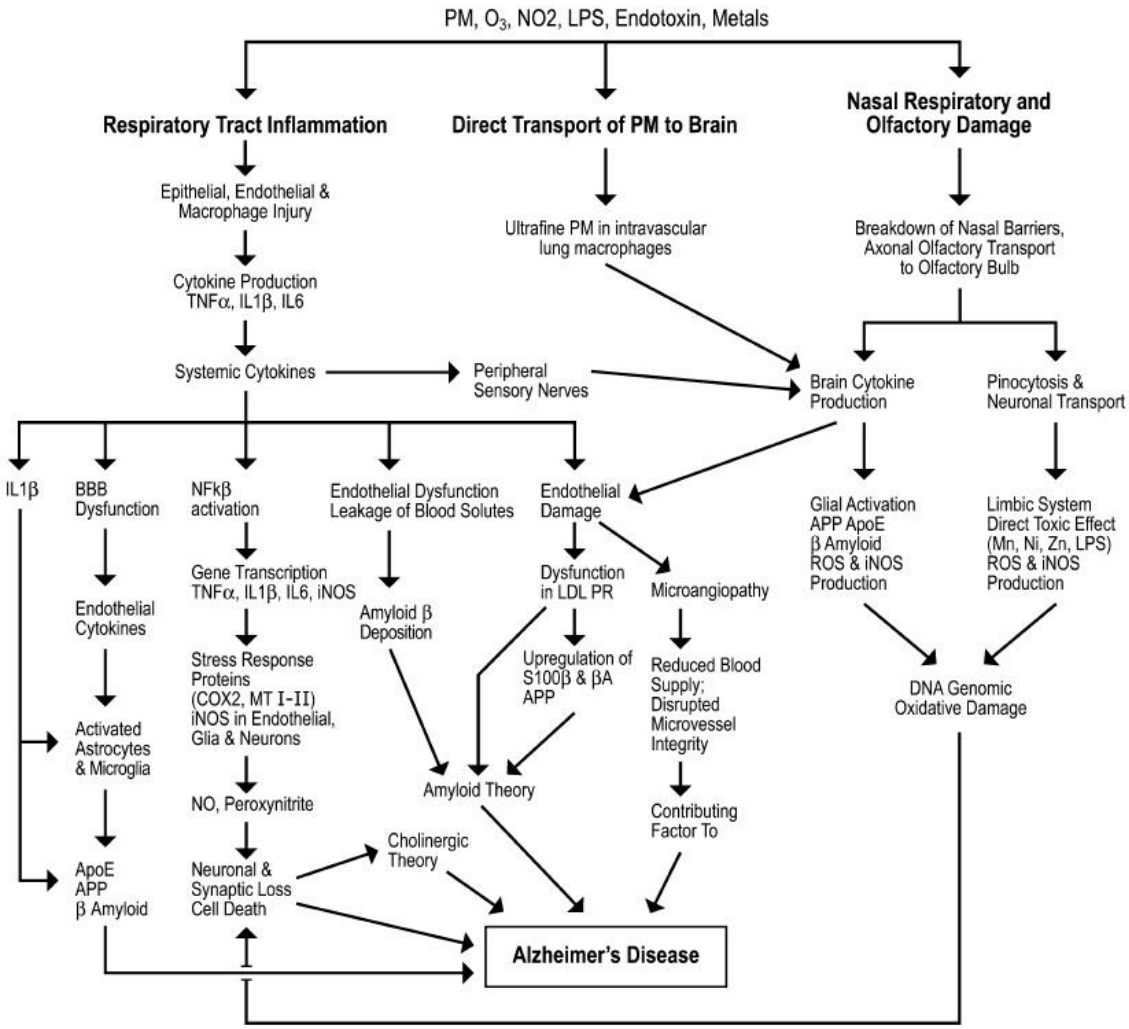


FIGURE 7.—Air pollution and brain damage. Potential pathways by which air pollutants may cause brain damage.

“Early Alzheimer’s and Parkinson’s Disease Pathology in Urban Children: Friend versus Foe Responses—It Is Time to Face the Evidence”

Lilian Calderón-Garcidueñas,1 Maricela Franco-Lira,2 AntonietaMora-Tiscareño,3 Humberto Medina-Cortina,3 Ricardo Torres-Jardón,4 andMichael Kavanaugh1

1 Center for Structural and Functional Neurosciences,The University of Montana, 32 Campus Drive, Skaggs Building 287,
Missoula, MT 59812, USA
2 Departamento de Investigaci´on, Hospital Central Militar, Secretaria de la Defensa Nacional, 11649 M´exico, DF, Mexico
3 Departamentos de Radiolog´ıa y Patolog´ıa Experimental, Instituto Nacional de Pediatria, 04530 M´exico, DF, Mexico
4Centro de Ciencias de la Atm´osfera, Universidad Nacional Aut´onoma de M´exico, 04510 M´exico, DF, Mexico

BioMed Research International
Volume 2013, Article ID 161687

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“Neuroinflammation, hyperphosphorylated tau, diffuse amyloid plaques, and down-regulation of the cellular prion protein in air pollution exposed children and young adults.”

Calderón-Garcidueñas L[1], Kavanaugh M, Block M, D'Angiulli, et al.

1
Instituto Nacional de Pediatría, Mexico City, Mexico.

J Alzheimers Dis. 2012;28(1):93-107

Autopsien an 43 Kindern.

Bei Kindern mit hoher Feinstaubbelastung werden bereits frühe Zeichen von Alzheimer- und Parkinson-Pathologie beobachtet.

“Association between Traffic-Related Air Pollution in Schools and Cognitive Development in Primary School Children: A Prospective Cohort Study”

Jordi Sunyer*1,2,3,4, Mikel Esnaola1,2,3, Mar Alvarez-Pedrerol1,2,3, Joan Forns1,2,3, Ioar Rivas1,2,3,5, Mònica López-Vicente1,2,3, Elisabet Suades-González1,2,3,6, Maria Foraster1,2,3, Raquel Garcia-Esteban1,2,3, Xavier Basagaña1,2,3, Mar Viana5 , Marta Cirach1,2,3, Teresa Moreno5 , Andrés Alastuey5 , Núria Sebastian-Galles2 , Mark Nieuwenhuijsen1,2,3, Xavier Querol5

1 Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Catalonia, Spain, 2 Pompeu Fabra University, Barcelona, Catalonia, Spain, 3 Consortium for Biomedical Research in Epidemiology and Public Health (CIBERESP), Madrid, Spain, 4 Institut Hospital del Mar d’Investigacions Mèdiques–Parc de Salut Mar, Barcelona, Catalonia, Spain, 5 Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Catalonia, Spain, 6 Learning Disabilities Unit (UTAE), Neuropediatrics Department, Hospital Sant Joan de Déu, Universitat de Barcelona, Barcelona, Spain

PLOS Medicine | DOI:10.1371/journal.pmed.1001792 March 3, 2015

Studie an 2715 Kindern im Alter von 7 bis 10 Jahren.

Grundschulkinder zeigen Einschränkungen ihrer kognitiven Entwicklung durch Feinstaubbelastung.

“Association between neighbourhood air pollution concentrations and dispensed medication for psychiatric disorders in a large longitudinal cohort of Swedish children and adolescents”

Anna Oudin,1 Lennart Bråbäck,1 Daniel Oudin Åström,1 Magnus Strömgren,2 Bertil Forsberg1

1 Department of Public Health and Clinical Medicine, Occupational and Environmental Medicine, Umeå University, Umeå, Sweden 2 Department of Geography and Economic History, Umeå University, Umeå, Sweden
BMJ Open 2016;6:e010004

Studie an 552 221 Kindern und Jugendlichen unter 18 Jahren in einem durchschnittlichen Beobachtungszeitraum von 3,5 Jahren.

Kinder mit hoher Feinstaubbelastung zeigen schon früh psychische Auffälligkeiten und psychiatrischen Erkrankungen.