Cognitive decline, dementia, and Parkinson’s disease: Environmental contributors and potential pathways to prevention

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Finally, Sam admits he hasn’t been getting out much since his wife died, as she was always the one who organized the social activities. They talk more and Lisa mentions Sam’s yearly physical at the VA in a couple of weeks. Lisa asks if she could go with him so they could ask some questions together and she could be his “health advocate.”

Definition: health advocate

Sam reluctantly agrees. He already dislikes going to the doctor, much less having someone with him.
Social Interaction and Health

National Institute on Aging

• Social relationships are consistently associated with biomarkers of health

• Positive indicators of social well being associated with lower levels of interleukin-6, an inflammatory marker associated with Alzheimer’s disease, cardiovascular, and other disorders

• Social isolation constitutes a major risk factor for morbidity and mortality, especially in older adults

• Loneliness is a unique risk factor for depression
  • Loneliness and depression have a synergistic adverse effect on well being in middle aged and older adults
# Livable Communities: An Evaluation Guide

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Dr. Gomez also asks Sam if he is feeling lonely, down or depressed.

When Sam replies that he has been depressed since his wife died, Dr. Gomez asks him if he is drinking more than usual or using other kinds of drugs.

Sam says he has been drinking more than he used to, several beers a day.

When his exam is over Dr. Gomez invites Sam into his office for further discussion. Sam says he’d like his daughter-in-law Lisa to be there.
Psychosocial and Socioeconomic Stressors

Studies support:

• Early life or earlier onset depression increases risk of cognitive impairment and dementia
• Major depression may increase risk for dementia but also may be a reaction to cognitive decline
• Chronic and perceived stress associated with faster decline in healthy and those with mild cognitive impairment (MCI)
• Lower SES associated with increased risk for memory decline and dementia
Cognitive Decline
Sam's Story

Workplace risk factors: Effects of lead on cognitive function

While lead's role as a neurodevelopmental toxicant and a danger to infants' and children's health has been well known, more recent evidence shows that lead is a neurotoxicant across the lifespan. Higher cumulative lifetime lead exposures, as estimated by bone lead levels, are associated with higher risk of impaired cognitive function (Shih, 2007; Bandeen-Roche, 2005; Weuve, 2009) as well as Parkinson's disease (Coon, 2006; Weiskopf, 2016; Weuve, 2013). The impacts on various measures of cognitive function are particularly pronounced in studies of older people whose bone lead levels are elevated, regardless of current blood lead levels. These findings are supported by experimental data (Wu, 2008; Bashu, 2005).

Lead in the workplace
Lead is still used in some industrial processes and fuels. Some people are more highly exposed because of recycling practices, occupation, or environmental contamination. OSHA estimates that approximately 804,000 workers in general industry and an additional 836,000 workers in construction are potentially exposed to lead. Organic lead compounds continue to be used in high octane fuel in the aviation industry for piston engine aircraft.

Interactive Effects of Lead and Stress on Elder Cognition
It is well established that childhood lead exposure harms cognitive development in childhood. More recent evidence shows that cumulative lead exposure harms cognitive function later in life as well. Chronic stress can exacerbate the adverse impacts of lead on cognitive function.

Watch:
- Lead and Neurodegeneration
  Samuel M. Goldman MD, MPH, University of California, San Francisco, Division of Occupational and Environmental Medicine and Department of Neurology

Key Concept: Aging begins at conception

Early life exposure to lead, later life disease

Early life experiences can influence later life health, disease.

- Low birth weight
- Obesity, hypertension, cardiovascular diseases, diabetes
- Alzheimer's, dementia, Parkinson's

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Early Life Lead Exposure and Later Life Dementia

• Monkeys given lead from birth to one year
  • Levels 19-25 mcg/dl, similar to some children
• At 23 years
  • Increased expression of AD related genes including amyloid precursor protein (APP)
  • Altered levels and distribution of plaques in frontal cortex
• Epigenetic changes supported as mechanism of early life lead exposure resulting in AD related changes later in life
Air pollution and the brain

Air pollution is a complex mixture of particles, gases, ozone, carbon monoxide, nitrogen and sulfur oxides, metal and metal compounds, and toxic organics. In addition to inorganic pollutants, air pollution also contains variable mixtures of soot, metals, and other combustible materials (soot-free condensates). Commercial and industrial combustion is a major source of air pollution in the modern world, leading to local, regional, and global environmental health impacts.

A large population-based prospective study in Canada found a four percent increased risk of dementia with a 50 micrograms/m³ increase in particulate matter exposure. Furthermore, over a 15-year period, the risk of degenerative dementia related to air pollution has been found to be much higher in children. Autopsy studies comparing the brains of even relatively young people who had died accidentally with those living in cleaner cities found numerous inflammatory markers. Especially vulnerable are the brain's microvascular units and associated structures, including neurons, axons, and dendrites. Respiratory and cardiovascular effects of ambient air pollution are well-established. Glowing evidence shows that it also harms the brain.

Extensive small pollution-related neuroanatomical abnormalities were observed in neurovasculature, including meningeal vessels, and inflammatory cells lining blood vessels, including macrophages, neutrophils, and monocytes. Inflammation activation of glial cells, and oxidative stress in the brain is associated with increased risk of dementia with exposure to air pollution.

In the developed world, the risk of dementia related to air pollution and the brain is associated with the use of air pollution levels exceeding 10 micrograms/m³. For every 10 micrograms/m³ increase in air pollution exposure, there has been a 1.4% increase in the risk of degenerative dementia, regardless of age, sex, or socioeconomic status.
Public Policies Make a Difference

Recommendations at the public policy level:

- Address socio-economic disparity.
- Encourage community solutions.
- Provide healthier food supplies.
- Promote public transportation.
- Support sustainable food production.
- Reduce exposures to chemicals.
- Develop eco-friendly products.

PUBLIC POLICIES THAT MAKE A DIFFERENCE
Mean blood lead levels in toddlers in the US population 1976-2012

- Lead paint ban 1976
- Lead & copper rule 1991
- Can solder phase out begins 1978
- Can solder ends 1992
- Unleaded gasoline introduced 1979
- Leaded gas ends 1996

Mean blood lead levels in US toddlers (micrograms/dl)

- 18 in 1974
- 16 in 1976
- 14 in 1978
- 12 in 1980
- 10 in 1982
- 8 in 1984
- 6 in 1986
- 4 in 1988
- 2 in 1990
- 1 in 1992
- .8 in 1994
- .6 in 1996
- .4 in 1998
- .2 in 2000
- .1 in 2002
- .07 in 2004
- .06 in 2006
- .04 in 2008
- .02 in 2010
- .01 in 2012

Mean blood lead levels in US toddlers (micrograms/dl)
California gasoline related emissions drop 70% from 1996

- Same amount of gas used
- 95 of top 100 VOCs Decreased
- Attributable largely to regulation and gas reformulation