

Air Pollution and Dementia – Protect our Brains with Improved Ambient Air Quality Guidelines

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Key points

- › The numbers of people with dementia in Europe will double by 2050 if urgent action is not taken.
- › Air-pollution is a well-established risk factor for dementia.
- › More than 500,000 people in the EU have dementia associated with air pollution.
- › The financial costs of dementia in the European Region are estimated to be 392 billion EUR.
- › The financial and social costs associated with dementia are enormous, but also preventable, in part, by reducing air pollution levels.

Background

Dementia imposes a large burden on health and social care systems, and this burden will rise over the next decades. In Europe, a recent report by the WHO estimates the costs of caring for the 14.1 million people living with dementia in the European Region at EUR 392 billion or almost EUR 28,000 per person with dementia in 2019 (WHO 2019). For European Union countries (EU27), the costs are estimated to reach over 250 billion euros by 2030 (Brain council 2023).

A growing body of evidence supports that modifiable risk factors for dementia account for around 40% of the cases (Livingston et al 2020), which could be prevented or delayed. Such evidence has paramount policy implications.

In particular, air pollution is one of the well-established risk factors for dementia, at present accounting for more than 500,000 in the EU. Reduction of exposure to air pollution is one of the specific recommendations to reduce the prevalence of dementia by the Lancet Commission on Dementia Prevention, Intervention, and Care, which petitions policymakers to expedite improvements in air quality, particularly in areas with high air pollution. Cities are hotspots of air pollution and also where most people live in Europe, making cities a focal point for the prevention of air-pollution related dementia (Khomenko et al 2021).

Dementia

Dementia is a general term to describe the loss of memory, language, problem-solving and other thinking abilities that are severe enough to interfere with daily life. Dementia can be caused by a number of diseases, with Alzheimer's disease being the most frequent and accounting for about 70% of the cases. Other causes of dementia include vascular dementia, Parkinson's disease, dementia with Lewy bodies or frontotemporal dementia, among others. The number of people living with dementia in the European Union (EU27) is estimated to be almost 8 million, and this is expected to double by 2050 to almost 19 million people (Alzheimer Europe 2023).

Dementia has physical, psychological, social and economic impacts, not only for people living with dementia, but also for their caregivers, families and society at large. Dementia is one of the leading causes of care dependence and disability in old age. The onset of cognitive impairment compromises their ability to carry out complex but essential tasks in daily life. In addition, people living with dementia will increasingly have difficulty in meeting their basic personal care needs.

Air Pollution, Alzheimer's Disease and other Dementias

In a recent article published in the *British Medical Journal (BMJ)*, researchers at Harvard T.H. Chan School of Public Health conducted a systematic review and meta-analysis of air pollution and dementia (Wilker et al 2023). The findings from this study suggested consistent evidence of an association between ambient air pollution and clinical dementia. Every 2 to 3 $\mu\text{g}/\text{m}^3$ upsurge in average yearly exposure to PM_{2.5} increased the risk of developing dementia by 4%. Almost half cases go undetected.

These recent findings add to previous evidence supporting that air pollution is a well-established risk factor for dementia and related to 6.3% of the cases (Power et al 2016, Chen et al 2017). Recent estimates show that the estimated incidence rate (cases per year) of Alzheimer's disease (AD) and dementia with unspecified causes (DU) associated with exposure to air pollution over Europe is 498,000 and 314,000, respectively (Guzman et al 2022). An important increase in the future incidence rate is projected (around 72% for both types of dementia) when considering the effect of climate change together with the foreseen changes in the future population, because of the expected aging of European population.

Airborne particulate pollutants might accelerate neurodegenerative processes through cerebrovascular and cardiovascular disease as well as protein processing in the brain. A recent report by the UK Committee on the Medical Effects of Air Pollutants (COMEAP 2022) concludes that air pollution, particularly small particle pollution, can affect the heart and the circulatory system, including circulation to the brain. Therefore, air pollution might primarily contribute to mental decline and dementia caused by effects on the blood vessels. Further, air pollution might also stimulate the immune cells in the brain, which can then damage nerve cells. In addition, very small air pollution particles might enter the brain, and may cause direct damage.

A recent review reported significant associations between air pollution and decreased volumes of specific brain structures, specifically hippocampal volume, cortical thickness and surface area such as in the prefrontal cortex and temporal lobe, as well as the weakening of functional connectivity pathways, largely the Default Mode (DMN) and Frontal Parietal (FPN) networks, as detected by fMRI (Balboni et al 2022, Yuan et al 2023). This may explain why air pollution has been related to memory loss, cognitive decline, and dementia.

Action Needed

Better air is within our reach. We urgently need to create safer and healthier environments for our ageing population in our cities and beyond. High air pollution levels are an obvious concern and require action to prevent many potential cases of dementia in the future. Adopting new EU ambient air quality guidelines that are aligned with the WHO air quality guidelines are a critical step to protect the health of our ageing population.

The EU air ambient air quality directive is an essential opportunity to protect the health and wellbeing of European ageing population and will provide the catalyst for member states and cities to take action.

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