



UMEÅ UNIVERSITET

# Air Pollution and Dementia in a Low Exposure Setting

the Role of Noise, Olfaction,  
and the APOE gene

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för  
avläggande av filosofie doktorsexamen framläggs till offentligt  
försvar i SAM.A.247, Samhällsvetarhuset, fredagen den 24 mars, kl.  
09:00. Avhandlingen kommer att försvaras på engelska.  
Fakultetsopponent: Dr. Tom Russ, University of Edinburgh, division  
of psychiatry.

Department of Psychology

**Organization**  
Umeå University  
Department of Psychology

**Document type**  
Doctoral thesis

**Date of publication**  
3 March 2023

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## **Air Pollution and Dementia in a Low Exposure Setting** the Role of Noise, Olfaction, and the APOE gene

### **Abstract**

Previous research indicates an association between air pollution exposure, and risk of dementia. Still, a number of factors that may play a role in this association remain to be explored. In addition, while most studies on air pollution and brain health have taken place in highly exposed large urban areas, the studies included in this thesis are conducted in an area with relatively low levels of air pollution and road traffic noise. The overall aim of this thesis is to investigate possible mechanisms - more specifically the role of noise, olfaction and the APOE-ε4 allele - in the association between air pollution and dementia, in a low exposure area. Because olfactory deficits have been linked to air pollution, and can be an early sign of dementia, an additional aim is to examine associations between exposure to air pollution and olfactory function.

**Methods:** Participants were drawn from the Betula project – a prospective cohort study – in Umeå, Sweden. Modelled data on concentrations of nitrogen oxides (NO<sub>x</sub>), fine particle matter (PM<sub>2.5</sub>) and levels of road traffic noise, were matched with participants residential address at baseline. PM<sub>2.5</sub> levels at the day of testing were obtained from a measuring station. Data on dementia diagnoses, APOE status, olfactory functions, and covariates, were drawn from the Betula project. Dementia assessment was primarily based on medical records. Odor identification was assessed using the Scandinavian Odor Identification Test, and odor detection threshold by “sniffin’ sticks”. APOE genotype was determined by DNA analyses of blood samples.

**Study I.** The aim of study I was to investigate the individual and combined effect of noise and air pollution on risk of dementia. The results showed an association between NO<sub>x</sub> and dementia. However, noise from road traffic did not contribute to this association.

**Study II.** Olfactory deficits can be an early sign of dementia and might also be caused by air pollution. Olfactory receptor cells in the nasal cavity are exposed to inhaled air, and the olfactory bulb is one of the areas of the brain most affected by air pollution. The APOE-ε4 allele is important to consider, as it is a risk factor for both dementia and declining olfactory functions. The aim of study II was to investigate the role of olfaction and the APOE-ε4 allele in the association between air pollution and dementia. Stratified analyses showed that associations between PM<sub>2.5</sub> and dementia persisted only among APOE-ε4 carriers, and those with poor odor identification ability.

**Study III.** The olfactory system may be vulnerable to air pollution, and olfactory dysfunction is an early sign of dementia. In addition, the moderating effect of odor identification ability found in study II, could be explained by air pollution increasing the risk of olfactory functions and dementia independent of each other. Thus, the aim of study III was to investigate the associations between PM<sub>2.5</sub> (both long term exposure, and concentrations on the day of testing), and odor identification and detection. A *positive* association was observed between long term air pollution exposure and odor identification ability. No association was found between long term air pollution exposure and odor detection, or between short term exposure and either olfactory outcome.

**Conclusion:** Low levels of long-term exposure to air pollution increases the risk of dementia. APOE-ε4 carriers, and those with poor odor identification ability, seem particularly vulnerable. No residual confounding from road traffic noise was found, suggesting that air pollution is the main component in the association between traffic related exposures and dementia in low-exposure areas. The positive association between air pollution and odor identification might be explained by socioeconomic status, and the links between olfaction and semantic memory.

### **Keywords**

Air pollution, dementia, olfaction, road traffic noise, APOE

**Language**  
English

**ISBN**  
978-91-8070-020-7 (print)  
978-91-8070-021-4 (PDF)

**Number of pages**  
53 + 3 papers