

# Cardiovascular and pulmonary health effects of air pollution – long-term effects in Sweden and effects of wood smoke

Akademisk avhandling

som för avläggande av medicine doktorsexamen vid Sahlgrenska Akademin, Göteborgs universitet, kommer att offentlig försvaras i sal Hamberger, Arbets- och miljömedicin, Medicinaregatan 16A, Göteborg, fredagen 18 mars 2016 kl. 9:00

av

Leo Stockfelt

## Fakultetsopponent:

Professor Per Gustavsson  
Institutet för miljömedicin,  
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Avhandlingen baseras på följande arbeten:

- I.* Stockfelt L, Sallsten G, Olin A-C, Almerud P, Samuelsson L, Johannesson S, Molnár P, Strandberg B, Almstrand A-C, Bergemalm-Rynell K, Barregard L. Effects on airways of short-term exposure to two kinds of wood smoke in a chamber study of healthy humans. *Inhalation Toxicology* 2012; 24, 47-59.
- II.* Stockfelt L, Sallsten G, Almerud P, Basu S, Barregard L. Short-term chamber exposure to low doses of two kinds of wood smoke does not induce systemic inflammation, coagulation or oxidative stress in healthy humans. *Inhalation Toxicology* 2013; 25, 417-425.
- III.* Molnár P, Stockfelt L, Barregard L, Sallsten G. Residential NO<sub>x</sub> exposure in a 35-year cohort study. Changes of exposure, and comparison with back extrapolation for historical exposure assessment. *Atmospheric Environment* 2015; 115, 62-69.
- IV.* Stockfelt L, Andersson EM, Molnár P, Rosengren A, Wilhelmsen L, Sallsten G, Barregard L. Long term effects of residential NO<sub>x</sub> exposure on total and cause-specific mortality and incidence of myocardial infarction in a Swedish cohort. *Environmental Research* 2015; 142, 197-206.



UNIVERSITY OF GOTHENBURG

Göteborg 2016

# Cardiovascular and pulmonary health effects of air pollution – long-term effects in Sweden and effects of wood smoke

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## ABSTRACT

Exposure to air pollution is associated with increased morbidity and mortality in cardiovascular and pulmonary diseases. Main suggested mechanisms are airway and systemic inflammation, affecting hemostasis in the short term and atherosclerosis in the long term. Few studies have investigated the effects over decades, or which time-windows of exposure are the most relevant. In Sweden and many other countries wood burning is one of the largest sources of air pollution. The main aims of this thesis are to increase the knowledge of the mechanisms through which wood smoke causes respiratory and cardiovascular diseases, and the effects of long-term exposure to air pollution in a Swedish cohort.

In an experimental chamber study in healthy adults, short term exposure to two types of wood smoke was associated with symptoms and biomarkers of airway effects, but not with biomarkers of systemic inflammation or coagulation. This indicated that relatively low doses of wood smoke induce effects on airway epithelial permeability and possibly airway inflammation. In a long-term cohort study of residential exposure to nitric oxides (NO<sub>x</sub>) in Gothenburg, we observed a time trend of decreasing exposure. Back extrapolation of exposure was fairly correct for 5-7 years but not for longer time spans, showing that historical dispersion models and residential history are important for accurate long-term exposure estimations. Total non-accidental mortality was associated with residential NO<sub>x</sub> exposure. The effect estimates were similar for NO<sub>x</sub> exposure the last year, the mean NO<sub>x</sub> exposure the last 5 years, and the mean NO<sub>x</sub> exposure since enrolment. The effect estimates for cause-specific cardiovascular mortality were similar to those for total mortality. The effect was near linear with no evidence of any threshold, and only marginally affected by confounders and effect modifiers.

**Keywords:** Air pollution, wood smoke, human exposure studies, dispersion modelling, cohort studies, cardiovascular disease

**ISBN (printed):** 978-91-628-9726-0, **ISBN (e-publ.):** 978-91-628-9797-7  
Electronic version available at: <http://hdl.handle.net/2077/41243>