

# Cardiovascular and renal effects of long-term particle exposure

Akademisk avhandling

som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet kommer att offentligen försvaras i sal Stora Änggården, Guldhedsgatan 5A, Göteborg, den 16 maj 2025, klockan 13.00

av Karl Kilbo Edlund.

Fakultetsopponent:

Jonas Björk, professor, Lunds universitet

## Avhandlingen baseras på följande delarbeten

- I. Kilbo Edlund K., Molnár P., Andersson E.M., Ögren M., Segersson D., Fagman E., Fagerberg B., Barregard L., Bergström G., Sallsten G., Stockfelt L. "Long-term exposure to air pollution, coronary artery calcification, and carotid artery plaques in the population-based Swedish SCAPIS Gothenburg cohort" *Environ Res* **2022**, 214, 113926, doi: 10.1016/j.envres.2022.113926.
- II. Kilbo Edlund K., Andersson E.M., Asker C., Barregard L., Bergström G., Eneroth K., Jernberg T., Ljunggren S., Molnár P., Sommar J.N., Oudin A., Pershagen G., Persson Å., Pyko A., Spanne M., Tondel M., Ögren M., Ljungman P., Stockfelt L. "Long-term ambient air pollution and coronary atherosclerosis: Results from the Swedish SCAPIS study" *Atherosclerosis* **2024** May 8:117576 doi: 10.1016/j.atherosclerosis.2024.117576.
- III. Kilbo Edlund K., Xu Y., Andersson E.M., Christensson A., Dehlin M., Forsblad-d'Elia H., Harari F., Ljunggren S., Molnár P., Oudin A., Svartengren M., Ljungman P., Stockfelt L. "Long-term ambient air pollution exposure and renal function and biomarkers of renal disease" *Environ Health* **2024** 23, 67 doi: 10.1186/s12940-024-01108-9.
- IV. Kilbo Edlund K., Xu Y., Andersson E.M., Asker C., Bennet C., Molnár P., Rosengren A., Harari F., Stockfelt L. "Long-term ambient air pollution exposure and CKD at low exposure levels: a cohort study in Gothenburg, Sweden" *Manuskript*.
- V. Kilbo Edlund K., Andersson E.M., Andersson M., Barregard L., Christensson A., Johannesson S., Harari F., Murgia N., Torén K., Stockfelt L. "Occupational particle exposure and chronic kidney disease: a cohort study in Swedish construction workers" *Occup Environ Med* **2024** Juni 3;81(5):238-243, doi: 10.1136/oemed-2023-109371.

**SAHLGRENKA AKADEMIN  
INSTITUTIONEN FÖR MEDICIN**



# Cardiovascular and renal effects of long-term particle exposure

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## ABSTRACT

**Background and aims** Long-term particle exposure is a major risk factor for cardiovascular disease, claiming millions of lives annually. However, it remains uncertain if atherosclerosis mediates the cardiovascular effects of particle exposure. Similarly, the impact of particle exposure on the kidneys is not sufficiently understood. This thesis explores how particle exposure is associated with atherosclerosis, renal function, and chronic kidney disease.

**Methods** Ambient particle exposure was assessed in the general population using large air pollution models validated against monitoring station data. Occupational particle exposure in a cohort of construction workers was estimated via a job-exposure matrix developed by experienced occupational hygienists. Coronary and carotid atherosclerosis, as well as cardiovascular biomarkers and estimated renal function, were measured cross-sectionally and analysed using multivariable-adjusted robust Poisson, ordinal logistic, and linear regression models. Incident chronic kidney disease was identified longitudinally from healthcare registers and analysed using multivariable-adjusted Cox proportional hazard models.

**Results** Fine particle exposure appeared to be associated with more rupture-prone non-calcified plaques, but not with total coronary atherosclerosis, and with elevated levels of a biomarker of plaque vulnerability. Traffic-related pollutants were suggestively linked to a higher prevalence of carotid plaques and greater carotid plaque area. Both ambient and occupational particle exposure were associated with an increased risk of chronic kidney disease. Ambient particle exposure was associated with slight hyperfiltration, which may be due to chance or an early sign of renal stress.

**Conclusions** These results highlight plaque vulnerability, rather than calcification, as a mechanism linking long-term low-level particle exposure to cardiovascular disease. They also underscore the importance of considering chronic kidney disease in health impact assessments of particle exposure. From a policy perspective, these findings support that stricter regulations of particle exposure in both ambient and occupational settings would have substantial benefits for public health, even at low exposure levels.

**Keywords:** Air pollution, particle exposure, atherosclerosis, chronic kidney disease