

To: Transport & Health Policy Makers, & Practitioners
From: Prof Adrian Davis, TRI, Edinburgh Napier University
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Subject: Essential Evidence 4 Scotland: No. 5 Association
Between Ambient Air Pollution and cardiac structure
and function damage

Top line: There is growing evidence of the damaging effects of ambient pollution even in the setting of relatively low exposure levels and this suggests that air pollution should be recognized as a major modifiable risk factor that needs to be targeted via public health measures.

The deleterious effect of air pollutants on cardiovascular health is well established. Several studies have demonstrated strong associations between exposure to air pollution and increased risks of coronary artery disease, heart failure, stroke, cardiovascular mortality, and all-cause mortality. Traffic-related environmental pollution consists of a complex mixture of gaseous and particulate components, alongside auxiliary elements such as noise and psychological stress. Among all air pollutants, particulate matter (PM) pollution—specifically fine particulates with an aerodynamic diameter $<2.5\ \mu\text{m}$ (PM_{2.5})—has repeatedly been associated with cardiovascular morbidity and mortality.

Little is known about the influence of air pollutants on cardiac structure and function. Although the associations between ambient air pollutants and increased incidence of myocardial infarction and heart failure have been established there is a paucity of information in the current literature about the influence of air pollution on cardiac structure and function. Determining the impact of individual air pollutants on cardiac disease is challenging for several reasons owing to socioeconomic confounders, relatively small effect sizes, and the variability of exposure and outcome measurement techniques.

The UK Biobank is a large-scale prospective cohort study of half a million people aged 40 to 69 years. In addition to a rich repository of information on demographics, risk factors, and environmental exposure data, a subgroup of UK Biobank participants undergo deep phenotyping (observable characteristic or trait of a disease) with cardiovascular magnetic resonance.

In a cross-sectional analysis of a large population of men and women aged 55-70, free from pre-existing cardiovascular disease,¹ drawing on the above Biobank data, higher past exposure to fine particulates with an aerodynamic diameter $<2.5\ \mu\text{m}$ and nitrogen dioxide were associated with larger cardiac biventricular volumes, which is a well-recognized pathophysiological adaptation, heralding heart failure development. Proximity to major roads, a surrogate for chronic air pollution exposure, was additionally associated with higher left ventricular mass, which is known to signal risk of sudden cardiac death.

The association between ambient air pollution and adverse cardiac phenotypic changes in individuals without prevalent cardiovascular disease suggests that air pollution should be recognized as a major modifiable risk factor that needs to be targeted via public health measures. These cardiac morphological alterations are apparent despite relatively low exposure levels meeting the current air quality standards, making a strong case to double efforts to control emission of the noxious pollutants.

¹ Aung, N. et al, 2018. Association Between Ambient Air Pollution and Cardiac Morpho-Functional Phenotypes, *Circulation*. 138:00–00. DOI: 10.1161/CIRCULATIONAHA.118.034856