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# Policy Research Programme
# Summary Final Report

**Project details:**

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| **NIHR reference** | 002/0028 |
| **Project title** | Short and Long-Term Effects of Air Pollution on Cardiovascular Disease Events |
| **Project duration (months)** | 30 |
| **Start date** | 1 October 2009 |
| **Original contracted end date** | 30 September 2011 |
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**Grant holder's details:**


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**Keywords**

Air pollution, CVD disease, myocardial infarction, mechanistic processes, epidemiology, case-crossover analysis, acute exposure, chronic exposure


**Executive summary**


Background: Patho-physiological mechanisms of air pollution effects on cardiovascular disease (CVD) are not well understood. To inform potential mechanisms, this study investigated short-term and long-term associations between ambient air pollution and a range of cardiovascular events based on 3 national databases, including the MINAP database which records detailed information on myocardial infarction (MI) events.

Methods: To assess short-term associations, time-stratified case-crossover analysis was conducted on MI events during 2003-2009, emergency hospital admissions for various CVD outcomes (2003-2008) and CVD-related deaths (2003-2006) across England and Wales. Approximately 400,000 MI events from MINAP, over 5 million CVD hospital admissions, and over 63,000 CVD deaths were linked with priority pollutants. Pollution effects were modeled using lags up to 0-4 days, and adjusted for ambient temperature and day-of-week. For long-term exposure, survival and readmission for MI within the MINAP cohort was examined in relation to annual average air pollution

maps. Hazard rations were estimated using a Cox proportional hazards model.

Results: From the MINAP database, we observed little short-term effect of air pollution on MIs, although small risks for NO2 and SO2 were detected among non ST-elevation myocardial infarctions. Few investigated risk-factors were modifiers of pollution effects. For hospital admissions data, 10th to 90th percentile changes in CO, NO2, PM10, PM2.5, and SO2 were associated with a respective 6.6, 15.1, 5.3, 2.3 and 5.5% increase in chronic ischaemic heart disease risk, but there was little raised risk for MI admissions. All pollutants except O3 were strongly associated with admissions for arrhythmias and atrio-ventricular conduction disorders. For CVD mortality outcomes, the most consistent detrimental effect was with PM2.5. For long-term exposure, there was no clear association between air pollution and readmission of MINAP patients, but PM10 and NO2 were associated with non-significant increases in subsequent all-cause mortality.

Conclusions and implications: The lack of a pollution effect on MI suggests the mechanistic processes by which pollution impacts on cardiovascular health may not primarily be via thrombotic pathways. The high prevalence of heart disease in the UK and the ubiquitous nature of air pollution exposure means that associations between pollutants and CVD events, however small, have the potential to carry a large public health burden. Efforts to educate vulnerable individuals and health care providers about this particular risk factor are therefore important. Our findings indicate that people with underlying heart problems may be particularly susceptible to air pollution, but not from heart attacks. Recognition that air pollution has detrimental effects on cardiovascular health as well as on respiratory disease and other conditions provides additional information for consideration when air quality guidelines are set by national governments and regulatory bodies.

**Plain English summary**

Background: As well as causing breathing problems, exposure to air pollution can have an effect on heart disease, but relatively little is currently understood about the biological pathways in which air pollution may do this. To inform potential mechanisms, this work characterises pollution effects on different types of heart disease outcomes, including heart attacks.

Methods: Information on cardiovascular disease events were obtained from a database recording cases of heart attacks from all hospitals in England and Wales, as well as from national databases of emergency hospital admissions and mortality. The day on which each cardiovascular disease event occurred was linked to air pollution concentrations as measured by the nearest monitoring station to each subject's location of residence. Over 400,000 heart attacks, over 5 million CVD hospital admissions, and over 63,000 CVD deaths were analysed in this way.

Results: There was little acute association between the timing of heart attacks and air pollution levels. A detrimental effect of air pollution was observed with hospital admissions for chronic ischeamic heart disease, but not specifically with heart attacks. A raised risk was also observed with admissions for arrhythmias. Chronic exposure to air pollution did not result in increased risk of readmission among heart attack patients, but there was a slight raised risk of subsequent death.

Conclusions and implications: Our results indicate that the ways in which air pollution may have an effect on cardiovascular health is not via mechanisms that lead to heart attacks. However, people with underlying heart problems may be particularly susceptible to air pollution exposure. Efforts to educate such vulnerable individuals and health care providers about this particular risk factor are therefore important. Our findings provide additional information for consideration when air quality guidelines are set by national governments and other regulatory bodies.

**Details of patient and public involvement in the research**

As air pollution is a pervasive expsoure and can have adverse impacts on all sections of the population, the results of this work are of relevence to the public and clinical practitioners. Although there was no direct involvement of the public or professional agencies, the project was conducted closely with the MINAP Academic Group, which has clinical representation from cardiologists and other potential users, as well as input from lay members.

Presentation of results in journal publications and conferences disseminated the main project findings to public health, environmental and policy audiences.

## Addressing equality and inequality

Air pollution exposure applies to all population groups. Effects were assessed separately by age and sex for the MINAP, HES and mortality databases. In addition, modification of pollution effects by other social and vulnerability factors were assessed for the patients on the MINAP database where this information was available.

## Publications

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| Long-term exposure to air pollution is associated with survival following acute coronary syndrome |
| Short-term Effects of Air Pollution on Cardiovascular Events in England and Wales |

**Data sharing statement**

The NIHR strongly supports the sharing of data in the most appropriate way, to help deliver research that maximises benefits to patients and the wider public, the health and care system and which contributes to economic growth in the UK. All requests for data should be directed to the award holder and managed by the award holder.

NIHR position on the sharing of research data

**Disclaimer**

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The main report for this study/project was peer reviewed by independent academic referees.