Links between urban ambient particulate matter and health – time series analysis of particle metrics

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Introduction

- Many epidemiological studies have reported associations between outdoor particulate matter and adverse health effects
- Particulate matter is a mixture of particles of varying size, number and composition and the nature of this mixture varies according to emission sources, secondary chemical reactions in the atmosphere, weather conditions and other factors
- For the protection of public health it would be desirable to know which component of the particulate mixture to target with regulation
- The purpose of this study was to analyse, using time series methods, the health effects of various particle metrics within London and to identify which of the particle metrics are most important for health impact considerations

Method

- Daily measurements for carbon, nitrate, sulphate, chloride and particle number concentrations made at North Kensington (NK) were obtained for the period 1st January 2000 to 31st December 2005. Mass measurements of PM_{10} (particles with a median diameter of 10 microns or less) and $PM_{2.5}$ made using different measurement techniques were also obtained
- Daily counts of deaths and emergency hospital admissions for respiratory and cardiovascular disease were also compiled
- Time series regression methods accounting for seasonal patterns in deaths/admissions, temperature, and other potential confounders were used to evaluate the associations between each particle metric and the health endpoints
- The analysis focused on days when data were available for all pollutants (695 days)
- Results are presented as percentage increase in the average number of daily deaths per interquartile range increase in particle metric

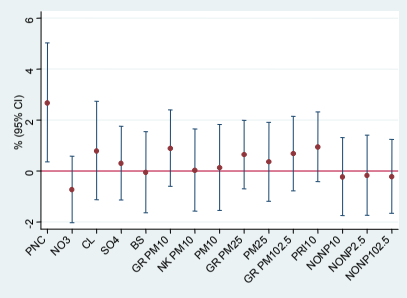

Figure 1 Associations between cardiovascular mortality and the previous day particle concentrations

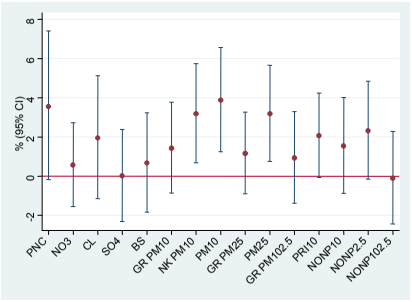

Figure 2 Associations between respiratory mortality and particle concentrations two days before

Key to figures: PNC – particle number concentration measured at North Kensington (NK); NO3, CL, SO4 – nitrate, chloride and sulphate concentrations measured at NK; BS – London-wide average Black Smoke; GR PM10, GR PM2.5 & GR PM10-2.5 – gravimetric PM10, PM2.5 and coarse concentrations measured at NK; NK PM10 & PM10 - TEOM corrected measured at NK and London-wide; PM2.5 - TEOM corrected measured London-wide; PRI PM10, NONP10, NONP2.5 & NONP PM10-2.5 – modelled primary PM10 and non-primary PM10, PM2.5 and coarse particles

Results

- Results for deaths due to cardiovascular and respiratory mortality are shown in Figures 1 and 2
- A specific association between particle number concentrations and deaths due to cardiovascular diseases was observed. This association was independent of other metrics and was also observed for admissions for cardiovascular diseases (not shown)
- Respiratory mortality was associated with a range of metrics most notably the mass based measurements (PM_{10} and $PM_{2.5}$) . A similar pattern of associations for respiratory admissions was also observed

Conclusions

- Preliminary conclusions from these analyses suggest that particle numbers (predominantly very fine particles) are the most relevant particle metric in terms of cardiovascular disease
- Deaths and admissions from respiratory disease were associated with a range of particle metrics and it is less clear which metric(s) are the most relevant. Further work is underway to investigate this issue

Acknowledgements

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Relationship between central site measurements and personal exposure

- A further component of this study was to examine the relationship between central site measurements and personal exposure to various PM metrics using published work and results from the RUPIOH study
- This analysis helps inform the evidence from ecological time series studies based upon pollution data collected at a single location within a city
- The key finding relevant to this ecological time series study was that there were substantial longitudinal correlations between outdoor measurements (central or home) and personal exposure ($PM_{2.5}$ & PM_{10})