

Science for Environment Policy

Composition of particulate matter influences its long-term health effects



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Long-term effects of elemental composition of particulate matter on inflammatory blood markers in European cohorts. *Environment International*, 82, pp.76-84. DOI: 10.1016/j.envint.2015.05.008

Contact:

regina.hampel@helmholtz-muenchen.de

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A link between particulate matter (PM) exposure and inflammatory disease has been shown by many studies, but few have explored how the chemical composition of PM influences inflammatory processes. This study investigated the connection between different components of PM and markers of inflammation in the blood, finding that long-term exposure to transition metals, emitted by traffic and industry, may cause chronic inflammation.

A growing body of evidence links long-term exposure to PM to cardiovascular and respiratory disorders, severe sickness and premature deaths. Investigating this link, most previous studies have focused on the effects of different sizes of PM, while very few have investigated the role of its different [chemical components](#).

PM is made up of many different elements, originating from numerous sources including fossil fuel combustion, transport and industry. Transition metal components such as copper and iron are thought to be particularly harmful as they have the potential to produce reactive oxygen species, causing [inflammation](#) throughout the body. Over time, this may cause disease.

This European multi-centre study, funded by the European Commission via the projects ESCAPE¹ and TRANSPHORM², is one of the first to assess how the chemical composition of long-term concentrations of PM affects the inflammatory responses of the human body.

The researchers monitored inflammation in members of cohort studies across Northern and Central Europe, including in Finland, Germany, Sweden and Switzerland. To do this, they measured levels of two inflammatory markers in the blood: C-reactive protein (CRP) and fibrinogen. Both are released during the acute phase of inflammation and are indicative of cardiovascular disease when present at high levels. The researchers took a total of 21 558 high sensitivity (hs) CRP measurements and 17 428 fibrinogen measurements.

The researchers were interested in the effects of PM (specifically PM₁₀ and PM_{2.5}), as well as selected components, on these markers. In each study region, PM was measured in three two-week periods at 20 monitoring sites between 2008 and 2011. The sites were intended to represent the spatial variation of air pollution at the home addresses of the study subjects. In other words, sites in areas with low, medium and high air pollution were chosen, as participants live in low, medium and highly polluted areas.

The PM samples were then analysed to determine the elements they contained. A total of 48 elements were measured, eight of which were selected for further analyses: copper, iron, potassium, nickel, sulphur, silicon, vanadium and zinc. These elements were chosen because they were detected in over three quarters of the samples, there is evidence they have adverse health effects, and they represent major anthropogenic sources of air pollution.

To estimate the long-term concentrations of pollutants at the participants' home addresses, the authors applied land-use regression models, which combine measured levels of pollutants with other variables such as traffic to predict levels of pollution in a location. Finally, to associate the PM components and inflammatory markers, the authors applied statistical models.

They found that long-term exposure to iron and copper within PM was associated with increased hsCRP concentrations. They also found that zinc in PM_{2.5} was associated with elevated fibrinogen levels, although these associations were slightly weaker. All three of these elements are found in the non-tailpipe emissions of vehicles.

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These findings suggest that not all components of PM are equally harmful. Long-term exposure to transition metals in particular, commonly emitted by traffic and industry, may be associated with the inflammation that precedes respiratory and cardiovascular disease.

However, the authors say their findings should be interpreted with caution, as the observed effects were relatively small and long-term concentrations were modelled estimates rather than directly measured. Despite these limitations, these results shed important new light on the role of the components of PM in inflammatory response and its potential link to chronic disease, suggesting that future studies might consider not only the size of particulate matter but also its chemical composition.

