Differentiated health impacts of primary and secondary ultrafine particles

Results in Brief

Ultrafine particles and health impact: revising EU policy

Exposure to particulate matter (PM) with a diameter between 2.5 µm and 10 µm has been linked to various negative health effects. European researchers have investigated the impact of nanoscale-size PM: these ultrafine particles (UFPs) are suspected to exacerbate health problems.

Particle pollution in the atmosphere is a mixture of dust, dirt and liquid droplets emitted from vehicles, factories, construction sites and the burning of fossil fuels and biomass. To date, techniques and legislation have focused on determining the levels and health impact of large-diameter PM across Europe. However, UFPs with a diameter smaller than 0.1 µm may induce greater damage, as the nose and bronchioles are inefficient at filtering such matter.

UFP identification in big cities across Europe
The EU-funded Health1UP2 project identified and quantified the sources of UFPs in four European cities, to determine the health impact of exposure to them. Since different meteorological conditions, pollutant emissions and other parameters may influence the sources of UFP divergently, the study didn’t focus on one single city.

By studying ultrafine particle number size distribution (PNSD) over long periods of time, researchers identified the sources contributing to UFP concentrations in Barcelona, Helsinki, London and Zurich. “Our goal was to evaluate how the different sources of UFP relate to mortality and hospital admissions,” explains project coordinator and principal investigator, Frank Kelly.

In central European cities, UFP particle concentrations are mainly affected by road traffic emissions. Indeed, Health1UP2 results demonstrated that traffic is the source of over 70 % of UFPs in European cities. Surprisingly, airport emissions also seem to affect the air quality of the cities – even if they are located a few kilometres away. “To reduce UFP concentrations, policies should aim to decrease the use of vehicles and minimise exposure to aircraft emissions,” advises Kelly.

Cities across Europe with high solar radiation, such as Barcelona, display maximum UFP concentration at midday due to photochemical nucleation of precursor gaseous pollutants. Researchers discovered that this type of UFP was much less important in the other cities being studied. The energy from the solar radiation favours the chemical reactions needed for these gases to nucleate and form particles.

**Future air pollution policies**

Existing literature shows inconsistent associations between UFP concentration and health impact. “Although some associations for specific lags and UFP sources were evident for some of the cities under study, globally we didn’t observe a clear association between specific sources and daily mortality,” notes Marie Skłodowska-Curie fellow Ioar Rivas. This could be due to the high spatial variability for UFP concentrations, which makes exposure assessment extremely complicated. At the same time, it highlights the need to measure UFP simultaneously in different locations of the city and to model their spatial and temporal distribution.

Currently, there are no legal ambient standards for UFPs. “Our results determine the main sources of UFPs affecting cities in Europe, strengthening the justification of policies targeting the road traffic as the main culprit of bad air quality,” concludes Kelly.

Health1UP2’s analysis of the associations between UFP sources and mortality strengthen the case for improving exposure assessment and for developing stations that routinely measure UFPs. Future revisions to the air policy by the European
Commission should include discussions about the inclusion of new standards for other metrics and for pollutants such as UFPs.

**Keywords**

Health1UP2, ultrafine particles (UFP), health, emissions, solar radiation

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