Evidence for PM Sources and Types Causing Premature Mortality

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Abstract

Ambient particulate matter (PM) comprises a complex mix of chemical constituents that derive from a variety of sources. Combustion-related constituents in PM can vary considerably both in kind and relative concentration and appear to concentrate largely in the smallest diameter fractions. We have evaluated the cardiopulmonary toxicity of previously collected as well as freshly generated emission PM in rodents to address questions regarding the "biologic plausibility," the identification of hazardous components, and the influence of susceptibility traits on health outcomes. To date, toxicity appears to correlate with certain attributes of emission PM as well as ambient PM, but a clear distinctive causative component in ambient PM which would be suspect at ambient levels of exposure remains elusive. Those primary attributes of PM that appear most active include particle size fraction ($<PM_{2.5}$), transition metals (primarily V, Ni, Zn, Fe, and Cu), and the bioavailability (water solubility) of those metals. The organic constituents of emissions are not as well characterized regarding acute effects, though PAH's have long been associated with cancer. Power plant emission PM collected under different combustion conditions, from different areas within an full scaled electrostatic precipitator or post stack cleaning can have quite different toxicities in keeping with the attributes noted. Finally and likely importantly with regard to human extrapolation are certain susceptibility traits that appear to influence the expression of toxicity under specific exposure conditions or degrees of disabilities. Some of these traits would be pulmonary arterioritis, hypertension/cardiac disease, and bronchitis. A number of source attribution approaches to link health outcomes in human and animal toxicology studies are currently being pursued by various laboratories, with the goal to focus mitigation on those sources which have the most health impact. In conclusion, the physicochemical attributes of PM are likely to be important contributors to toxicity, and may vary considerably by source. Ultimately, the sources from which these arise in abundance may be the most appropriate means of public health protection. (This abstract does reflect EPA policy.)