Title: The toxicology studies of the health effects of particulate matter components

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ABSTRACT

Particulate matter, an ambient air criteria pollutant, is a complex mixture of chemical components. As part of HEI's integrated National Particle Component Toxicity (NPACT) Initiative research program, we conducted a series of 6-month subchronic inhalation exposure studies (6 hours/day, 5 days/week) of $PM_{2.5}$ concentrated 10X from ambient air (CAPs) with apolipoprotein E–deficient ($ApoE^{-/-}$) mice (a mouse model of atherosclerosis). The CAPs studies were conducted in five different U.S. airsheds (New York City; Tuxedo, NY; East Lansing Michigan; Seattle Washington; Irvine, California); we measured the daily mass concentrations of $PM_{2.5}$, black carbon (BC), and 16 elemental components to identify their sources and their roles in eliciting both short- and long-term health-related responses. In addition, from the same five airsheds we collected samples of coarse ($PM_{10–2.5}$), fine ($PM_{2.5–0.2}$), and ultrafine ($PM_{0.2}$) particles. Aliquots of these samples were administered to cells *in vitro* and to mouse lungs *in vivo* (by aspiration) to determine their comparative acute effects.

Overall, the studies have demonstrated that the toxicity of PM is driven by a complex interaction of particle size range, geographic location, source category, and season. Across all studies, fossil-fuel combustion source categories were most consistently associated with both short- and long- term adverse effects of $PM_{2.5}$ exposure. The components that originate from the Residual Oil Combustion and Traffic source categories were most closely associated with short-term effects; and components from the Coal Combustion category were more closely associated with long-term effects.

The results of these studies provide a basis for guiding future research and for helping to determine more targeted emission controls for the PM components most hazardous to acute and chronic health. Application of the knowledge gained in this work may therefore contribute to an optimization of the public health benefits of future PM emission controls.

Keywords: *ambient air pollution, particulate matter, inhalation, composition, source category*