EPA-RC2009-STAR-C1

Center Title: Air Pollution Mixtures: Health Effects across Life Stages

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Institution: Harvard School of Public Health, Boston, MA

Project Period and Location: 2010-2015, Boston MA

Project Cost: $8 million

Project Summary:

(1) Objectives and hypotheses: The main objectives of the proposed Center are: 1) to investigate the acute and chronic health effects across life stages of six exposure metrics (short- and long-term exposures to individual pollutants, pollution sources and multi-pollutant mixtures) on: cognitive/neuropsychological function, cardiovascular/endothelial function, inflammation, birth weight/growth, and CVD-related hospitalization/mortality; and 2) to identify susceptibility and vulnerability factors that modify these effects.

(2) Experimental approach: Project 1 will investigate the toxicity of air pollutant mixtures in Boston, focusing on the identification of pollutant characteristics that are responsible for the most toxic effects, including: individual components, combinations of components (mixtures), formation processes, and source types. Exposures will be generated using a novel integration of our ambient particle concentrator and photochemical chamber technologies. Sprague-Dawley rats will be exposed and toxicity will be assessed by changes in: in vivo oxidant response, blood pressure, inflammation, and vascular reactivity. Projects 2-5 will examine the health effects of the six exposure metrics on multiple integrated specific health outcomes. Project 2 will examine effects of these exposure metrics on cognitive and neuropsychological function; cardiovascular and endothelial function; inflammation; and oxidative stress among elderly individuals living in New England enrolled in the Normative Aging Study. Project 3 will investigate effects of the six metrics on cognitive impairment and interference, as well as vascular and endothelial function, among middle-aged and older adults living in New England enrolled in the Framingham Offspring and Third Generation Study. Project 4 will investigate effects of the metrics on somatic growth, blood pressure, cardiovascular fitness, and cognition, in the Viva ongoing pre-birth study of over 1,300 children from Eastern Massachusetts. Project 5 will estimate mortality and hospitalization risks in hundreds of Counties across the US. It will also study two cohorts in New England to: 1) estimate risks of adverse birth outcomes using approximately 700,000 live births; and 2) assess mortality and morbidity risks using 2.3 million Medicare enrollees. Finally, these Projects (2-5) will study the modifying effect of measures of susceptibility (clinical/biologic) and vulnerability (social milieu) and will link outcomes to the same pollution mixtures across all life stages.

(3) Expected Results: Our Center will address four of the six research priorities of the EPA solicitation to establish Clean Air Centers. It will: 1) investigate the effects of pollutants and mixtures through animal and human studies; 2) identify sub-populations that are at increased risk through the investigation of the modifying effects of gender, diabetes, obesity, socioeconomic disparities, stress, depression, violence, smoking, and omega-3 fatty acid intake in children, adults, and elderly; 3) explain regional and temporal differences in air pollution risks; and 4) examine the shapes of exposure-response relationships for associations resulting from the use of multiple exposure metrics, outcomes and populations.

Keywords: particles, air pollution mixtures, cognitive health, cardiovascular health, inflammation, air pollution, children, elderly