



Why the Evidence Supports a Coarse Particle Standard Now

The evidence reviewed in the Staff Paper makes clear that coarse particles contribute to increased risk of hospitalization for heart and lung disease, increased respiratory symptoms and decreased lung function, and may also contribute to mortality. Studies of respiratory and cardiovascular hospitalization in Detroit and Seattle, and with respiratory symptoms in children in six U.S. cities reported significant associations with coarse particle concentrations of 30 to 40 $\mu\text{g}/\text{m}^3$, 98th percentile.ⁱ

Since the publication of the final Staff Paper in late June 2005, there have been five important new studies published, including a major review article, and studies reporting short-term effects of coarse particles on respiratory hospital admissions in children and the elderly, and increased long-term risk of death from coronary heart disease in women. These recent studies—reviewed below—bolster the case for establishment of a new National Ambient Air Quality Standard for coarse particles.

The European Respiratory Journal Review

A systematic review of the epidemiological literature published in the *European Respiratory Journal* reinforces many of the conclusions of the EPA staff scientists in the final Staff Paper. This review article examined studies that have investigated the effects of both fine and coarse particles, and found that for some health endpoints, the effects are even stronger for coarse particles than for fine. Specifically, the paper finds that “in studies of chronic obstructive pulmonary disease, asthma and respiratory admissions, **coarse PM has a stronger or as strong short-term effect as fine PM**, suggesting that coarse PM may lead to adverse responses in the lungs triggering processes leading to hospital admissions.” The review also found support for an association between coarse PM and cardiovascular hospital admissions.

With respect to the toxicology of coarse particles, the review concluded that “studies clearly show that coarse PM exerts toxic effects in laboratory experiments, and that such effects are at least as potent as those observed in experiments using fine PM, when expressed on a mass basis,” while cautioning that fine particles may deliver a higher dose of toxic material to the lungs. Researchers concluded that the coarse particle fraction is of importance in the regulatory process as well as for control measures.ⁱⁱ

In an accompanying editorial, Swedish, German, and Dutch researchers argued that systematic review offers evidence for the separate regulation of the coarse particle fraction.ⁱⁱⁱ

***Pediatrics* study found increased hospitalization in <15 year olds from coarse particles**

A study published online in *Pediatrics* reported a detrimental effect of relatively low levels of coarse particulate matter on hospitalizations for respiratory infections in children. This study used a case-crossover design to examine the relationship between various air pollutants and hospitalization for respiratory infections among children younger than 15 years in Toronto over a 4-year period. When PM and gaseous pollutants were both taken into account, the effect remained pronounced for $\text{PM}_{10-2.5}$ in both boys and girls.^{iv}

Women's risk of developing and dying from coronary heart disease increases

A multi-decade study In Press in *Environmental Health Perspectives* reports that women who live in areas with greater coarse particle concentrations have a higher risk of developing and dying from coronary heart disease. In this long-term follow-up of the ASHMOG cohort, coarse particles were associated with increased risk of fatal heart disease in women, especially older women, but not in men, though the effect was stronger for fine particles.^v

Mechanisms for coarse particles developed

The results of laboratory toxicology study which exposed human alveolar macrophages and airway epithelial cells to particles in vitro and followed them for endpoints of inflammation and oxidant stress were reported in *Toxicology and Applied Pharmacology*. These are the two main airway cell types likely to interact with inhaled particles. The study found that the proinflammatory response in alveolar macrophages was driven by material present in the coarse PM. Cultures of bronchial epithelial cells also responded to the coarse fraction with higher levels of certain markers of inflammation than induced by fine or ultrafine PM. These epithelial cells also showed evidence of oxidant stress in response to coarse particle exposure, as well as to other size fractions of PM. This study adds to our understanding of potential mechanisms.^{vi}

Coarse particles in Vancouver had larger effect on elderly hospital admissions than fine

A time-series study of nearly 9,000 adults over age 65 in Vancouver, Canada examined the relationship between hospital admissions for respiratory disease and daily measures of PM₁₀, PM_{2.5}, and PM_{10-2.5}. After adjustment for gaseous copollutants and meteorological variables, the study found that coarse particles have a larger effect on respiratory hospital admissions in the elderly than PM_{2.5}.^{vii}

The clear evidence from the recently published health studies is that EPA is that EPA should establish a stringent new NAAQS for coarse particles.

ⁱ U.S. EPA "Staff Paper" at p. 5-64.

ⁱⁱ Brunekreef B, Forsberg B. Epidemiological Evidence of Effects of Coarse Airborne Particles on Health. *Eur Respir J* 2005; 26:309-318.

ⁱⁱⁱ Sandström T, Nowak D, and van Bree L. Health Effects of Coarse Particles in Ambient Air: Messages for Research and Decision-Making. *Eur Respir J* 2005; 26:187-188.

^{iv} Lin M, Stieb DM, Chen Y. Coarse Particulate Matter and Hospitalization for Respiratory Infections in Children Younger Than 15 Years in Toronto: A Case-Crossover Analysis. *Pediatrics* 2005;116:235-240.

^v Chen LH, Knutsen SF, Shavlik D, Beeson WL, Petersen F, Ghamsary M, Abbey D. The Association between Fatal Coronary Heart Disease and Ambient Particulate Air Pollution -- Are Females at Greater Risk? Available online August 2, 2005 at: <http://ehp.niehs.nih.gov/members/2005/8190/8190.pdf>.

^{vi} Becker S, Mundandhara S, Devlin RB, Madden M. Regulation of Cytokine Production in Human Alveolar Macrophages and Airway Epithelial Cells in Response to Ambient Air Pollution Particles: Further Mechanistic Studies. *Toxicol Appl Pharmacol* 2005 Jul 1; [Epub ahead of print].

^{vii} Chen Y, Qiuying Y, Krewski D, Burnett RT, Shi Y, McGrail KM. The Effect of Coarse Ambient Particulate Matter on First, Second, and Overall Hospital Admissions for Respiratory Disease Among the Elderly. *Inhalation Toxicology* 2005; 17:649-655.