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The Clean Air Act : Science, Policy, and Politics

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The Clean Air Act

Science, Policy, and Politics

The Clean Air Act is the law that requires the US Environmental Protection Agency (EPA) to set national air-quality standards for particulate matter (PM) and five other pollutants considered harmful to the public health and the environment. The current primary standards for PM_{10} (PM with an aerodynamic diameter ≤ 10 μm) and $PM_{2.5}$ (PM with an aerodynamic diameter ≤ 2.5 μm) are 150 μg/m^3 (24-h average) and 35/15 μg/m^3 (24-h average/annual average), respectively. The US House of Representatives recently passed legislation that prohibits the EPA from spending any funds in fiscal year 2011 to update the current standards for PM_{10} (see "Policy Riders" in HR 1, Sec 4048).[1] The impetus for this provision came largely from Congressional members representing rural districts, who are trying to prevent the EPA from regulating agricultural-related PM_{10} emissions. They argued that agricultural PM_{10} emissions are dust and not harmful to the public health; however, has their contention actually been validated?

PM is a complex mixture of particles with varying sizes and chemical characteristics that are derived from numerous different sources. In general, the coarse PM fraction (PM with an aerodynamic diameter between 2.5 and 10 μm, or $PM_{2.5\text{-}10}$) is less derived directly from combustion processes, such as coal-fired power plants or automobile emissions, than the fine PM fraction ($PM_{2.5}$); nonetheless, coarse PM contains a variety of both natural (eg, resuspended crustal material, sea salts, pollen, mold, spores, endotoxins) and anthropogenic compounds (eg, suspended residues from brake pads, tire wear, and road usage; fugitive and other industrial emissions), many of which may pose a risk to the public health. Depending on the location, coarse PM composes between 40% and 60% of the total PM_{10} mass but only a minute fraction of the concentration of particle numbers.

Inhalation of PM_{10} is associated with adverse pulmonary and extrapulmonary health effects, even at concentrations of particles near the current regulatory standards.[2,3] This association has been documented in numerous observational and experimental studies worldwide and is remarkably consistent. The adverse pulmonary effects include increased respiratory symptoms and infections, leading to acute exacerbations of COPD and asthma. The extrapulmonary adverse effects of PM are primarily those related to the cardiovascular (CV) system, such as myocardial infarctions, strokes, heart failure exacerbations, and arrhythmias. The evidence suggests that the smaller particles (ie, $PM_{2.5}$ or ultrafine PM [PM < 0.1 μm]) are more strongly linked to CV health effects. The adverse health effects of PM pollution in general are responsible for increased ED visits, increased hospital admissions, and excess mortality.[4] The health risk is especially high in the elderly and patients with chronic cardiopulmonary diseases. Children are also at risk since long-term exposure to PM impairs lung growth.[5]

In agricultural communities, significant amounts of PM_{10} can be generated. In the San Joaquin Valley, California, farming was the second largest PM_{10} contributor (at 23%) during the year 2001, after road dust (38%). Certain agricultural operations, such as cotton and almond harvesting, produce very high amounts of PM_{10}. In the Calexico/Mexicali region of California, multiple episodes of PM_{10} spikes can occur in the winter during a 24-h time period, with concentrations much greater than the current PM_{10} standards.[6] This region also has high rates of chronic bronchitis and childhood asthma. In Chillán, Chile, average concentrations of PM_{10} for the 2001 to 2003 period ranged from 43.4 to 81.8 μg/m^3. The main constituents of PM_{10} in this region were organic matter, soil dust, nitrate, elemental carbon, ammonium, and sulfate.[7] Different from PM_{10} in nonfarming regions, agricultural PM_{10} usually contains a higher proportion of coarse PM from road dust and a relatively smaller amount of $PM_{2.5}$ of anthropogenic origin, such as agricultural burning and motor vehicle traffic.[8,9]

While it is well established that exposure to $PM_{2.5}$ is associated with many adverse health effects (most notably excess CV morbidity and mortality),[10] the independent health risks of the coarse PM fraction per se (ie, separate from the direct health effects induced by $PM_{2.5}$) remain a point of contention and are the basis for the recent House provision. Nonetheless, recent observational and experimental studies have provided

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evidence that coarse PM, like $PM_{2.5}$, can cause health effects. A review of published epidemiologic studies showed that coarse PM was associated with short-term and long-term mortality, although the magnitude of the effects was smaller than that of $PM_{2.5}$.[11] Coarse PM also had a strong effect on CV and respiratory admissions.[11] In a national analysis that included 112 US cities, coarse PM was associated with an increased risk of death for all causes, CV disease, myocardial infarction, stroke, and respiratory mortality.[12] In four Chinese cities, exposure to coarse PM was associated with increased respiratory morbidity in children, including bronchitis, cough, and sputum production.[13] Similarly, in Spokane, Washington, the coarse PM fraction was associated with cough, sputum production, and running nose in children.[14] Short-term (2 h) exposure to concentrated coarse PM induced mild pulmonary inflammation in healthy individuals.[15] The lungs of farm workers in California showed significant accumulation of carbonaceous and mineral dusts around terminal and respiratory bronchioles, with increased wall thickness and interstitial inflammation, as compared with non-farm workers.[16] Thus, exposure to PM_{10} in agricultural regions is associated with increased adverse health effects, and both coarse and fine PM fractions are important contributors.

The Clean Air Act is the law that gives the EPA the responsibility to set up a framework of air-quality standards to protect the public from harmful air pollutants. Whether the PM_{10} policy rider will be enacted remains to be determined and is one of the many points of negotiation for federal funding bills between the Congress and the White House. However, to insert this provision now, given the emerging scientific evidence of adverse health effects from coarse PM, is irresponsible. We strongly urge the Congress to preserve the authority of the EPA to control air pollution as mandated by the Clean Air Act, including regulating PM_{10} pollution. The evidence that PM_{10} pollution from agricultural and urban sources has adverse health effects is compelling, and it warrants that the EPA update pollution control measures.

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