Editorial

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Editorial Note on Nanotechnology and Health

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Editorial Note

Nanomaterials are manufactured in various shapes and sizes. Engineered nanoparticles are defined by most national nanotechnology programs and the International Organization for Standardization as manufactured particles with all three dimensions in the range of 1 to 100 nm. However, some safety and health experts have proposed increasing the upper limit to 450 nm to better encompass the full-size range of particles with potentially similar toxicologic properties. Nanofibers are a form of manufactured nanomaterials with one axis elongated compared with the other two axis dimensions in the nanometer range. Nanofibers include hollow structures nanotubes and solid structures nanorods. Because of their small size, nanoparticles and nanofibers often have different physical and toxicological properties compared with larger particles of the same chemical composition, perhaps in part because of their much greater surface area for any given mass. These size-related properties potentially lead to greater biological reactivity and a greater ability to penetrate through membranes and into tissues. Their shape as a fiber with a high aspect ratio may also impart different toxicological properties. Finally, their physical form will affect the biological effect from exposure [1,2].

One source of data on the impact of small particle exposure is research on air pollution and ultrafine particles. These particles have a similar-size distribution to, though different composition than, engineered nanoparticles. Unlike larger particles, such as PM-2.5 for which mass concentrations are provided in $\mu g/m^3$, ultrafine particles are typically measured in particle number concentrations. Epidemiologic studies have evaluated health outcomes in populations environmentally exposed to particular matter, including fine and ultrafine particles, as a result of air pollution. There is evidence from these studies for increased pulmonary and cardiac morbidity and mortality, such as from asthma and ischemic heart disease, related to increases in ultrafine particulate concentration [3,4]. The role of ultrafine particle exposures in inducing these effects is a topic of ongoing research. A study in Germany found that reduced lung function, increased respiratory symptoms, and increased need for medications in adult asthmatic patients were significantly associated with exposure to ultrafine particles at mean particle number concentrations from 7700 to 9200/cm^3. Studies of workers exposed to mixtures of fine and ultrafine particulates also have documented declines in pulmonary function and excesses of respiratory symptoms. Experimental human exposure to ultrafine particulate has been associated with alterations in heart rate variability, a potential risk factor for short-term cardiovascular mortality, as well as suggestions of mild inflammatory and prothrombic responses in blood or lavage fluid. These findings may predict potential adverse health effects from engineered nanoparticles.

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