A Compact Exposure

Estimating Inhalation of Engineered Nanoparticles in Cosmetic Powders

The growing use of engineered nanomaterials in consumer products raises questions regarding potential adverse health effects of nanomaterial exposures. Although a considerable amount of research exists on the toxicity of pure nanomaterials, there is only limited information exposure to nanomaterials combined with other ingredients in consumer products. A team of researchers now reports their observations on inhalation exposure through the use of nanotechnology-enabled and non-nanoenabled ("regular") cosmetic powders [*EHP* **120(6):885–892; Nazarenko et al.**].

Nanoparticles in cosmetics often cluster into larger agglomerations.

There are currently more than 1,300 documented nanoenabled consumer products (that is, products that incorporate ingredients measuring 1–100 nm in at least one dimension). This figure represents only those products voluntarily reported by manufacturers. In a previous study, these investigators examined the potential for inhalation of nanoparticles through the use of nanoenabled and regular consumer spray products. This time, they analyzed particle size, shape, agglomeration (clustering), and distribution for three nanoenabled and three regular cosmetic powders. To simulate real-world exposures, they applied each powder to a life-size female mannequin head using its enclosed brush or pad. Then they measured the size distribution and concentration of particles that could be inhaled as a result of such application.

All particles in the first sample of nanoenabled powder were in the nanoscale range. The second nanoenabled powder contained a wide range of agglomerated particles, with the majority being nanosized. Despite its label, the third nanoenabled powder contained no nanoscale particles. The researchers did find a number of nanoparticles agglomerated with larger particles in two regular powders, which were not marketed as nanoenabled. The third regular powder contained mostly particles measuring greater than 5 mm in diameter.

Particles under 100 nm in diameter may travel all the way to the terminal alveoli, where air exchange takes place. However, the authors' electron microscopy data and airborne particle measurements suggest that exposure to nanoparticles would be largely through agglomerates of 5–10 mm and larger, which are likely to lodge in the tracheobronchial and head airway regions. But because these agglomerates have a combined surface area greater than that of solid particles of the same size, they may pose different health hazards than solid particles.

The study offers a methodology that could be applied to future studies focusing on real-world inhalation exposures related to nanoenabled consumer products. Results from such studies can help guide estimates of exposures through the short- and long-term use of such products.

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Global Bang for the Buck

Cutting Black Carbon and Methane Benefits Both Health and Climate

Black carbon and methane have both been implicated in climate change. They also pose more direct human health threats, with black carbon constituting one component of fine particulate matter ($PM_{2.5}$) and methane acting as a precursor of ground-level ozone. An international team of researchers analyzed 14 control measures for human-caused emissions of black carbon and methane to investigate health benefits that might occur in tandem with actions to help mitigate climate change in the next 20–40 years [*EHP* **120(6):831–839; Anenberg et al.**].

Black carbon and methane are attractive climate-change mitigation targets because they are relatively short-lived in the atmosphere compared with carbon dioxide, with emission restrictions leading to fairly rapid benefits. Some of the primary sources of methane are fossil-fuel extraction, landfills, livestock, rice production, and wastewater treatment. Among major sources of black carbon are many types of incomplete combustion, including that tied to transportation, industry, housing, and burning of biomass. The 14 measures target sources such as fossil-fuel operations, vehicle emissions, landfill gas, sewage, agriculture, brick kilns, and biomass-fueled cook stoves.

Using published emissions scenarios as a basis for their calculations, the investigators estimate that if all 14 measures were fully implemented by 2030, average global population-weighted surface concentrations of $PM_{2.5}$ could be reduced by 23–34% and ozone could drop 7–17% within the same period. That could prevent anywhere from 640,000 to 4,900,000 premature deaths annually, or about 1–7% of all deaths estimated to occur with the projected global population of 8.4 billion. The estimated health benefits would be due almost entirely to the black carbon control measures—with their attendant reductions in $PM_{2.5}$, organic carbon, and non-methane ozone precursors—and would occur mostly in Asia and portions of Africa. Climate-change mitigation effects could have their own health benefits, although the authors didn't attempt to calculate these. The authors accounted for just outdoor exposures from biomass-fueled cook stoves, not the well-documented health benefits of avoided indoor exposures; adding that information with a geographically appropriate distribution likely would substantially increase the number of avoided premature deaths.

The researchers used two atmospheric models, each of which predicted substantially different air-quality responses to the 14 measures and incorporated a wide range of data from numerous epidemiological studies as factors in their equations. Uncertainties and variations in the models and data suggest the number of averted premature deaths could be substantially higher or lower. The researchers didn't address the difficulties or costs of implementing the 14 measures but did note that some related efforts are already under way on many continents, including adoption of European vehicle-emission standards and reductions in cook-stove emissions in some developing countries.

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