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Is Total Mass or Mass of Alveolar-Deposited Airborne Particles of Beryllium a Better Predictor of the Prevalence of Disease? A Preliminary Study of a Beryllium Processing Facility

Michael S. Kent,[1] Thomas G. Robins,[2] and Amy K. Madl[3]
[1]Brush Wellman Inc., Elmore, Ohio; [2]School of Public Health, University of Michigan, Ann Arbor, Michigan; [3]Exponent, Menlo Park, California

Cases of chronic beryllium disease (CBD) and beryllium (Be) sensitization continue to be identified among Be industry workers. The currently accepted method for measuring exposure, which involves measuring the total mass of airborne Be per cubic meter, shows an inconsistent dose-response relationship with the prevalence of CBD. This study was conducted to evaluate which Be aerosol characteristics other than total mass may be more informative in understanding the dose-response relationship between exposure to Be and disease. Personal (n = 53) and general (n = 55) area airborne Be samples were collected in five furnace areas at a Be manufacturing facility where prevalence rates of CBD and Be sensitization had been previously studied among 535 employees with significant Be exposure. In the five furnace areas, particle-size specific personal samples and area samples were collected using an Andersen impactor and a microorifice uniform deposit impactor (MOUDI), respectively. The calculated concentrations were expressed in terms of total mass per cubic meter, and in forms of mass, number, and surface area of particles less than 10 μm or less than 3.5 μm mass median aerodynamic diameter per cubic meter that are predicted to deposit in the alveolar region of the lung. Tests for linear trend of the relationships of the various exposure metrics to prevalence of CBD and sensitization demonstrated highly significant associations between mass concentration (MOUDI) of particles less than 10 μm, and less than 3.5 μm, predicted to deposit in the alveolar region of the lung and CBD ($p = 0.0004$ and 0.000003, respectively) and sensitization ($p = 0.025$ and 0.003, respectively). However, no statistically significant association was found between these two exposure metrics and personal (Andersen) samples. The number and surface area concentration (MOUDI) of alveolar-deposited particles (less than 10 μm) also showed