

AUTHORS: Daigle CC, Chalupa DC, Gibb FR, Morrow PE, Oberdorster G, Utell MJ, Frampton MW.

TITLE: ULTRAFINE PARTICLE DEPOSITION IN HUMANS DURING REST AND EXERCISE.

PUBLISHED: January-03

CITE: Inhal Toxicol. 2003 May;15(6):539-52. 12692730 Daigle CC, Chalupa DC, Gibb FR, Morrow PE, Oberdorster G, Utell MJ, Frampton MW.

ABSTRACT: Ultrafine particles (diameter < 100 nm) may be important in the health effects of air pollution, in part because of their predicted high respiratory deposition. However, there are few measurements of ultrafine particle deposition during spontaneous breathing. The fractional deposition for the total respiratory tract of ultrafine carbon particles (count median diameter = 26 nm, geometric standard deviation = 1.6) was measured in 12 healthy subjects (6 female, 6 male) at rest (minute ventilation 9.0 +/- 1.3 L/min) using a mouthpiece exposure system. The mean +/- SD fractional deposition was 0.66 +/- 0.11 by particle number and 0.58 +/- 0.13 by particle mass concentration, similar to model predictions. The number deposition fraction increased as particle size decreased, reaching 0.80 +/- 0.09 for the smallest particles (midpoint count median diameter = 8.7 nm). No gender differences were observed. In an additional 7 subjects (2 female, 5 male) alternating rest with moderate exercise (minute ventilation 38.1 +/- 9.5 L/min), the deposition fraction during exercise increased to 0.83 +/- 0.04 and 0.76 +/- 0.06 by particle number and mass concentration, respectively, and reached 0.94 +/- 0.02 for the smallest particles. Experimental deposition data exceeded model predictions during exercise. The total number of deposited particles was more than 4.5-fold higher during exercise than at rest because of the combined increase in deposition fraction and minute ventilation. Fractional deposition of ultrafine particles during mouth breathing is high in healthy subjects, and increases further with exercise.