Acute respiratory response on workers exposure to nanoparticles in different occupational settings

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Keywords: nanoparticles, pulmonary function, occupational exposure
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Introduction

Information about the risk of nanotechnology and its influence for human health is still out of our knowledge. Scientific study results on the route of exposure, and further penetration of nanoparticles into different tissues and organs are very limited. The respiratory system seems to be main routes which nanoparticles emitted into the environment can get into the body and easily achieve the smallest bronchi and alveoli.

Number of workers involved with nanotechnology is still increasing. Occupational exposure to nanoparticles concerning the workers engaged directly in manufacture or processing of nanomaterials, but also the people using these nano-products for the production of other goods as well as the consumers.

Epidemiological study have shown that exposure to airborne nanoparticles is correlated with adverse health effects, particularly increased pulmonary and cardiovascular responses.

Aim:

The aim of this study was to analyse nanoparticle exposure in different occupational settings and its effects on cross-shift changes in workers respiratory airflow.

Methods:

The nanoparticles exposure assessment included determination the number concentration of nanoparticles (CPC TSI model 3007-2) and the surface area concentration of particles potentially deposited in alveolar (A) and tracheo-bronchial (TB) region of lungs (AeroTrak 9000 TSI).

Cross-shift spirometric measurements were performed using portable spirometer and changes in FEV1 (ΔFEV1) were calculated.

The workposts under measurements were:

- abrasion of textile coating containing nano-Ag and nano-Cu
- manual plastering and grinding of mortar containing nano-SiO2
- abrasion test of dental materials with nanoparticles
- manual abrasion of dental components with nanoparticles

Results:

The number concentration of released particles ranged from 1500 p/cm3 during manual abrasion of dental components to 20000 p/cm3 during plastering and grinding of mortar. Similar situation concerned the surface area concentration. The highest value of surface area concentration of particles in A and TB region were observed during manual plastering and grinding of mortar and there were respectively 65,2 µm2/cm3(A) and 14,1 µm2/cm3(TB).

Analysis of FEV1 values before and after work-shift showed decrease of this parameter in most workers under study. There was observed slight correlation between number concentration of released nano-sized particles and FEV 1 decrease.

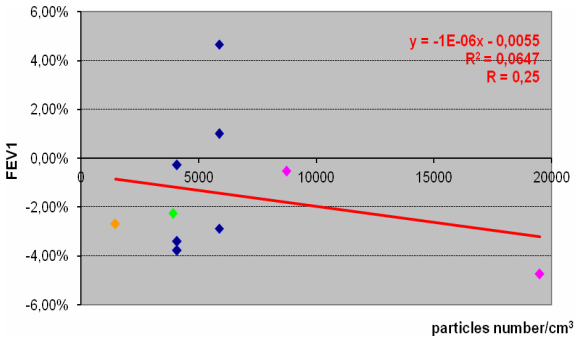

Figure 1. Relationship between the number concentration of nanoparticles and spirometric parameters changes

Slight correlation was observed also between surface area concentration and cross-shift declines in FEV1.

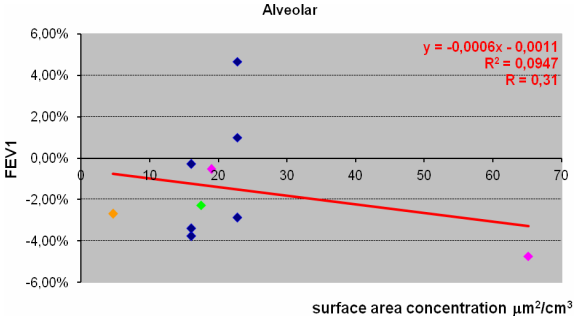

Figure 2. Relationship between the surface area concentration of particles potentially deposited in A region and spirometric parameters changes

Conclusion:

Our results suggest that exposure to nanoparticles released in different processes could be considered as a factor influencing the activity of the respiratory system and further studies should be done to prove this relationship.

This work was supported under grant agreement nr 5052/B/P01/2010/38.