MODELLING EXPOSURE AND LUNG DEPOSITION OF PARTICLE-BOUND POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)

O. Hänninen (1), P. Lipponen (1), R. Sorjamaa (1), M. Lamberti (2), C. Gariazzo (2)

(1) National Institute for Health and Welfare, Finland, POB 95, 70701 Kuopio, Finland; (2) Italian Workers' Compensation Authority (INAIL), Monte Porzio Catone (RM), 00040, Italy

Presenting author email: otto.hanninen@thl.fi

Summary

Polycyclic aromatic hydrocarbons (PAHs) are known to be harmful to human health. EU Life+ study EXPAH measured exposures and microenvironmental concentrations in Rome, Italy. The measurements were used to identify main determinants of exposure and to develop exposure models for two susceptible population groups, elderly and school children. The current work used this exposure model together with a respiratory tract deposition model to characterize the PAH uptakes in the lungs and demonstrated that both ultrafine and accumulation mode particles play a significant role.

Introduction

Mainstream risk assessments for particulate matter and chemical particle constituents are based on ambient concentrations. However, it is well-known that urban populations spend a majority of their time indoors, where the buildings partly protect the occupants from outdoor pollution. Moreover, the health effects must be caused by actual uptake of the particles. The aim of this paper is to utilize these data together with the aerosol-based infiltration model, integrated with a semi-empirical human respiratory tract particle uptake model to estimate initial PAH doses obtained by elderly and school children over one year.

Methods

Advanced exposure modelling for PAH compounds has been developed in the Life+ -project EXPAH. The study collected an extensive set of indoor, outdoor and personal exposure measurements for analysis of the exposure determinants and estimation of exposure model parameters such as time-use variables, microenvironmental concentrations of PAHs for estimation of potential contribution from indoor sources, infiltration of ambient particles and PAHs indoors and PAH levels in traffic.

Limited measurements were conducted on the particle size distribution of PAH-compounds. Particle size dependent infiltration is estimated using the model validated earlier against population-based experimental data (Hänninen et al., 2013). Respiratory tract uptake of particles is modelled using ICRP (1994) model.

Results

The study found that exposures are dominated by winter and heating season as biomass combustion was found to be the dominating source of PAHs in Rome, Italy. It was found that indoor exposures, while slightly lower than outdoor levels, dominated overall exposures. When accounting for the particle size distribution of PAHs, it was seen that the alveolar tract uptake is driven by ultrafine (Dp < 180 nm) and accumulation mode (560 < Dp < 1000 nm) particles.

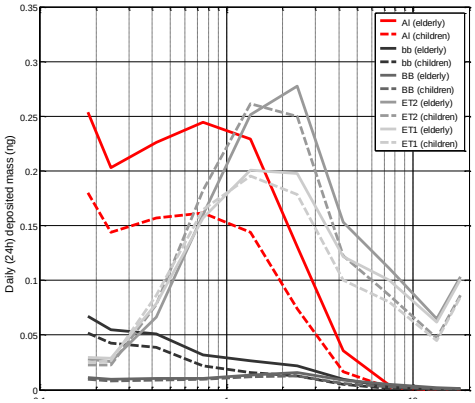

Fig.1. Uptake of particle mass by particle size and respiratory tract region.

Conclusions

Particle uptake by lungs is strongly affected by particle size. Broncheolar and alveolar uptakes are dominated by ultrafine and accumulation particles while extra thoracic uptakes consist mainly of supermicron particles.

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References

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