Excluding Non-Occupancy Data Improves Exposure Assessment in Indoor Environments

Aneta Wierzbicka[1,*], Mats Bohgard[1], Joakim H. Pagels[1], Andreas Dahl[1], Jakob Löndahl[1], Tareq Hussein[2,3], Erik Swietlicki[4] and Anders Gudmundsson[1]

[1]Division of Ergonomics and Aerosol Technology, Lund University, Lund, Sweden
[2]Department of Physics, University of Jordan, Amman, Jordan
[3]Department of Physics, University of Helsinki, Helsinki, Finland
[4]Division of Nuclear Physics, Lund University, Lund, Sweden
Keywords: exposure assessment, particles, residences, schools
Presenting author email: aneta.wierzbicka@design.lth.se

For the assessment of personal exposure in indoor environments, information about the concentration of pollutants when people are in given indoor environments (occupancy time) are of prime importance. However, this kind of data frequently is not reported (Morawska et al., 2013).

The aim of the study was to assess the differences in particle characteristics between occupancy and the total monitoring period, with the latter being the most frequently used averaging time in published studies on particle characteristics in indoor environments. Assessed particle characteristics comprise: number and mass concentrations as well as number size distributions.

Five indoor environments were selected in Sweden and Finland: an apartment, two houses and two schools. They were assessed for particle number and mass concentrations and number size distributions. The measurements using a Scanning Mobility Particle Sizer and two photometers were conducted for seven consecutive days during winter in each location.

Particle concentrations in residences and schools were, as expected, the highest during occupancy time. In the apartment median $PM_{2.5}$ mass concentration during the occupancy time was 17% higher compared to total monitoring period. In both schools, the median values of the $PM_{2.5}$ mass concentration was on average 32% higher during teaching hours compared to the total monitoring period. When it comes to particle number concentration (PNC), in the apartment during occupancy, the median value was 58% higher than in the total monitoring period. In both houses and schools the median PNC was similar for the occupancy and total monitoring periods.

The major differences, in number and mass concentrations, observed between occupancy and total monitoring periods in residences were due to indoor sources, which can greatly elevate indoor particle levels for prolonged periods (up to 12.5h after activity ceased), especially in residences with low AER.

In both schools PNC during teaching hours were very similar to values during total measurement periods and were mainly influenced by outdoor concentrations.

In summary, to improve exposure assessment to particles, crucial for studying health effects, only data from occupancy periods should be used. Non-occupancy periods, while useful for studying influence of outdoor particles and establishing a baseline, should not be included in the exposure assessment. Data from total monitoring, as it includes non-occupancy periods, may underestimate the concentrations for exposure assessment.

General conclusions on the basis of measurements in the limited number of indoor environments cannot be drawn. However, the results confirm a strong dependence on type and frequency of indoor activities that generate particles and site specificity. The results also indicate that the exclusion of data series during non-occupancy periods can improve the estimates of particle concentrations and characteristics suitable for exposure assessment, which is crucial for estimating health effects in epidemiological and toxicological studies.

This work was supported by Vinnova through project 2010-01004, the Swedish Research Council, FORMAS, and the Development Fund of the Swedish Construction Industry, SBUF. The Environment Department of Malmö Municipality are acknowledged for providing the PM2.5 data from the roof top of the town hall in Malmö city centre.

Wierzbicka, A., Bohgard, M., Pagels, J. H., Dahl, A., Löndahl, J., Hussein, T., Swietlicki E., Gudmundsson A., 2014. *Quantification of differences between occupancy and total monitoring periods for better assessment of exposure to particles in indoor environments*, Atmospheric Environment, 106, 419-428

Morawska L, Afshari A, Bae G, Buonanno G, Chao C, Hänninen O, Hofmann W, Isaxon C, Jayaratne E, Pasanen P, Salthammer T, Waring M, Wierzbicka A, 2013. *Indoor aerosols: From personal exposure to risk assessment.* Indoor Air 23, 6, 462-487.