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One aspect of better understanding the potential health risks of inhalation of airborne particles, is to understand the particle size resolved respiratory tract deposition and inter-subject variability. In this work this was done experimentally after improving an existing method for determination of the respiratory tract deposition of airborne particles, RESPI (Löndahl et al., 2006).

The particle sizes were measured with a scanning mobility particle sizer (SMPS, design Lund University) in the range 10-600 nm and an aerodynamic particle sizer (APS 3321, TSI Inc.). The improved method extended the measuring particle size range from 10-600 nm to 10-3 000 nm by redesigning the system to minimize particle losses, and by including the APS. A schematic picture of the improved set-up can be seen in Figure 1. The tree-way-valves switched in a way that the SMPS and the APS alternated between sampling from the inhalation tank and the exhalation tank. The size dependent particle deposition fraction was calculated by comparing the particle concentrations in the inhaled and the exhaled air for each particle size channel, compensating for instrumental losses.

To avoid particle size changes due to particle hygroscopic growth in the humid lung, hydrophobic particles were used. The inhaled aerosol was a mixture of Carnauba wax particles covering the SMPS size range and spherical factory made glass particles covering the APS size range. The particles were generated and then mixed in a 22 m^3 stainless steel chamber with a controlled air exchange rate of 1.0, air temperature of 22°C and relative humidity of 40%.

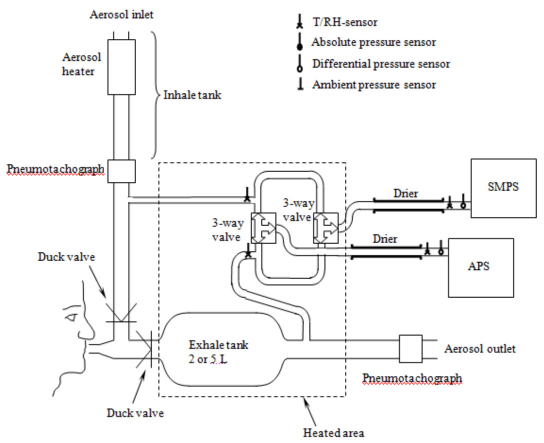

Figure 1. Schematic picture of the improved RESPI set-up.

In total, data from 63 (37 female and 26 men) volunteers of ages 7-67 years participated. This is, to our knowledge, the most extensive data-set collected of its kind. For each subject, the measurements consisted of a standard medical complete lung function investigation and a lung deposition measurement with the improved RESPI, performed at two separate occasions. Additional measurements of deposition of ambient particles (corresponding to urban background) were performed for a subset of 6 subjects. Finally, the measured deposition patterns were compared with predictions by the MPPD-model (Chemical Industry Institute of Toxicology, Research Triangle Park, NC, USA) using the lung function data on an individual basis.

The initially analyzed deposition fractions for five of the participating subjects are shown in Figure 2. Preliminary results show a good correlation between individual breathing pattern (tidal volume and breathing frequency)and measured particle deposition ($p<0.001$). For the smallest particles (<50 nm) there were also significant correlations between measured particle deposition and age ($p<0.05$), residual volume ($p<0.01$), functional residual capacity ($p<0.05$). For larger sized particles, associations with lung function appear to be weak.

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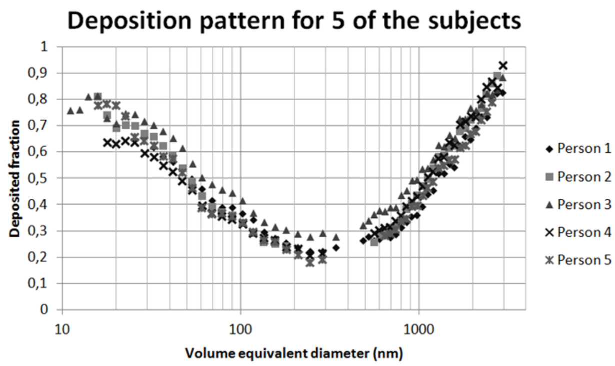

Figure 2. The measured deposition patterns for five of the subjects

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