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Keywords: deposited fraction, physical activity, children, deposited dose, respiratory tract.
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Exposure to ambient air pollution can cause a number of health problems and may be particularly dangerous to susceptible population groups such as children. Health effects caused by air pollution are critically dependent on both the deposited fraction (DF) of the inhaled particles and in what region of the respiratory tract the deposition takes place. With increasing physical activity, the breathing pattern is altered and the airflow in the respiratory tract increase, this affects the DF and deposition site. In this study we investigated changes in DF at increasing physical activity for three population groups: ~5 and 10 year-old children, and adults.

We performed a meta-analysis of data found in scientific literature on the alteration of breathing pattern at different levels of activity and used the resulting parameters to model the DF in different regions of the respiratory tract: alveolar (AI), bronchial and bronchiolar (Bb) and extra-thoracic (ET). The deposition modelling was performed in Mimetikos Preludium™ using the extra-thoracic deposition model from NCRP (Cuddihy *et al.*, 1997) and the thoracic deposition model and lung anatomy model from Yeh and Schum (1980). Nasal and oral contributions to breathing were weighted according to results from Bennett *et al*. (2007). Categorization of the activity levels was done according to the Exposure Factors Handbook (U.S. EPA, EFH, 2011).

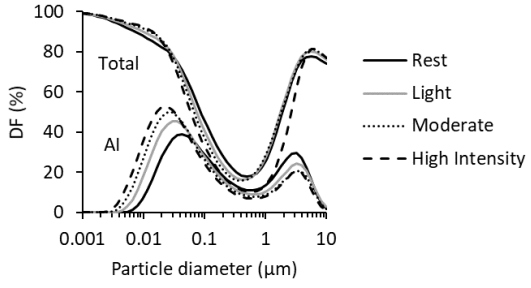


Figure 1. Total and alveolar (AI) DF for a 5 year-old child at different activity levels.

Examples of the size dependent DF curves can be seen in Figure 1. The changes with activity in total DF were very small. For the high intensity, DF dropped for particles >0.5 µm, explained by that the nasal breathing was set to zero. In the AI region, increasing activity led to increased DF for the ultrafine particles (UFPs; <0.1 µm), and similar or decreased DF for the larger particles. The peak DF shifted from ~40 nm at rest to ~20 nm at the high intensity example for a ~5 year-old (Figure 1). A similar trend was seen for the two other groups. The observed increased DF in the AI region could be explained by a less effective deposition of UFPs in the upper regions of the respiratory tract as DF decreased with activity in the ET and Bb regions (Figure 2).

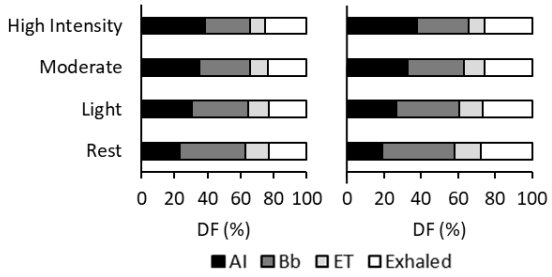


Figure 2. Average DF of UFPs (0.005-0.1 µm) in AI, Bb and ET regions at different activity levels. Left: ~5 year-old; Right: adult.

Our results indicate that the variation in total DF with physical activity is minor, but that the DF for the UFPs increase in the AI region at higher activity levels. This is important since the removal of particles in the AI region is not effective and UFPs are believed to pose a specific health risk. Therefore, activity patterns and DF of different population groups need to be considered when estimating particle dose and evaluating health risks.

This work was funded by Formas [prn 2018-00693] with support from EMPIR AeroTox [18HLT02].

**References**

Bennett, W.D. *et al*. (2007). *J. Toxicol. Environ. Health – A*. 71(3):227-237.

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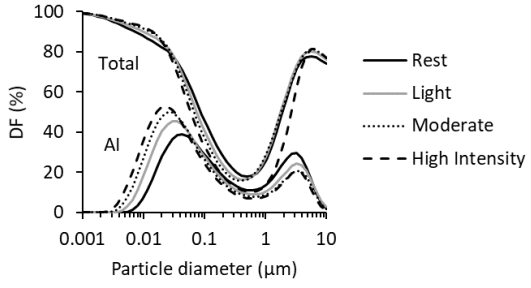


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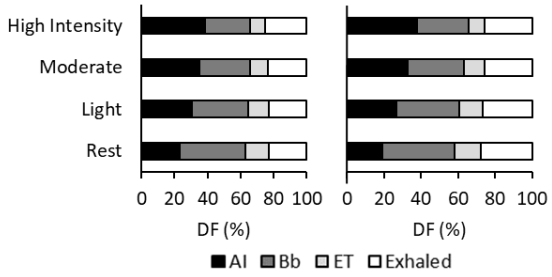


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