

Estimating children's exposure to per- and polyfluoroalkyl substances

Kerstin Winkens

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Abstract

Per- and polyfluoroalkyl substances (PFASs) are highly stable, surface active chemicals, which are water- and oil/stain-repellent. Because of their unique properties, PFASs are widely used in consumer products. Their application ranges from personal-care products, food packaging and textiles to interior materials, thus leading to a continuous human exposure to PFASs in every-day life. Possible exposure pathways are the ingestion of food, drinking water and dust; the inhalation of fine dust and air; as well as dermal absorption after contact with the products and dust.

Despite the increasing number of monitoring studies, including measurement of concentrations in human exposure media and blood, childhood exposure is poorly understood.

The state of current knowledge on childhood exposure was investigated in **paper I**, by reviewing existing PFAS literature on exposure media, on daily intakes via different exposure pathways and on levels in blood and serum. Subsequently, recommendations for future research needs were made and implications presented on the regulation and assessment of PFASs. For **paper II, III and IV**, a cohort of background-exposed Finnish children was followed throughout childhood. Indoor air and floor dust samples of their bedrooms were taken at the age of 10.5 years in 2014/2015 and analysed for a wide range of PFASs (**paper II and III**). The estimated daily intakes (EDIs) via these two media were calculated in **paper III**. The EDIs revealed that dust ingestion and air inhalation are of similar importance for the intake of single perfluoroalkyl acids (PFAs), if the metabolism of PFAA precursors to PFAs was included. The metabolism of precursors contributed considerably to the total intake of PFAs via the inhalation of air (e.g. 38 % for perfluorooctanoic acid (PFOA) and 90 % for perfluorooctane sulfonic acid (PFOS)) and to the total intake of PFOS via the ingestion of dust (69 %; median values at the intermediate exposure scenario). In **paper IV**, the internal exposure during childhood was monitored by measuring serum concentrations, which were decreasing with age; and by calculating body burdens at 1, 6 and 10.5 years of age, which were constant or increasing, depending on the respective PFAS. These results demonstrated that it is crucial to account for growth dilution when studying exposure trends and PFAS intakes during childhood.

This thesis contributes to a better understanding of children's exposure to PFASs, especially the internal exposure during childhood and the relative importance of both, indoor exposure pathways, as well as individual PFASs.

Keywords: PFAS, PFAA, fluorinated, fluorotelomer, FTOH, PAP, early life, child, human, exposure, intake, indoor, bedroom, air, dust, serum.

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Department of Environmental Science and Analytical Chemistry
Stockholm University

Stockholm University, 106 91 Stockholm