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Harmonized human biomonitoring in European children, teenagers and adults: EU-wide exposure data of 11 chemical substance groups from the HBM4EU Aligned Studies (2014-2021)

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Keywords Adults; Children; Exposure biomarkers; Hbm4eu; Human biomonitoring (HBM); Teenagers; Jose V. Tarazona is employed by the European Food Safety Authority (EFSA). The; views expressed in this publication are those of the authors and should not be; interpreted as representing the official position of EFSA.
As one of the core elements of the European Human Biomonitoring Initiative (HBM4EU) a human biomonitoring (HBM) survey was conducted in 23 countries to generate EU-wide comparable HBM data. This survey has built on existing HBM capacity in Europe by aligning national or regional HBM studies, referred to as the HBM4EU Aligned Studies. The HBM4EU Aligned Studies included a total of 10,795 participants of three age groups: (i) 3,576 children aged 6-12 years, (ii) 3,117 teenagers aged 12-18 years and (iii) 4,102 young adults aged 20-39 years. The participants were recruited between 2014 and 2021 in 11-12 countries per age group, geographically distributed across Europe. Depending on the age group, internal exposure to phthalates and the substitute DINCH, halogenated and organophosphorus flame retardants, per- and polyfluoroalkyl substances (PFASs), cadmium, bisphenols, polycyclic aromatic hydrocarbons (PAHs), arsenic species, acrylamide, mycotoxins (deoxynivalenol (total DON)), benzophenones and selected pesticides was assessed by measuring substance specific biomarkers subjected to stringent quality control programs for chemical analysis. For substance groups analyzed in

different age groups higher average exposure levels were observed in the youngest age group, i.e., phthalates/DINCH in children versus teenagers, acrylamide and pesticides in children versus adults, benzophenones in teenagers versus adults. Many biomarkers in teenagers and adults varied significantly according to educational attainment, with higher exposure levels of bisphenols, phthalates, benzophenones, PAHs and acrylamide in participants (from households) with lower educational attainment, while teenagers from households with higher educational attainment have higher exposure levels for PFASs and arsenic. In children, a social gradient was only observed for the non-specific pyrethroid metabolite 3-PBA and di-isodecyl phthalate (DiDP), with higher levels in children from households with higher educational attainment. Geographical variations were seen for all exposure biomarkers. For 15 biomarkers, the available health-based HBM guidance values were exceeded with highest exceedance rates for toxicologically relevant arsenic in teenagers (40%), 3-PBA in children (36%), and between 11 and 14% for total DON, Sigma (PFOA + PFNA + PFHxS + PFOS), bisphenol S and cadmium. The infrastructure and harmonized approach succeeded in obtaining comparable European wide internal exposure data for a prioritized set of 11 chemical groups. These data serve as a reference for comparison at the global level, provide a baseline to compare the efficacy of the European Commission's chemical strategy for sustainability and will give leverage to national policy makers for the implementation of targeted measures.
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