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THE HUMAN EARLY LIFE EXPOSOME PROJECT (HELIX): RESULTS FROM HARMONIZED BIOMONITORING OF POPS IN 1200 CHILDREN FROM SIX EUROPEAN COHORTS

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Introduction

The Human Early Life Exposome (HELIX) project is an ongoing collaborative research project, funded by the European Community's Seventh Framework Programme (2013-2017), designed to characterize in detail early life exposures to multiple environmental factors and associate these with child health outcomes through ages 6-10 years, in order to characterize the impact of the "Early-Life Exposome". HELIX selected a wide range of chemical and physical environmental exposures based on concern for foetal growth, neurotoxic, immunotoxic, or obesogenic/metabolic effects, and wide-spread general population exposure through food, consumer products, indoor and outdoor air, and the urban/built environment. More than 1200 children and mothers from Spain, Norway, Greece, Lithuania, England and France have now completed an extensive study, which also included donating blood samples. The children took part in a well-designed and harmonized clinical examination taking place during 2014-2015. As part of the exposome, a wide range of chemical exposure biomarkers were measured. To reduce uncertainty and have as comparable results as possible, HELIX used one laboratory for all chemical measurements. We hereby present the biomonitoring results for the children for a wide range of persistent organic pollutants i.e. 5 polychlorinated biphenyls (PCBs), 2 pesticides, 2 polybrominated diphenyl ethers (PBDEs) and 5 perfluoroalkyl substances (PFASs), as well as for three heavy metals (Lead (Pb), Mercury (Hg) and Cadmium (Cd)).

Materials and methods

The design of the HELIX project has been described in detail in a recent publication[1]. The HELIX project represents a collaboration across six established and ongoing longitudinal population-based birth cohort studies in Europe: the Born in Bradford (BiB) study in Bradford, UK, the Étude des Déterminants pré et postnatals du développement et de la santé de l'Enfant (EDEN) study in France, the INfancia y Medio Ambiente (INMA) cohort in Spain, the Kaunas cohort (KANC) in Lithuania, the Norwegian Mother and Child Cohort Study (MoBa), and the RHEA Mother Child Cohort study in Crete, Greece. There were approximately 200 children and their mothers from each cohort.

The following persistent organic pollutants were measured in 2 g serum (PBDEs, PCBs and pesticides) or 150 uL plasma (PFASs): PCBs (CB-118, 138, 153, 170, 180), PBDEs (BDE-47 and 153), pesticides (4,4'dichlorodiphenyldichloroethylene (DDE), 4,4'dichlorodiphenyltrichloroethane (DDT) and hexachlorobenzene (HCB)) and PFASs perfluorooctanoate (PFOA), perfluorononanoate (PFNA), perfluoroundecanoate (PFUnDA), perfluorohexane sulfonate (PFHxS) and perfluorooctane sulfonate (PFOS).The POPs were determined according to the method described in Caspersen et al 2015, except that GC-MS/MS was used for detection[2], while the PFASs were determined by column switching LC-MS/MS as described in detail by Haug et al. 2009[3]. All compounds were quantified using labelled internal standards. Procedural blanks, internal quality control samples and reference blood samples from NIST were frequently analyzed and the laboratory participated 2-4 times in the Arctic Monitoring and Assessment Program (AMAP) "Ring Test for Persistent Organic Pollutants in Human Serum". The

samples were randomized before analyses. All analyses were performed by the Norwegian Institute of Public Health (NIPH).

In addition Hg, Cd and Pb were measured in 0.5 mL whole blood by ALS Scandinavia using ICP-MS[4].

Results and discussion

In the following paragraphs aggregated results of the measurements of the chemical biomarkers are presented for the children in the six cohorts annotated accordingly: BiB=BIB (UK), EDEN=EDP (France), INMA=SAB (Spain), KANC=KAN (Lithuania), RHEA=RHE (Greece) and MoBa=MOB (Norway). The detection frequencies were about 100% for all compounds except DDT (80%), BDE-153 (54%), PFUnDA (67%) and Cd (85%).

This is to our knowledge the first study to present harmonized and completely comparable biomonitoring data for POPs and heavy metals in children from several European countries. The concentrations were significantly different between cohorts for more or less all compounds. The overall heat map shows that PCBs, pesticides, PBDEs and PFAS in general were highly correlated within the compound group, but the pattern differs in the specific cohorts (data not shown). The PBDEs and heavy metals are not highly correlated to any other compound group in any cohort.

These data in combination with the detailed questionnaires are likely to shed light on important sources of exposure of these pollutants and possibly also on their health impact.

Acknowledgements

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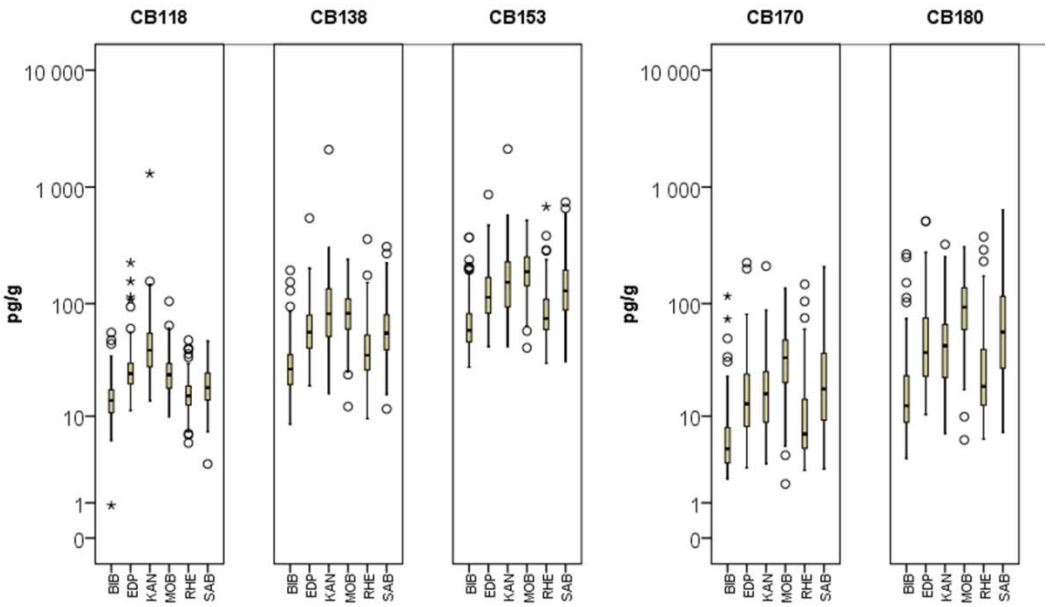

Figure 1. Box plot of concentrations of CB-118, CB-138, CB-153, CB-170 and CB-180 measured in serum from children (n=1197 samples).

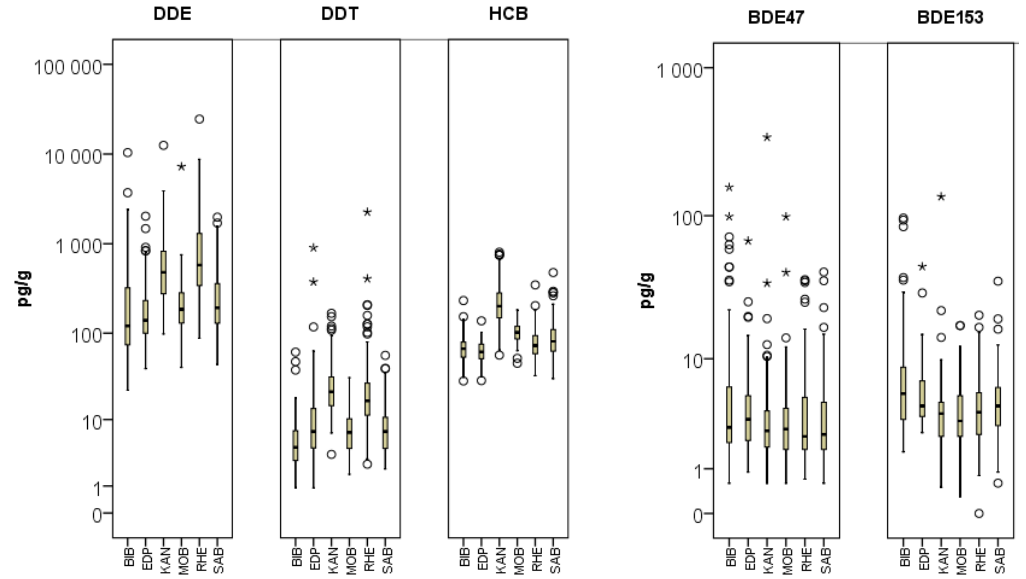

Figure 2. Box plot of concentrations of DDE, DDT, HCB, BDE-47 and BDE-153 measured in serum from children (n=1197 samples).

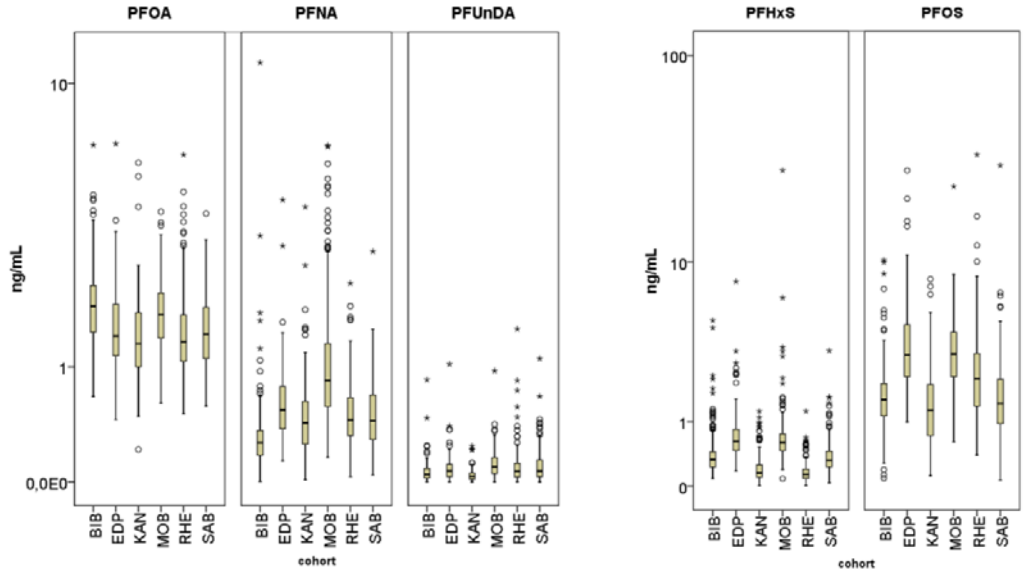

Figure 3. Box plot of concentrations of PFOA, PFNA, PFUnDA, PFHxS and PFOS measured in plasma from children (n=1204 samples).

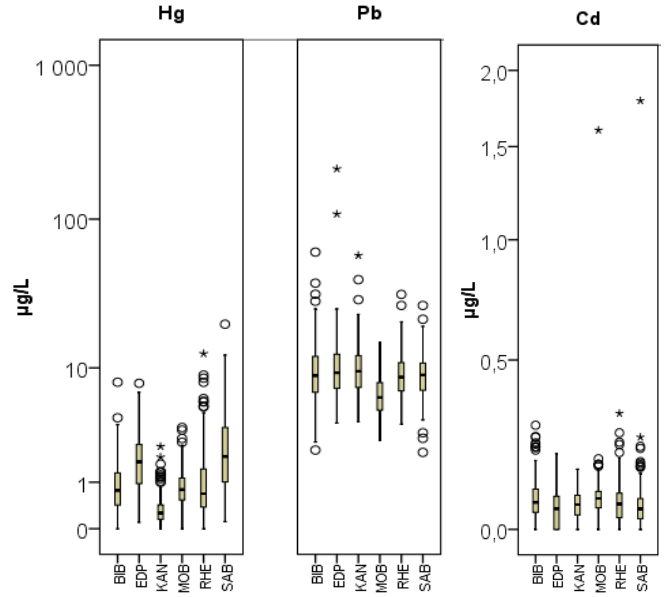

Figure 4. Box plot of concentrations Cd, Hg and Pb measured in whole blood from children (n=1203 samples).

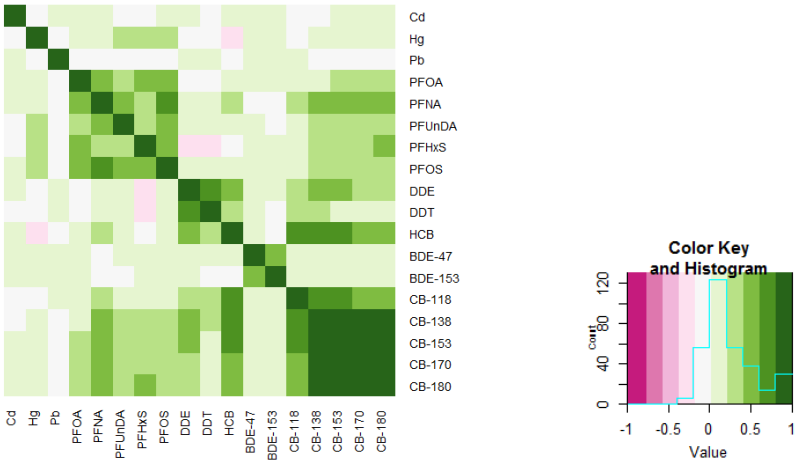

Figure 5. Heat map showing correlations (represented by different colors) of the 18 pollutants in the 1204 samples.