Exposure Assessment Of Multiple Chemicals Starting From Biomonitoring Data

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Abstract 1902

INTRODUCTION

The current study aimed at the estimation of external and target tissue exposure to 15 different chemicals, including both rapidly (BPA, DEHP, triclosan) and non-rapidly (PCBs, BDEs, HCB, DDT, Me-Hg) metabolized compounds, starting from human biomonitoring (HBM) data.

METHODOLOGY

The simulations were carried out in the INTEGRA computational platform, a software that provides realistic exposure scenarios coupled with a generic physiologic based bio-kinetic (PBBK) model and numerical “reversal” techniques for exposure reconstruction. The exposure reconstruction algorithm is based on the Markov chain Monte Carlo and dynamic evolution Monte Carlo techniques. The process starts from ancillary exposure-related data that are fed into the exposure model. The results are evaluated against the biomonitoring data distributions, aiming at the reduction of uncertainty in back-calculating doses, by minimizing the error between the predicted and the actual biomonitored data. Parameterization of the model for a large chemical space is facilitated by quantitative structure-activity relationship (QSAR) models. HBM data were obtained from cohort and biomonitoring studies from Mediterranean Countries. The study focused on perinatal and childhood exposure.

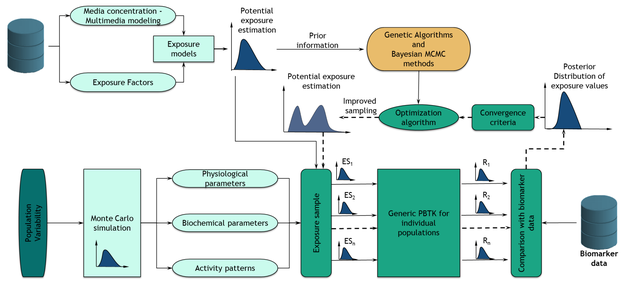

Figure 1. Conceptual methodological approach

RESULTS & DISCUSSION

The results showed that the predicted BPA intake dose is commensurate with intake estimates found in literature for both short and long term exposure scenarios of the European population. In all cases external intake estimates (0.4 μg/kg_bw/d) were significantly lower than the respective temporary tolerable daily intake (t-TDI) of 4 μg/kg)bw/d set by EFSA.

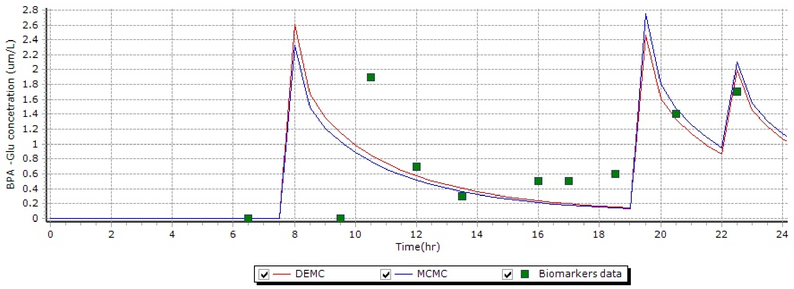

Figure 2. BPA exposure reconstruction starting from urinary BPA-Glu data using (a) the DEMC and (b) the MCMC algorithms respectively (time dynamic data)

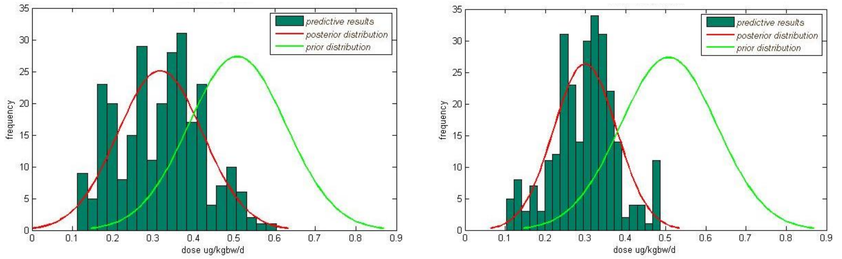

Figure 3. BPA exposure reconstruction starting from urinary BPA-Glu data using (a) the DEMC and (b) the MCMC algorithms respectively (population spot sample data)

The estimated internal dose and the respective concentration in breast milk of BPA, DEHP and triclosan was very low because of their rapid metabolism. The results of the exposure reconstruction algorithms are in agreement to the available biomonitoring data, indicating the correctness of the modeling process. The uncertainty of the results depends on the uncertainty in the prior distribution that influences the convergence efficiency of the algorithm.

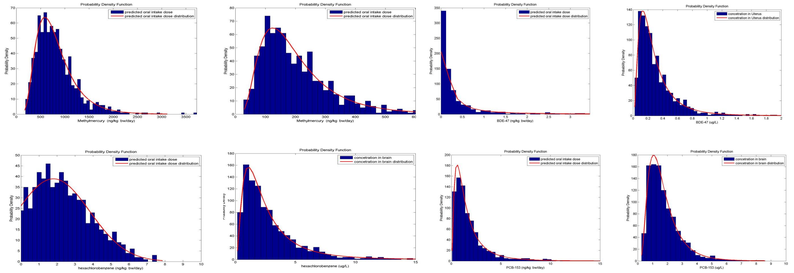

Figure 4. POPs and Hg exposure of Valencia (Spain) population : Coupled figures of predicted oral intake dose and estimated concentration in the respective target tissues

Fetuses and newborns were found to be highly exposed to POPs through trans-placental transfer during pregnancy and through maternal milk during lactation (Figure 4 regarding several persistent compounds). Although the use of these chemicals has been regulated, humans are still exposed to low doses due to their environmental persistence and the continuous transfer through the food web.

CONCLUSIONS

Exposure reconstruction offers unique capabilities for the utilization of the continuously growing amount of available biomonitoring data globally. In this way, biomonitoring data can be mechanistically linked to both external and internal exposure, effectively supporting the screening and prioritization process for assessing chemical risk.

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