

Internal phthalate exposure over the last two decades – A retrospective human biomonitoring study

Matthias Wittassek, Gerhard Andreas Wiesmüller, Holger Martin Koch, Rolf Eckard, Lorenz Dobler, Dieter Helm, Johannes Müller, Jürgen Angerer, Christoph Schlüter

International Journal of Hygiene and Environmental Health 210 (2007) 319-333

Abstract: In a retrospective human biomonitoring study we analysed 24h urine samples taken from the German Environmental Specimen Bank for Human Tissues (ESBHum), which were collected from 634 subjects, (predominantly students, age range 20-29 years, 326 females, 308 males) in 9 years between 1988 and 2003 (each $n \geq 60$), for the concentrations of primary and/or secondary metabolites of di-n-butyl phthalate (DnBP), di-iso-butyl phthalate (DiBP), butylbenzyl phthalate (BBzP), di(2-ethylhexyl) phthalate (DEHP) and di-iso-nonyl phthalate (DiNP). Based on the urinary metabolite excretion we estimated daily intakes of the parent phthalates and investigated the chronological course of the phthalate exposure. In over 98% of the urine samples metabolites of all five phthalates were detectable indicating a ubiquitous exposure of the German population to all five phthalates throughout the last 20 years. The median daily intakes in the subsets between 1988 and 1993 were quite constant for DnBP (approx. 7 $\mu\text{g}/\text{kg bw}/\text{d}$) and DEHP (approx. 4 $\mu\text{g}/\text{kg bw}/\text{d}$). However, from 1996 the median levels of both phthalates decreased continuously until 2003 (DnBP 1.9 $\mu\text{g}/\text{kg bw}/\text{d}$; DEHP 2.4 $\mu\text{g}/\text{kg bw}/\text{d}$). By contrast, the daily intake values for DiBP were slightly increasing over the whole time frame investigated (median 1989: 1.0 $\mu\text{g}/\text{kg bw}/\text{d}$; median 2003: 1.4 $\mu\text{g}/\text{kg bw}/\text{d}$), approximating the levels for DnBP and DEHP. For BBzP we observed slightly decreasing values, even though the medians as of 1998 levelled off at around 0.2 $\mu\text{g}/\text{kg bw}/\text{d}$. Regarding daily DiNP exposure we found continuously increasing values, with the lowest median being 0.20 $\mu\text{g}/\text{kg bw}/\text{d}$ for the subset of 1988 and the highest median for 2003 being twice as high. The trends observed in phthalate exposure may be associated with a change in production and usage pattern. Female subjects exhibited significantly higher daily intakes for the dibutyl phthalates (DnBP $p=0.013$; DiBP $p=0.004$). Compared to data from US National Health and Nutrition Examination Surveys (NHANES) exposure levels of the dibutyl phthalates were generally higher in our German study population, while levels of BBzP were somewhat lower. Overall, for a considerable 14% of the subjects we observed daily DnBP intakes above the tolerable daily intake (TDI) value deduced by the European Food Safety Authority (EFSA) (10 $\mu\text{g}/\text{kg bw}/\text{d}$). However, the frequency of exceedance decreased during the years and was beneath 2% in the 2003 subset. Even though transgressions of the exposure limit values of the EFSA and the US Environmental Protection Agency (US EPA) occurred only in a relatively small share of the subjects, one has to take into account the cumulative exposure to all phthalates investigated and possible dose-additive endocrine effects of these phthalates.