APPARENT HALF-LIVES OF DIOXINS, FURANS, AND PCBS IN ADULTS AND CHILDREN

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OBJECTIVE

Define a reference half-life value for 29 congeners of polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs) for an adult and for an infant.

INTRODUCTION

To account for the effect of historical intake on current serum concentration levels of persistent congeners, it is necessary to decay past concentrations over time as a function of their half-lives. Different dioxin, furan, and dioxin-like PCB congeners have different persistence in the human body. This study examines the half-life data for 29 congeners from the literature. Based on the available information, a value for each congener is defined that approximates the half-life for an infant and for an adult. These values can be used as reference half-lives, and can be further adjusted for individual variation with known modifiers such as age, sex, percent body fat, and smoking status.

METHODS

- An extensive literature search was conducted for studies with half-life or decay values for dioxins, furans, and PCBs in humans. The information from 30 studies was used.
- A subset of data representative of a middle -aged adult was selected based on the following criteria:
  - The blood serum concentration at the time of sampling was below 700ppt,
  - The subjects were adults,
  - The measurements were not later refined or reported as inaccurate in later studies,
  - The values were less than ten years if they were measured in assumed steady state conditions.

RESULTS

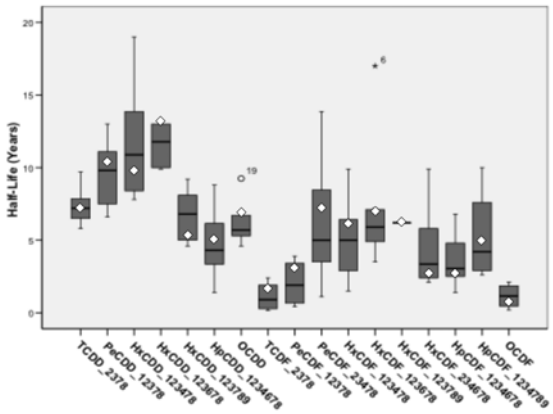

Figure 1. Range of half-life values for dioxins and furans based on the subset of values from the literature. White diamonds show the placement of the reference values within this range.

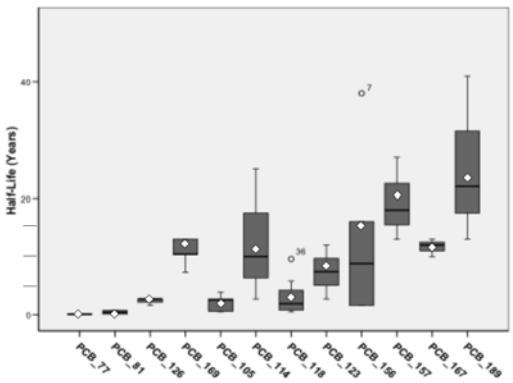

Figure 2. Range of half-life values for PCBs based on the subset of values from the literature. White diamonds show the placement of the reference values within this range.

There is large variation in half-life values between congeners. Some of the furans have mean half-lives of under 3 years, whereas the mean half-lives of some of the hexa-dioxins are over a decade. A portion of this variation is due to the fact that the cohorts studied have different composition with regard to age, sex, smoking status, and percent body fat; all characteristics known to affect half-life length. There is a paucity of information in the literature regarding the kinetics of PCBs, and the existing studies vary greatly in their methods,sampling timeline, and cohort demographics.

Reference values were chosen to represent the half-life in an infant and in a 40-50 year old non-smoking male with a percent body fat of 21.9. Sources had data over a range of congeners and values that remained in the 25% - 75% percentiles of the data subset.

	2378 TCDD	12378 PeCDD	123478 HxCDD	123678 HxCDD	123789 HxCDD	1234678 HpCDD	OCDD	2378 TCDF	12378 PeCDF	23478 PeCDF	123478 HxCDF	123678 HxCDF	123789 HxCDF	234678 HxCDF	1234678 HpCDF	1234789 HpCDF	OCDF	PCB 77	PCB 81	PCB 126	PCB 169	PCB 105	PCB 114	PCB 118	PCB 123	PCB 156	PCB 157	PCB 167	PCB 189
Adult Reference Value	7.2	11.2	9.76	13.1	5.1	4.92	6.73	2.13	3.5	7	6.42	7.22	7.22	2.79	3.09	4.61	1.4	0.07	0.73	1.6	7.3	2.4	10	3.8	7.4	16	18	12	22
Infant Reference Value	0.4	0.32	0.5	0.39	0.28	0.32	0.46	0.12	0.19	0.27	0.35	0.4	0.34	0.15	0.17	0.25	0.08	0	0.04	0.09	0.46	0.13	0.56	0.21	0.41	0.89	1	0.67	1.22
Adult Reference Source	1	2	2	2	2	2	2	3	3	3	2	2	*	3	2	3	3	4	4	5	5	5	5	5	5	5	5	5	5

Table1. Half-life reference values (in years) for an adult male and for an infant. Infant reference values are based on values from Leung *et al.* 2006

CONCLUSIONS

- Full understanding of the half-lives of different congeners in the body requires continued study of the kinetics of these compounds in humans, especially PCBs.
- The mean values and reference values provided above reflect well the current available data in the literature.
- These half-life values can be further adjusted to reflect individual characteristics that affect the persistence of the different congeners in the body, and can then be used to determine the effect of past intake on current body concentrations.

[1] Flesch-Janys, D., *Journal of Toxicology and Environmental Health Part A* 47, 363 1996. (reported median) [2] Flesch-Janys, D., *Journal of Toxicology and Environmental Health Part A* 47, 363 1996. (regression line) [3] Van Der Molen, G. W.; Kooijman, B. A L. M.; Wittsiepe, J.; Schrey, P.; Flesch-Janys, D.; Slob, W., *Journal of Exposure Analysis and Environmental Epidemiology* 10, 579 2000. (With Flesch-Janys data) [4] Ogura, I., *Organohalogen Compounds* 66, 3376 2004. (Blood data, mean age = 49.5) [5] Ogura, I., *Organohalogen Compounds* 66, 3376 2004. (Adipose, mean age 42.5)
Leung, H.-W., Kerger, B. D., and Paustenbach, D. J. (2006). Elimination Half-Lives of Selected Polychlorinated Dibenzodioxins and Dibenzofurans in Breast-Fed Human Infants. *Journal of Toxicology and Environmental Health Part A* **V69**, 437-443.
* There were no data for this congener. The reference point was chosen to be the same as 123678HxCDF.

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