

Electronic Supplementary Information

Environmental *versus* dietary exposure to POPs and metals: A probabilistic assessment of human health risks

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Table S1 Monte-Carlo parameter distributions for environmental exposure assessment and risk characterization

Parameter	Units	Type	Distribution ^a	Reference
Ventilation rate (V_T)	m ³ /day	log-normal	16.57 ± 4.05	Allan et al. ³⁷
Alveolar fraction retained in lungs (f_r)	unitless	triangular	0.75 (0 - 1)	Nouwen et al. ¹⁹
Averaging time (AT)	year	point	70	U.S. EPA ⁴⁰
Exposure duration Adult (ED)	year	log-normal	11.36 ± 13.72	U.S. EPA ⁴⁰
Exposed time fraction (E_t)	unitless	triangular	0.62 (0 - 1)	Nouwen et al. ¹⁹
Body weight (BW)	kg	log-normal	67.52 ± 12.22	Nadal et al. ²¹
Skin coverage with soil outside (Der_o)	kg/m ²	triangular	3.75·10 ⁻² (0 - 0.1)	Nouwen et al. ¹⁹
Matrix factor (f_m)	unitless	triangular	0.15 (0 - 1)	Nouwen et al. ¹⁹
Exposed skin surface area for arms (SA_o)	m ²	log-normal	0.319 ± 0.0461	U.S. EPA ³⁸
Exposed time fraction outside (t_{fso})	unitless	triangular	0.158 (0 - 1)	Nouwen et al. ¹⁹
Skin coverage with soil inside (Der_i)	kg/m ²	triangular	5.6·10 ⁻⁴ (0 - 5·10 ⁻³)	Nouwen et al. ¹⁹
Soil fraction in the inside dust (f_i)	unitless	triangular	0.8 (0 - 1)	Nouwen et al. ¹⁹
Exposed skin surface area for hands (SA_i)	m ²	log-normal	0.084 ± 0.0127	U.S. EPA ³⁸
Exposed time fraction inside (t_{fsi})	unitless	triangular	0.458 (0 - 1)	Nouwen et al. ¹⁹
Ingestion rate of soil particles (I_{sp})	kg/day	triangular	2.5·10 ⁻⁵ (1·10 ⁻⁷ - 5·10 ⁻⁵)	Nadal et al. ²¹
Sleeping time (t_s)	h/day	triangular	7.5 (3 - 14)	Unpublished data
Exposure frequency (EF)	day/year	triangular	345 (180-365)	Nadal et al. ²¹
Dermal absorption factor (inorganic) (ABS)	unitless	point	0.001	U.S. EPA ³⁹
Adult surface area (SA)	unitless	point	0.53	U.S. EPA ³⁸
Adherence factor (AF)	mg/cm ²	log-normal	0.52 ± 0.9	Nadal et al. ²¹
PCDD/F Tolerable Daily Intake (TDI)	pg/kg/day	uniform	1-4	Van Leeuwen et al. ⁴¹
PCDD/F Carcinogenic slope factor (SF)	kg·day/ng	uniform	3.4·10 ⁻² - 5.6·10 ⁻²	Katsumata and Kastenber ⁴²

Food group ^b	Units	Type	Distribution	Non-consumer frequency	
Meat	g/day	gamma*binomial	143.6 ± 70.2	0.006	
Fish	White fish	g/day	gamma*binomial	34.0 ± 23.4	0.060
	Blue fish	g/day	gamma*binomial	24.7 ± 17.9	0.114
	Cephalopod	g/day	gamma*binomial	9.9 ± 7.9	0.230
	Other seafood	Bivalve	g/day	gamma*binomial	5.5 ± 4.7
	Crustacean	g/day	gamma*binomial	6.9 ± 6.0	0.226
Pulses	g/day	gamma*binomial	15.6 ± 10.2	0.050	
Bread and cereals	g/day	gamma*binomial	147.2 ± 78.8	0.000	
Vegetables	g/day	gamma*binomial	229.3 ± 146.4	0.003	
Tubers	g/day	gamma*binomial	60.5 ± 39.6	0.021	
Fruit	g/day	gamma*binomial	281.5 ± 195.1	0.015	
Milk	g/day	gamma*binomial	253 ± 165.1	0.095	
Dairy products	g/day	gamma*binomial	112.5 ± 86.0	0.016	
Eggs	g/day	gamma*binomial	23.3 ± 13.9	0.027	
Bakery products	g/day	gamma*binomial	39.5 ± 38.2	0.000	
Oils and fats	g/day	gamma*binomial	36.1 ± 20.6	0.002	

^aMean and standard deviation were used for log-normal distributions and gamma*binomial; low and high for uniform distributions, and mean, low and high for triangular distributions.

^bDistributions were adjusted from the Frequency and Quantity Questionnaire data of ENCAT.²⁰ The binomial factors were included to take into account the non-consumer people (non-consumer frequency).

Table S2 Parameters for calculation of non-carcinogenic and carcinogenic risks

	RfD _o (mg/kg-day) ⁻¹	SF _o (mg/kg-day) ⁻¹	IUR (µg/m ³) ⁻¹	RfCi (mg/m ³)	
HEAVY METALS	As	3.00E-04	1.50E+00	4.30E-03	3.00E-05
	Cd	1.00E-03	-	1.80E-03	-
	Cr	0.00E+00	-	-	-
	Hg	0.00E+00	-	-	3.00E-04
	Mn	1.40E-01	-	-	5.00E-05
	Pb	0.00E+00	-	-	-
	V	5.00E-03	-	-	-
PAH	Naphthalene	2.00E-02	-	3.40E-05	3.00E-03
	Acenaphthene	6.00E-02	-	-	-
	Fluorene	4.00E-02	-	-	-
	Anthracene	3.00E-01	-	-	-
	Fluoranthene	4.00E-02	-	-	-
	Pyrene	3.00E-02	-	-	-
	Benzo(a)anthracene	-	7.30E-01	1.10E-04	-
	Chrysene	-	7.30E-03	1.10E-05	-
	Benzo(k)fluoranthene	-	7.30E-02	1.10E-04	-
	Benzo(a)pyrene	-	7.30E+00	1.10E-03	-
	Indeno(123-cd)pyrene	-	7.30E-01	1.10E-04	-
Dibenzo(ah)anthracene	-	7.30E+00	-	-	
Benzo(b)fluoranthene	-	7.30E-01	1.10E-04	-	
PCBs	PCB-118	-	3.90E+00	1.10E-03	-
	PCB-180	-	1.30E+00	3.80E-04	-

RfD_o: Oral Reference Dose; SF_o: Oral Slope Factor; IUR: Inhalation Unit Risk; RfCi: Inhalation Reference Concentration

Data from US EPA³⁷

Table S3 Environmental (direct), dietary, and total exposure to POPs and metals for children living in Tarragona County (Catalonia, Spain)

		Mean	Median	SD	Percentiles		
					75th	90th	95th
PCDD/Fs (ng WHO-TEQ/kg/day)	Direct	3.06E-05	9.61E-06	8.71E-05	2.49E-05	6.46E-05	1.19E-04
	Dietary	1.55E-03	1.47E-03	4.99E-04	1.81E-03	2.19E-03	2.49E-03
	Total	1.59E-03	1.51E-03	5.14E-04	1.87E-03	2.25E-03	2.53E-03
PCBs (ng/kg/day)	Direct	8.18E-02	3.13E-02	2.00E-01	7.15E-02	1.70E-01	3.05E-01
	Dietary	4.18E+00	3.75E+00	2.26E+00	5.27E+00	7.06E+00	7.75E+00
	Total	4.26E+00	3.76E+00	2.31E+00	5.28E+00	7.20E+00	8.61E+00
PCNs (ng/kg/day)	Direct	3.50E-03	2.31E-03	4.64E-03	3.99E-03	6.81E-03	1.01E-02
	Dietary	4.36E-01	1.41E-01	4.13E-01	5.89E-02	6.22E-01	7.01E-01
	Total	4.38E-01	3.22E-01	4.01E-01	5.54E-01	8.75E-01	1.18E+00
PAHs (ng/kg/day)	Direct	8.07E+00	5.22E+00	1.13E+01	9.06E+00	1.61E+01	2.32E+01
	Dietary	4.66E+02	4.46E+02	1.59E+02	5.53E+02	6.75E+02	7.65E+02
	Total	4.72E+02	4.48E+02	1.58E+02	5.57E+02	6.76E+02	7.68E+02
Carc. PAHs (ng/kg/day)	Direct	2.28E+00	1.18E+00	4.25E+00	2.33E+00	4.65E+00	7.52E+00
	Dietary	3.50E+01	3.35E+01	1.10E+01	4.10E+01	4.93E+01	5.55E+01
	Total	3.73E+01	3.54E+01	1.21E+01	4.36E+01	5.27E+01	5.95E+01
As (mg/kg/day)	Direct	1.37E-05	1.14E-05	9.65E-06	1.75E-05	2.57E-05	3.15E-05
	Dietary	4.58E-02	4.22E-02	1.84E-02	5.53E-02	6.98E-02	8.08E-02
	Total	4.60E-02	4.27E-02	1.88E-02	5.52E-02	7.02E-02	8.15E-02
Cd (mg/kg/day)	Direct	5.33E-07	4.54E-07	3.33E-07	6.71E-07	9.54E-07	1.16E-06
	Dietary	2.14E-03	2.04E-03	6.40E-04	2.49E-03	2.97E-03	3.31E-03
	Total	2.14E-03	2.05E-03	6.34E-04	2.48E-03	2.98E-03	3.31E-03
Cr (mg/kg/day)	Direct	4.22E-05	3.47E-05	2.92E-05	5.35E-05	7.90E-05	9.86E-05
	Dietary	3.83E-03	3.66E-03	1.25E-03	4.54E-03	5.40E-03	6.06E-03
	Total	3.89E-03	3.69E-03	1.27E-03	4.58E-03	5.55E-03	6.23E-03
Hg (mg/kg/day)	Direct	4.28E-05	3.35E-05	3.45E-05	5.46E-05	8.39E-05	1.08E-04
	Dietary	2.12E-03	1.95E-03	9.21E-04	2.60E-03	3.33E-03	3.84E-03
	Total	2.17E-03	1.99E-03	9.28E-04	2.62E-03	3.36E-03	3.91E-03
Mn (mg/kg/day)	Direct	6.56E-04	5.67E-04	4.11E-04	8.37E-04	1.18E-03	1.43E-03
	Dietary	1.49E-04	1.37E-04	6.17E-05	1.78E-04	2.29E-04	2.64E-04
	Total	8.01E-04	7.19E-04	4.07E-04	9.91E-04	1.31E-03	1.56E-03
Pb (mg/kg/day)	Direct	6.94E-05	5.22E-05	6.14E-05	8.70E-05	1.39E-04	1.84E-04
	Dietary	1.27E-02	1.21E-02	4.15E-03	1.49E-02	1.80E-02	2.01E-02
	Total	1.27E-02	1.22E-02	4.10E-03	1.50E-02	1.82E-02	2.03E-02
V (mg/kg/day)	Direct	6.13E-05	4.84E-05	4.90E-05	7.74E-05	1.16E-04	1.51E-04
	Dietary	1.93E-03	1.84E-03	6.27E-04	2.26E-03	2.75E-03	3.06E-03
	Total	2.00E-03	1.91E-03	6.29E-04	2.34E-03	2.82E-03	3.18E-03