

# Exposure assessment for dioxin and dioxin-like PCBs in Germany based on the BfR MEAL Study

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Scan for more information about the BfR MEAL Study

## Background and method

The BfR MEAL Study is the first Total Diet Study in Germany measuring more than 300 substances in foods as eaten that represent usual consumption behavior. Dioxin (PCDD/Fs) and dioxin-like PCBs (dl-PCBs) have been analyzed in 645 pools each consisting of 15-20 individual subsamples considering different brands, shopping locations and preparation methods (Stadion et al 2022). They have been analyzed in all food groups except fruit and vegetable juices, water and water-based drinks (Table 1). Concentration data has been used for calculating dietary exposure in combination with national food consumption data for children (Nowak et al 2022) and adolescents and adults (Heuer et al 2015). Finally, exposure has been compared to the tolerable weekly intake (TWI) of 2 pg/kg bodyweight (bw).

Table 1: Numbers of foods and pools analyzed for dioxin and dioxin-like PCBs in the BfR MEAL Study

main food group	numbers				
	food	pools			
		total	unspecific	conventional	organic
01 grains and grain-based products	38	94	48	32	14
02 vegetables and vegetable products	18	58	32	18	8
03 starchy roots or tubers and products thereof	7	15	5	6	4
04 legumes, nuts, oilseeds and spices	8	24	16	4	4
05 fruit and fruit products	8	10	6	2	2
06 meat and meat products	35	101	45	40	16
07 fish, seafood and invertebrates	30	39	39	0	0
08 milk and dairy products	23	37	16	7	14
09 eggs and egg products	2	10	0	8	2
10 sugar, confectionery and water-based sweet desserts	10	12	8	2	2
11 animal and vegetable fats and oils	8	13	4	4	5
12 fruit and vegetable juices and nectar	-	-	-	-	-
13 water and water-based drinks	-	-	-	-	-
14 coffee, cocoa, tea and infusions	7	9	5	2	2
15 alcoholic beverages	8	11	5	3	3
16 food products for infants and toddlers	11	15	7	4	4
17 products for non-standard diets and food imitates	7	8	6	1	1
18 composite dishes	52	170	48	88	34
19 seasoning, sauces and condiments	16	19	19	0	0
sum:	300	645	309	221	115



## Results

### Adolescents and adults (14-80 years)

Average exposure (P50) ranges from 0.17-0.30 (lb-ub) pg WHO<sub>2005</sub>-TEQ/kg bw per day in case of consumption of mainly **conventional foods**. In consequence TWI is exhausted to 59-104 % (P50, lb-ub). In case of consuming mainly **organic foods** dietary exposure (P50) is higher: 0.22-0.35 (lb-ub) pg WHO<sub>2005</sub>-TEQ/kg bw per day. This results in TWI exhaustion of 76-121 % (lb-ub). For high consumers (P95) dietary exposure is remarkably higher (figure 1).

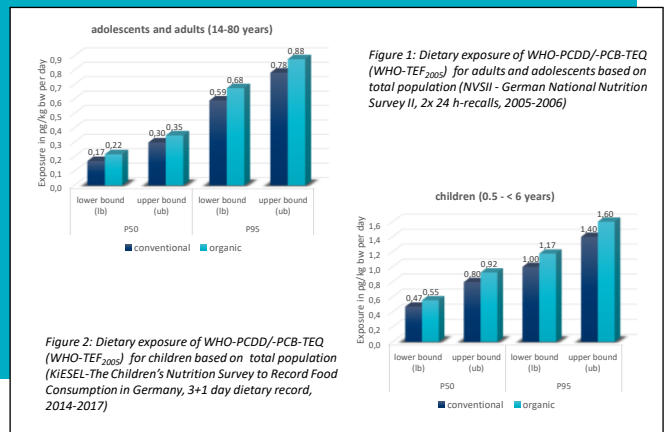
When **conventional foods** are preferred, "grains and grain-based products" are the highest contributor to total dietary exposure (lb/ub), followed by "milk and dairy products" and "animal and vegetable fats/oils". In case of **organic foods** (ub), ranking is changed to first "milk and dairy products" and second "grains and grain-based products" followed by "animal and vegetable fats/oils". In the lower bound, the contribution of "grain and grain-based products" shifts to rank 5 whereas "meat and meat products" move to rank 3.

### Children (0.5 - < 6 years)

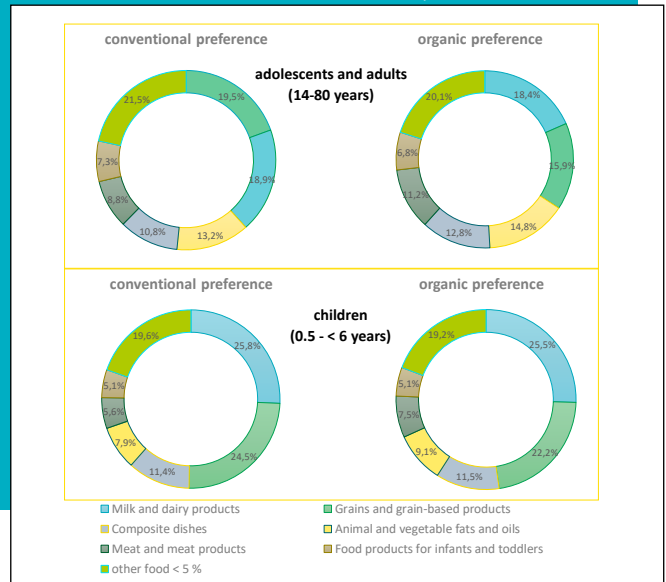
Average exposure is 0.47-0.80 (lb-ub) pg WHO<sub>2005</sub>-TEQ/kg bw per day assuming preference for **conventional foods**. That leads to TWI exceedance of 164-278 % (lb-ub). For **organic foods** exposure increases to 0.55-0.92 (lb-ub) pg WHO<sub>2005</sub>-TEQ/kg bw per day. Consequently TWI is exceeded to 194-323 %. For high consumers (P95) it is even higher (figure 2).

Consumption of "milk and dairy products" represents the main contributor for dioxin and dl-PCB exposure (lb/ub), followed by "grain and grain-based products" and "composite dishes" both for conventional and organic foods.

## Dietary exposure assessment



## Contribution of main food groups to exposure of WHO-PCDD/F-PCB-TEQ (WHO-TEF<sub>2005</sub>, upper bound)



## Conclusion

Dioxins and dl-PCB are undesirable in the food chain. In recent decades, legal regulations have considerably reduced the amount of these substances released into the environment by humans and the analysis based on the BfR MEAL Study confirmed that the intake via food has decreased considerably. Nevertheless, reduction efforts should be continued.

## References

- Heuer T, Krems C, Moon K, Brombach C, Hoffmann I. (2015): Food consumption of adults in Germany: results of the German National Nutrition Survey II based on diet history interviews. *Br J Nutr.* 113(10):1603-14.
- Nowak N, Diouf F, Golsong N, Hoepfner T, Lindtner O. (2022): KIESEL-The Children's Nutrition Survey to Record Food Consumption for the youngest in Germany. *BMC Nutr* 8(1):64.
- Stadion M, Hackethal C, Blume K, Wobst B, Abraham K, Fechner C, Lindtner O, Sarvan I (2022): The first German total diet study (BfR MEAL Study) confirms highest levels of dioxins and dioxin-like polychlorinated biphenyls in foods of animal origin. *Food Chemistry X* 16: 100459.