Human monitoring in Tanzania

Assessing exposure to dioxin-like compounds in Tanzanian mothers using DR CALUX®

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Monitoring and Risk Assessment of contaminants in Southern Africa - Arusha in Tanzania as a model

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- Biodetection Systems (Peter Behnisch, Emiel Felzel)
- Anita Solhaug Veterinary Institute
- Participating mothers and hospital staff at Mount Meru Hospital, Arusha
- Partners in the project

MOUNT MERU HOSPITAL REHABILITATION COMMITTEE ARUSHA

Sokoine University of Agriculture

vrije Universiteit

Veterinærinstituttet Norwegian Veterinary Institute

NIBIO NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

Overview

I
- **Dioxins and dioxinlike compounds**
- **Toxic effects**
- **Background Tanzania**

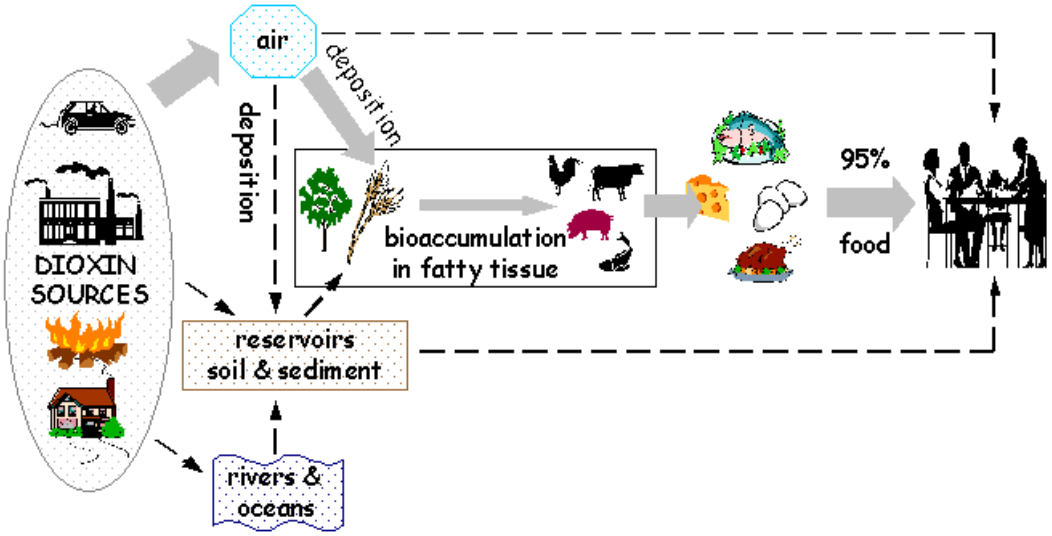
M
- **DR CALUX®**
- **Study population**

R
- **Dioxin-like activity levels**
- **Associations to mother/infant characteristics**

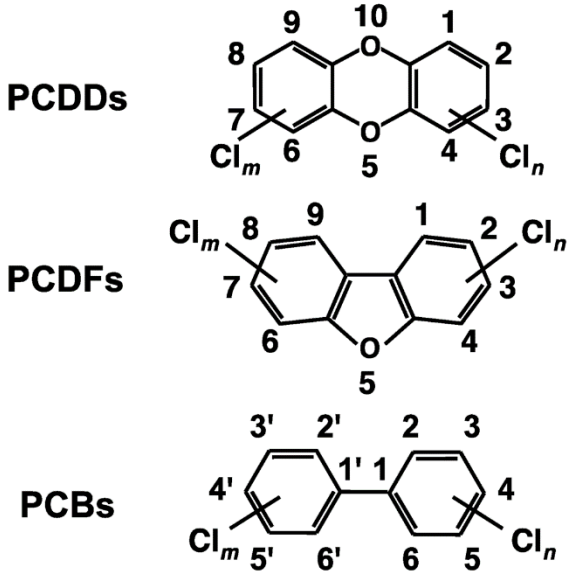
D
- **Comparison of dioxin-like activity levels to other studies**
- **Levels of other persistent chemicals in the same mothers**

C
- **Sum up**

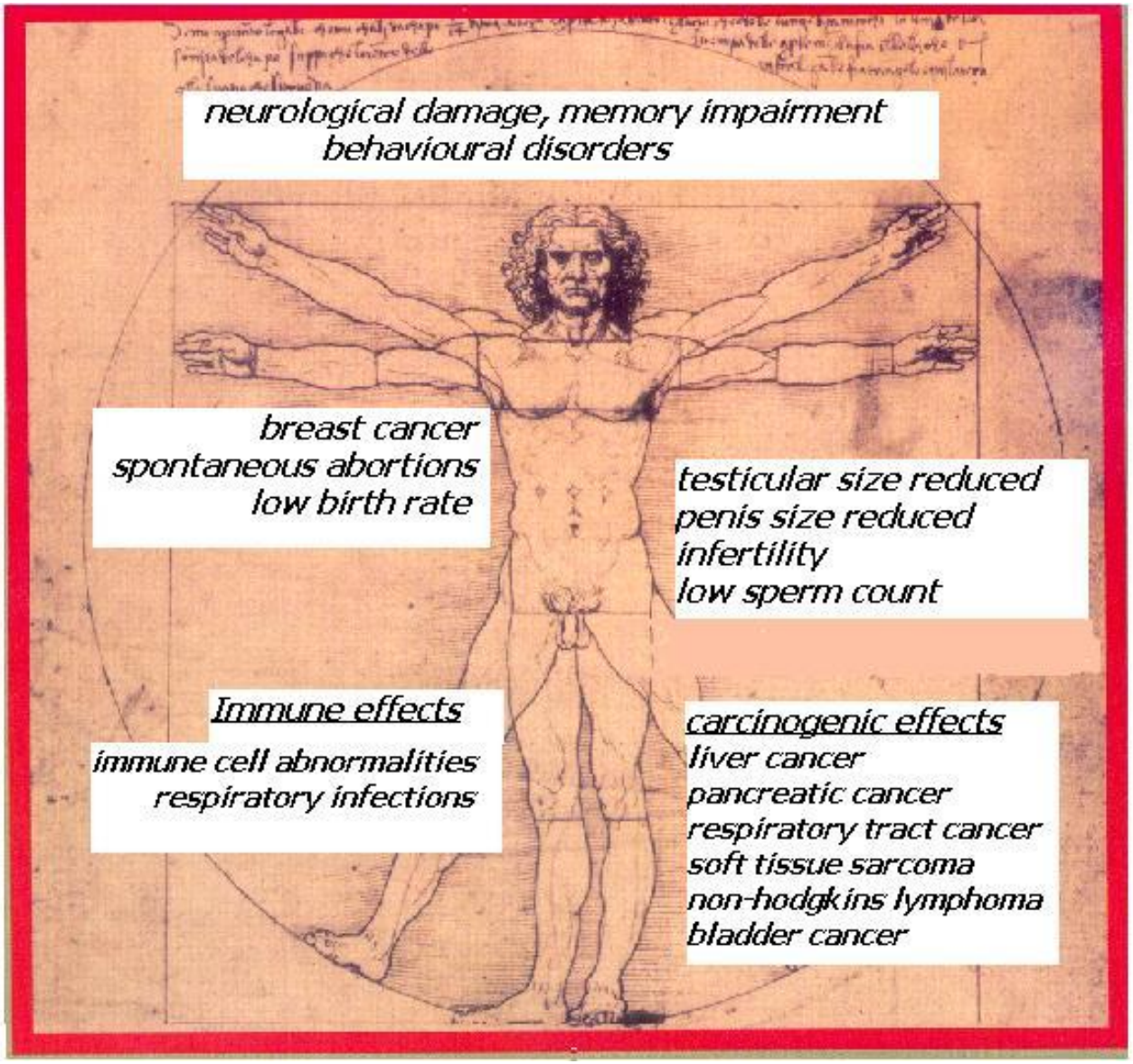
Dioxins and dioxin-like compounds



http://www.hearts.com/ecolife/choose-dioxinfree-life/

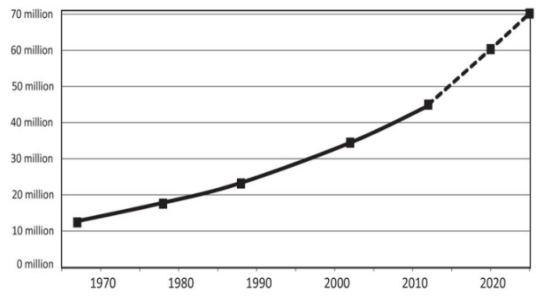


Introduction



Tanzania

- Industrialization
- Agricultural expansion
- Urbanization
- Population growth
- Importation of consumer products
- Limited municipal waste treatment
- Ratified Stockholm



Discharge of chemicals to the environment

Potential sources to dioxins and dioxin-like compounds in Tanzania




Waste management backyard burning
industry, hospitals, domestic

Cooking open fire inside the house

Food eggs from free-range chickens Polder et al., 2016

Geophagy Pemba Reeuwijk et al., 2013

Obsolete stockpiles Vikuge Farm IPEN 2005

Mount Meru Regional Referral Hospital

150 mother-child couples

Maternal blood

Cord blood

Placenta

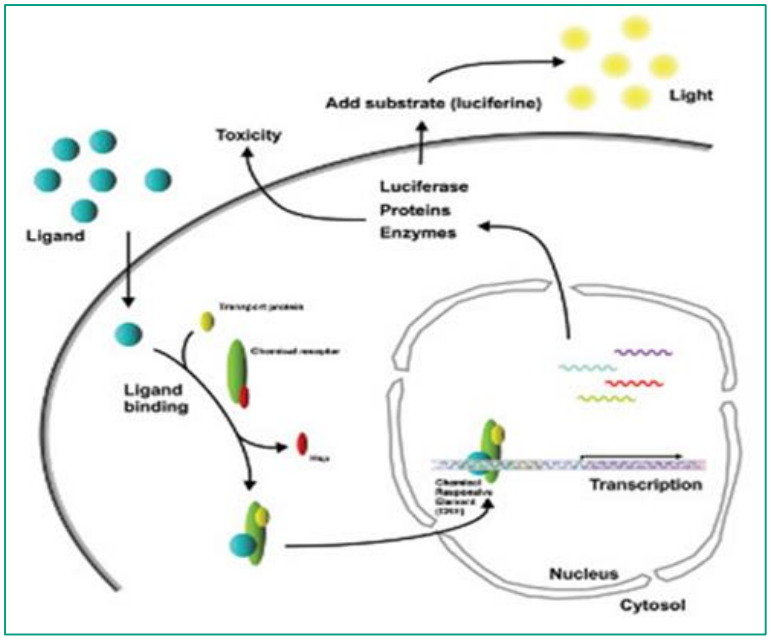
Breast milk

Meconium

Questionnaires

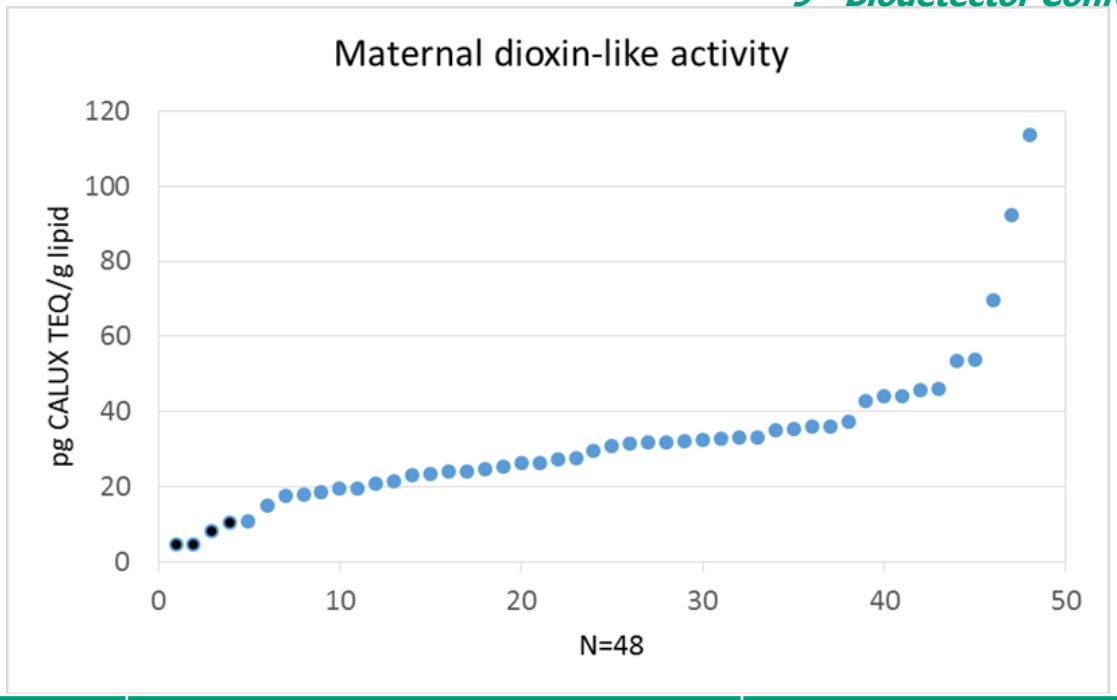
48 included in the present study

DR CALUX®



- Low sample amount
- Cost-efficient
- Unknown mixture of compounds
- Good monitoring tool

Results



N= 48	pg TEQ/g plasma	pg TEQ/g lipid
LOQ	0,15	4,41
N (%) > LOQ	44 (92%)	44 (92%)
Mean	0,21	32,2
Median	0,19	30,2
Min	0,03	4,41
Max	0,64	114

Mother/infant characteristics

	Mean	Min	Max
Age	22	19	30
BMI (kg/m^2) before pregnancy	22,6	18,4	30,9
Weight gain during pregnancy (kg)	6,6	2	17
Gestational age (weeks)	38,5	36	40
Birth weight (kg)	3,2	2,5	4,1
Birth length (cm)	48,8	42	52
Head circumference (cm)	34,7	33	37
Lipid %	0,7	0,4	2,2
	Number	**%**	
Infant sex (male/female)	25/22	53/47	
Farming as occupation	21	45	
Other occupation than farming	26	55	
Rural residence	22	47	
Urban residence	25	53	
Live close to industrial activities	10	21	

Discussion

- Levels higher than USA and some Asian and European countries…..
- Industrial activities- increasing trend?....
- Waste disposal- no information….
- Dietary habits- interpret with caution….
- Geophagy during pregnancy….

Country	Year	N	Mean*	Reference
Tanzania	2012	48	32,2	This study
Taiwan	2000	372	17	Chen et al., 2005
Korea	2001	22	21,5	Kim et al., 2005
USA	2001-02	1081	18,7	Ferriby et al., 2007
Germany	2000-03	169	28,4	Wittsiepe et al., 2007
France	2003	10	45,7	Pirard et al., 2005
Norway	2006-10	184	24,6	Vafeiadi et al., 2014
England	2006-10	111	26,0	Vafeiadi et al., 2014
Denmark	2006-10	190	45,7	Vafeiadi et al., 2014
Spain	2006-10	157	46,4	Vafeiadi et al., 2014

*pg TEQ/ g lipid

In utero exposure of greater concern than postnatally through breast milk

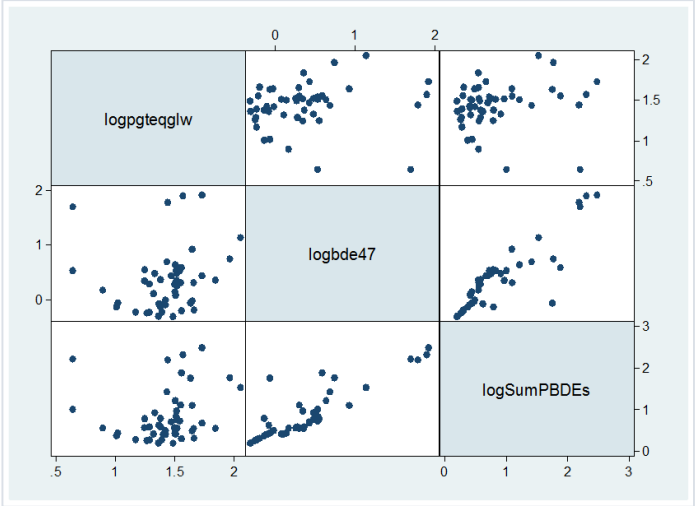
Maternal versus cord blood

PBDEs in maternal blood

∑PBDEs median 3.88 (range 1,59- 299 ng/g lipid)

BDE 47 median 1.95 (range 0,5-89,1 ng/g lipid)

- detection rate 65%
- dominated in 40% of the samples
- contributed in average 37% to ∑PBDEs



Levels of BDE 47 and ∑PBDEs correlated to the levels of dioxin-like activity

rho (*p-value*)	**pg TEQ/g lipid**
BDE 47	0.3251 (*0.02*)
∑PBDEs	0.3136 (*0.03*)

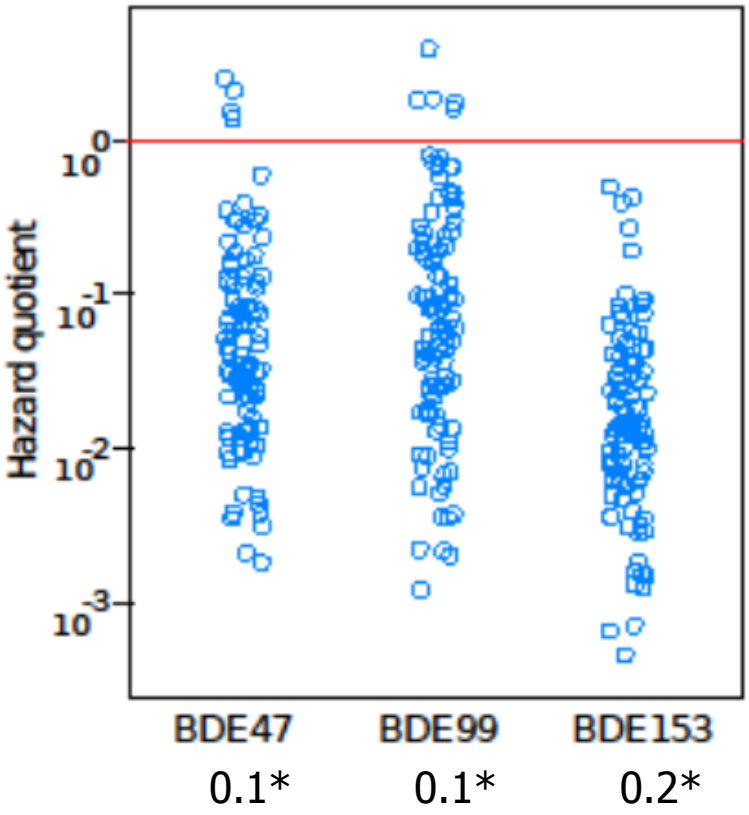
BFRs and OCs in breast milk

ng/g lipid

N=95	% > LOD	Min	25th	50th	75th	95th	Max
Lipid %		0.20					14.0
HCB	83	<LOD	0.65	1.44	2.25	4.56	29.8
∑HCH	88	<LOD	0.44	1.11	2.25	13.4	24.5
∑CHL	56	<LOD					12.9
∑Endosulfans	4	<LOD					11.1
∑DDTs	**100**	**26.3**	**95.7**	**205**	**619**	**1340**	**2486**
Dieldrin	**66**	**<LOD**	**1.82**	**3.74**	**8.99**	**60.3**	**937**
$\sum_7$PCBs	89	<LOD	2.48	4.19	8.38	29.0	157
Σ_7PBDEs	**100**	**<LOD**	**7.2**	**19.8**	**45.5**	**307**	**785**

Müller et al. 2016; Müller et al. in prep.

BFRs and OCs in breast milk



EDI exceeded RfD in 10% of the nursing infants

Estimated Daily Intake (EDI):

C_{milk} x F x 700g/ 5

Reference Dose: estimate of a daily oral exposure to a toxic substance that is likely to be without an appreciable risk of harmful effects during a lifetime.

HQ: ratio between EDI and toxicological values.
HQs exceeding 1 indicate a possible health risk.

Müller et al. 2016

*µg/kg/day *US EPA RfD for neurodevelopmental toxicity*

BFRs and OCs in breast milk

EDI exceeds PTDI in 6 infants

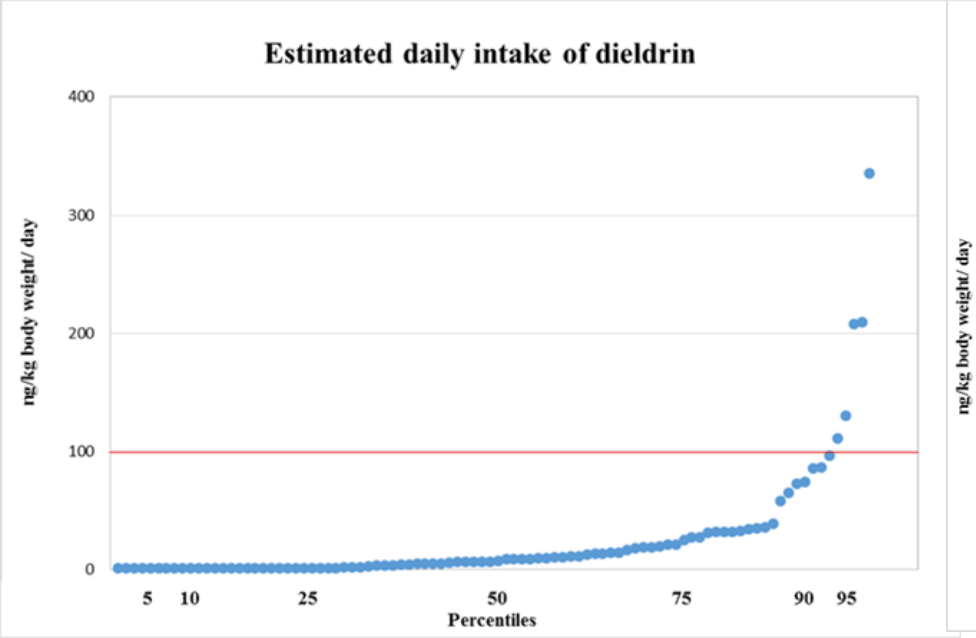
PTDI dieldrin: 100 ng/kg bw/day

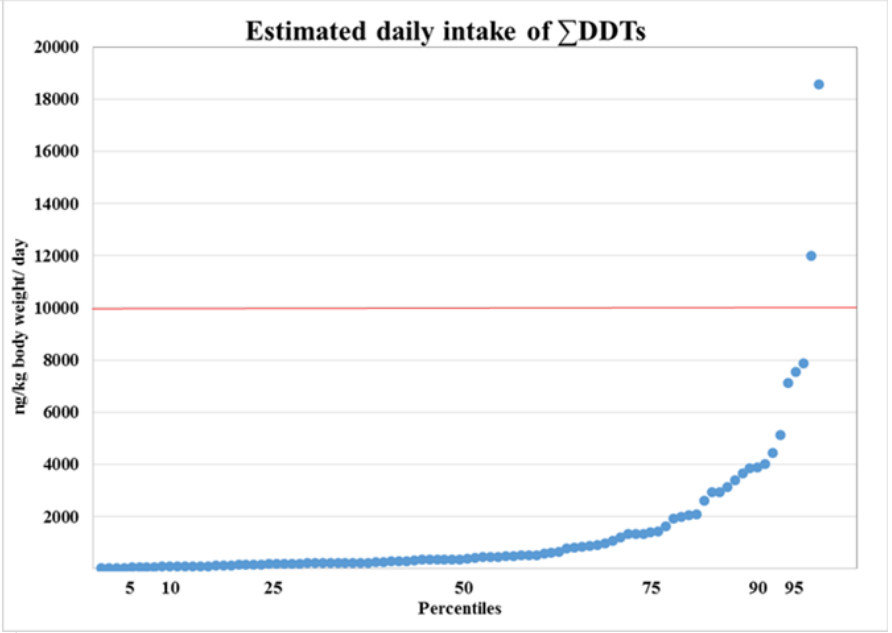
FAO/WHO, 1995

EDI exceeds PTDI in 2 infants

PTDI DDT: 10 000 ng/kg bw/day

FAO/WHO, 2001





Provisional Tolerable Daily Intake (PTDI)

Müller et al. in prep

- The compounds giving the dioxin-like activity?
- Chemical analysis for confirmation

Chlorinated versus brominated dioxins/furans/biphenyls

- additive effects in animal studies
- similar effects
- effects at similar low doses indicating comparable potencies
- limited *in vivo* and *in vitro* data for PBDDs, PBDFs, and non-ortho dl-PBBs

support the use of similar TEFs as temporary values for human risk assessment

- **DR CALUX:**

  Valuable tool for our monitoring purposes

  Use CALUX- TEQ in risk assessment?

- Confirmation of the dioxin-like compounds by chemical analysis
- Risk communication to increase Governmental efforts
- Nutritional guidance of women in child bearing age
- Further studies needed to assess
  - ➢ Sources
  - ➢ Potential health risks- especially for fetuses and nursing infants!

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Thank you for your attention!