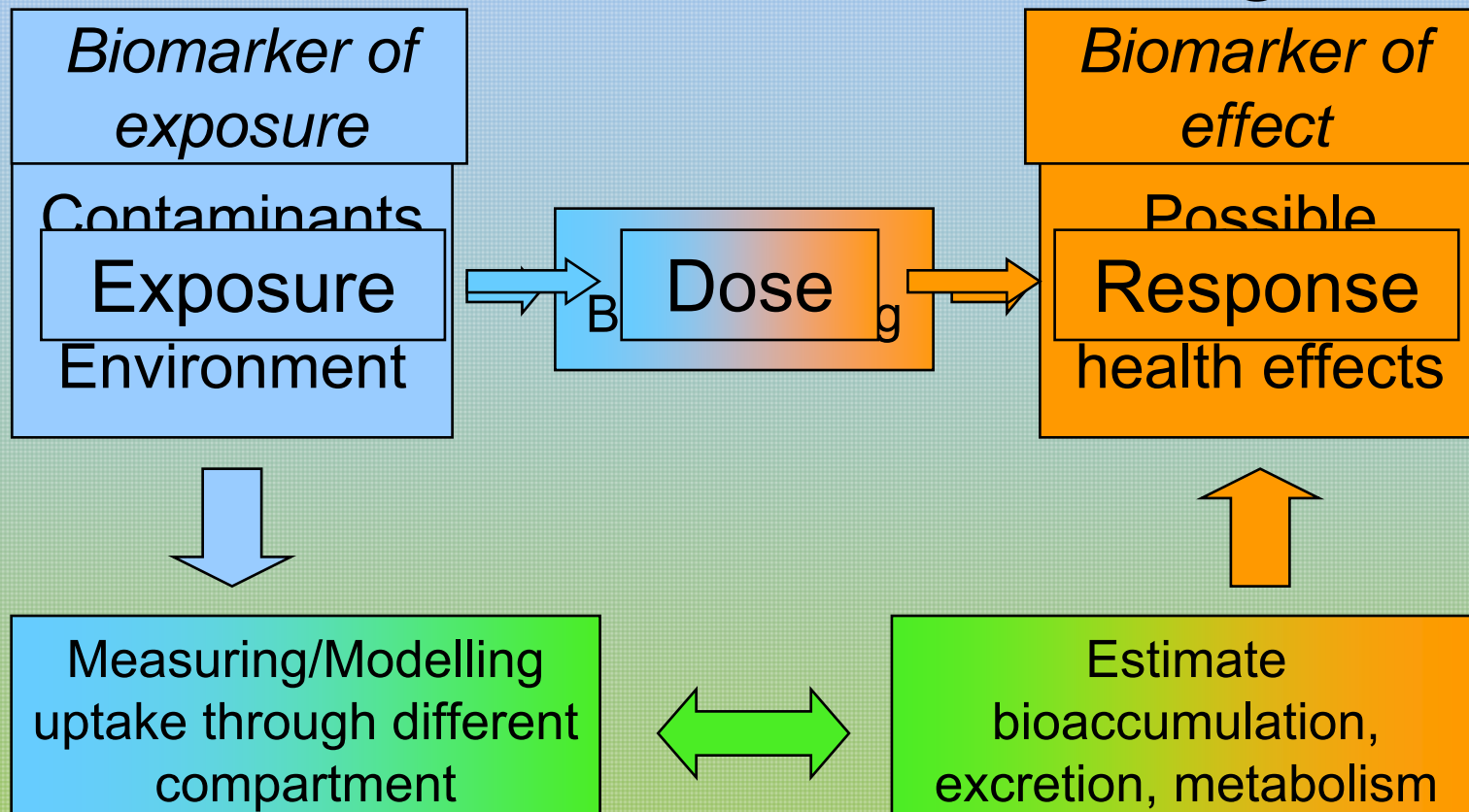


Exposure to environmental pollution in the general Flemish population: Results of the 2nd Flemish Environment and Health Study (2008-'09)

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Introduction to human biomonitoring



Flemish Center for Expertise on Environment and Health

First Flemish Human Biomonitoring campaign:
2001-'06



Second Flemish Human Biomonitoring campaign:
2007-'11



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Human biomonitoring 2007-2011

- 2007-'09: **reference values** for Flanders
 - Historical and new pollutants
 - Aims:
 - » Status of the general population (dose distribution)
 - » International positioning
 - » Control group for hot spots
- 2009-'11: **hot spots** in Flanders
 - Biomonitoring (of a specific biomarker) in a selected area or a selected population
 - Selection: through open call and transparent selection process
 - Genk-Zuid en Menen



Flemish reference values 2007-'11

METHOD

Study design

- 3 age groups:
 - 250 newborns and mothers – maternities
 - 200 students (14-15 jaar) – schools
 - 200 adults (20-40 jaar) – provincial institutes
- Multistage sampling strategy
- Selection criteria:
 - Living 10 years in Flanders
 - Being able to fill in questionnaire
 - Written informed consent

Biomarkers of exposure

- Selection:
 - Consultation of stakeholders
 - Inclusion based on:
 - Health effects, sensitive subgroups, expected levels, MOS, guidelines
 - Available SOPs, LOD's, costs
- Categories:
 - Heavy metals, POP's (chlorinated/brominated), PAH's, benzene, perfluors, phthalates, bisphenol A, pesticides, personal care products, tobacco smoke

Output

- Reference values
 - Geometric means (95% CI) and 90^e percentiles
 - Adjusted for *a priori* defined confounders
- Descriptive statistics per age group
 - Personal factors (sex, age,...)
 - Lifestyle (nutrition, smoking,...)
 - Environmental (urban, traffic,...)
- Time trends: comparison earlier values (2002-06)
- Comparison guidelines and international literature



Flemish reference values 2007-'11

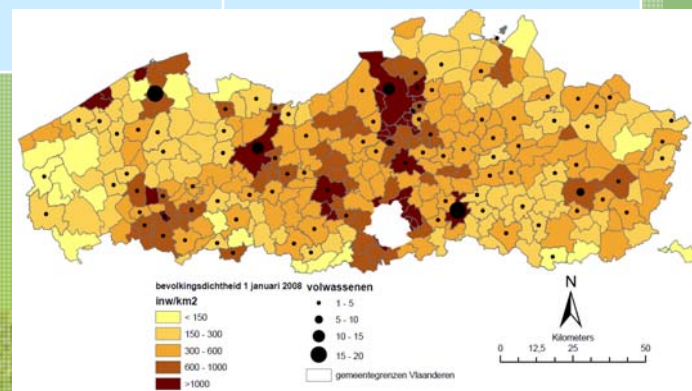
RESULTS

Response rate

	Newborns	Students	Adults
N	255	210	204
% response	-	51,8%	30,0%
% participation	88%	69,5%	92,3%

Study population

	Mothers of newborns	Students	Adults
N	255	210	204
Age(yr) Geometric mean(min.-max)	30,3 (18,2 – 42,4)	14,8 (13,8 – 16,3)	33,9 (21,4 – 40,6)
% male / female	0 / 100	57,6 / 42,4	47,1 / 52,9
% smokers	11,6	13,6	23,3
% higher education	61,5	56,0 (family)	77,5
% urban	61,6	36,7	48,5



Heavy metals: lead (Pb)

Age group	N	%>LOD	Mean (95%BI) - µg/L	90 ^e percentile (95%BI) - µg/L	Confounders
Newborns	241	100%	8,6 (8,1 – 9,2)	15,9 (13,9 – 17,9)	Smoking, age
Mothers	235	100%	11,1 (10,6 – 11,7)	18,9 (17,1 – 20,7)	Smoking, age
Students	207	100%	14,8 (14,0 – 15,6)	27,6 (23,1 – 32,1)	Smoking, age, sex

Health based reference value of WHO = 100 µg/L

- Mothers: all values < 100 µg/L (max. = 69,6 µg/L)
- Students: all values < 100 µg/L (max. = 76,9 µg/L)

International biomonitoring studies:

- Mothers: NHANES: 20+ yrs., 2003-04: median = 19,0 µg/L
GerES: 18-69 yrs., 1998: GM = 30,7 µg/L
- Students: NHANES: 12-19 yrs., 2003-04: median = 9,0 µg/L
GerES: 12-14 yrs., 2003-06: median = 14,6 µg/L

Heavy metals

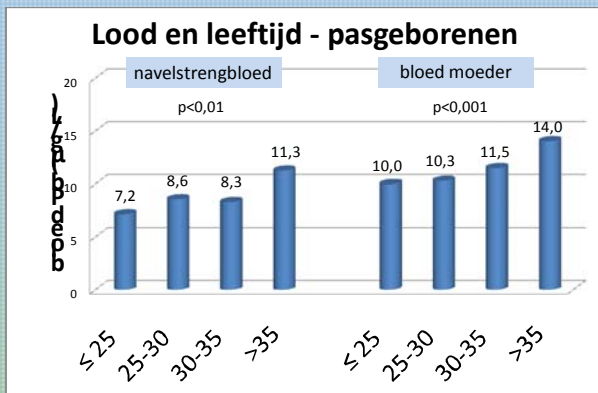
Pb, Cd, Mn, Cu, Th, As, Hg

- Detectable levels for all heavy metals
 - Detection frequency >LOD
 - 67,9% - 98,6% for blood cadmium (LOD = 0,6 µg/L)
 - 100% voor all other metals
- Reference mean: comparable with international studies
- Comparison with guidelines

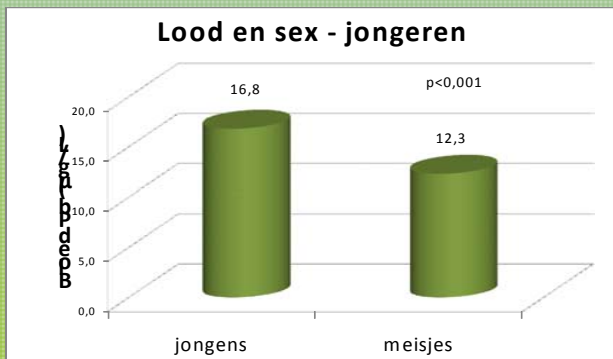
Biomarker	Reference value	Mothers	Students	Adults
Blood cadmium	5 µg/L (occup.)	99,5%	99,5%	-
Blood cadmium	2 µg/L	98,4%	98,6%	-
Urinary cadmium	2 µg/g crt (occup.)	-	-	100%
Urinary cadmium	1 µg/g crt			100%
Urinary cadmium	0,66 µg/g crt			97,0%

Determinants of heavy metals

Age ↑: Pb, Cd, As ↑



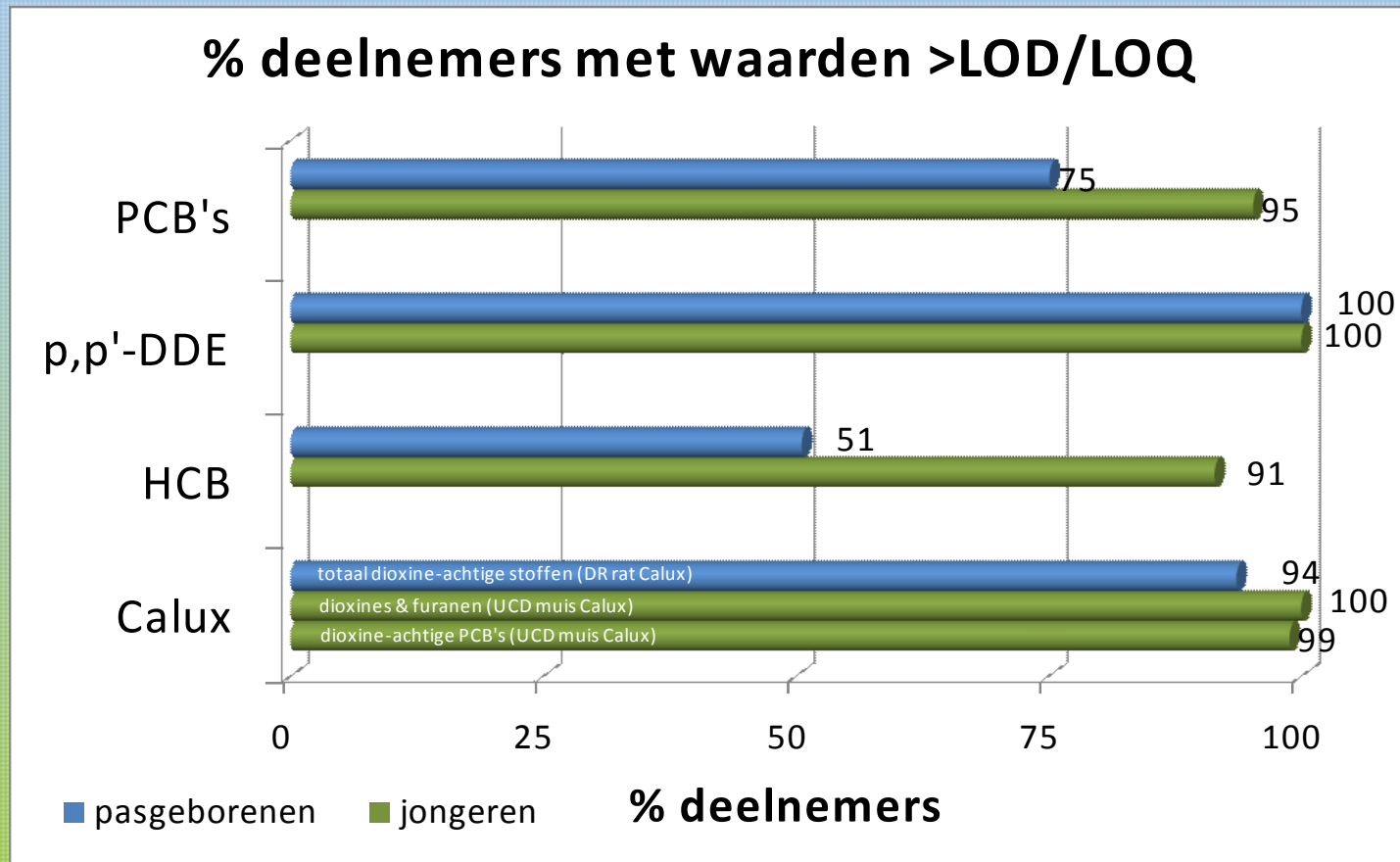
Gender: boys: Pb↑, Th↑, As↓



Life style / environment	Biomarker
Smoking	↑ Cd mothers
	↑ Cd students
	↑ Pb mothers
	↓ As mothers
	↓ As newborns
Urban	↓ As adults
	↑ Cd newborns
	↑ Pb newborns
	↑ Mn mothers
Iron status ↑	↑ Hg students
	↓ Cd students
Fish consumption	↑ As in students
	↑ As and TRA in adults
	↑ Hg and MeHg in students

Chlorinated POPs

markers PCBs, HCB, p,p'-DDE, Calux

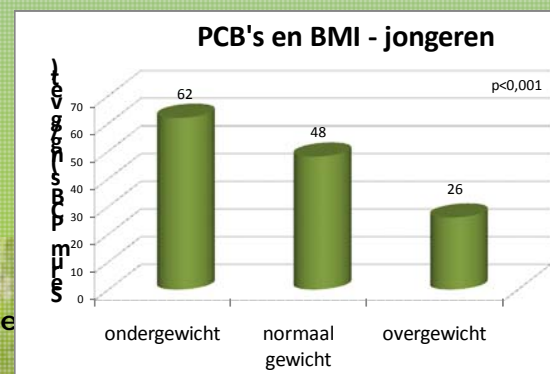
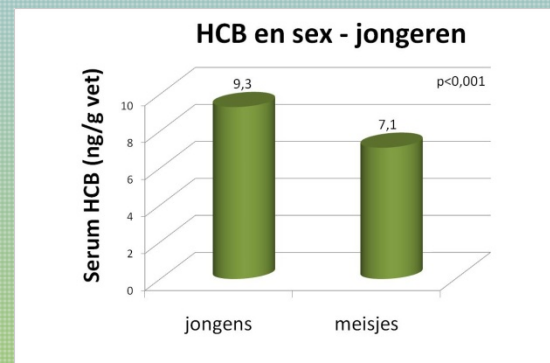
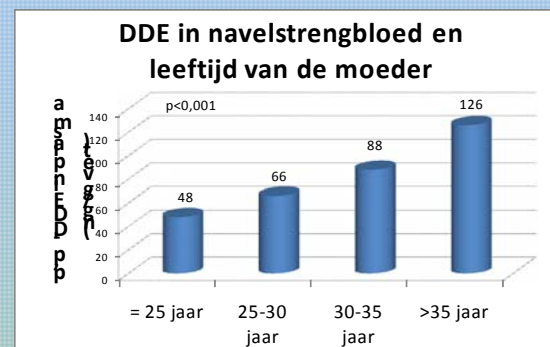


PCBs, p,p'-DDE, HCB, dioxins: person-related factors

Age: significant increase of
POPS with increasing age

Gender: boys > girls

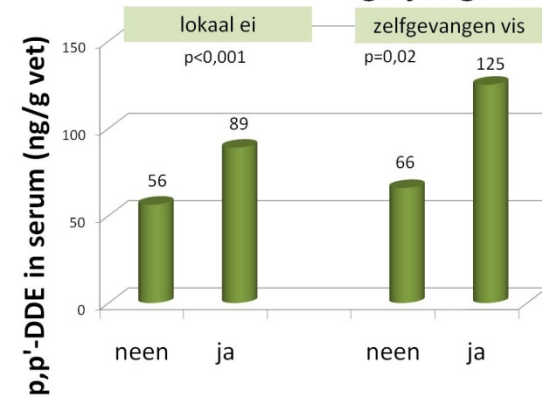
BMI: significant decrease of
POPs with increasing body-
mass index



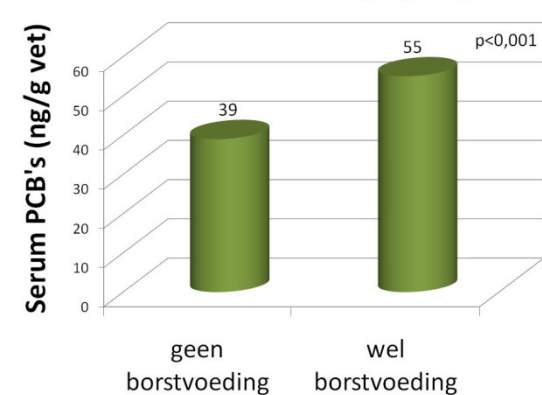
PCBs, p,p'-DDE, HCB, dioxins: environment-related factors

Life style / environment	Biomarker
Local fires	↑ dioxins newborns
Consumption of local eggs	↑ p,p'-DDE newborns ↑ p,p'-DDE students
Consumption of local fish	↑ p,p'-DDE students ↑ HCB students ↑ dioxins students
Breastfeeding	↑ PCBs students

DDE en lokale voeding - jongeren



PCB's en borstvoeding - jongeren



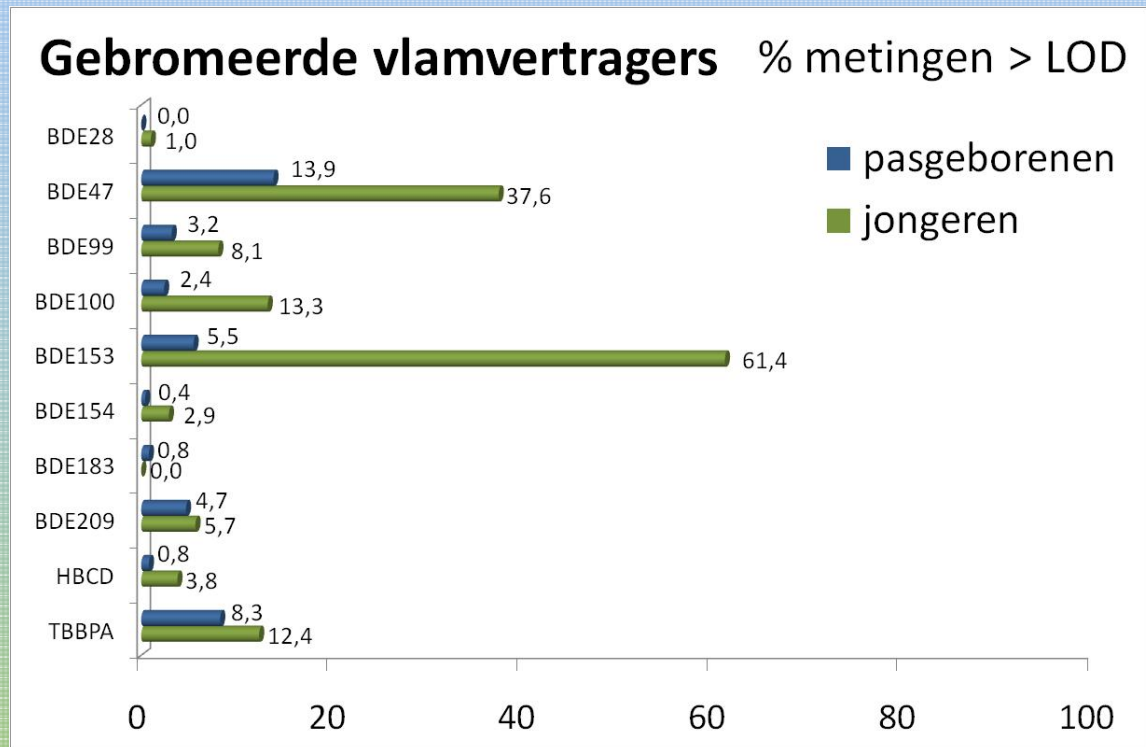
POP's: 1^e vs. 2^e campaign

Age group	Age group	1 ^e campaign	2 ^e campaign
marker PCB's (ng/g fat)	newborn	64 (61-68)	59 (56-63)
	student	68 (66-70)	50 (46-53)
p,p'-DDE (ng/g fat)	newborn	110 (104-116)	78 (72-85)
	student	94 (89-99)	70 (63-78)
HCB (ng/g fat)	newborn	19 (18-20)	9,3 (8,5-10,2)
	student	21 (20-21)	8,3 (7,8-8,9)
Calux (pg TEQ/g fat)	newborn	23 (21-24)	17,5 (16,4 – 18,6)

Decreasing trends, but:

- Difference in sampling strategy
 - 8 areas vs. reference population
 - other characteristics: gender, sex, BMI
- Comparison of chemical analysis ($R^2 = 0,994-1$; recovery = 92-105%)

Brominated POPs



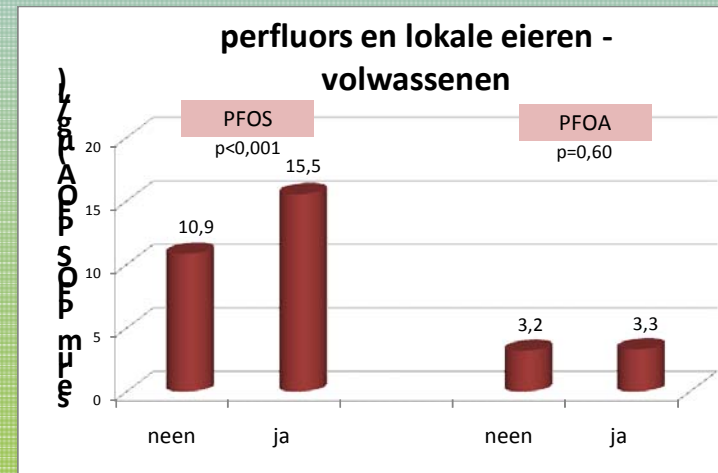
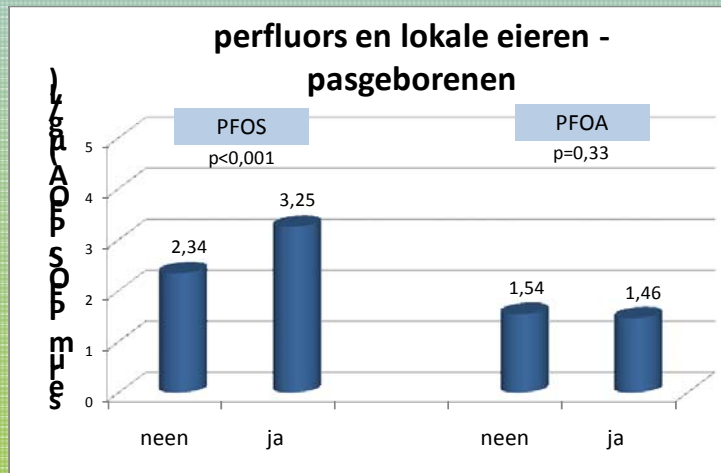
International comparison:

- Europe: most prominent congeners = BDE47 and BDE153
- US: most prominent congeners = BDE99 and BDE100

Perfluor compounds

PFOS, PFOA

- Levels: comparable with international literature
- Personal factors:
 - Men > women
 - Decreasing levels with increasing parity
- Environmental factors: local eggs → higher PFOS



Polycyclic aromatic hydrocarbons (PAHs)

1-hydroxypyrene

- Personal factors
 - women > men
- Environmental & life style factors
 - Increased by smoking: usual – last 3 days – passive smoking
 - BBQ in last 3 days: significantly higher
- Levels: comparable with 1^e campaign and literature

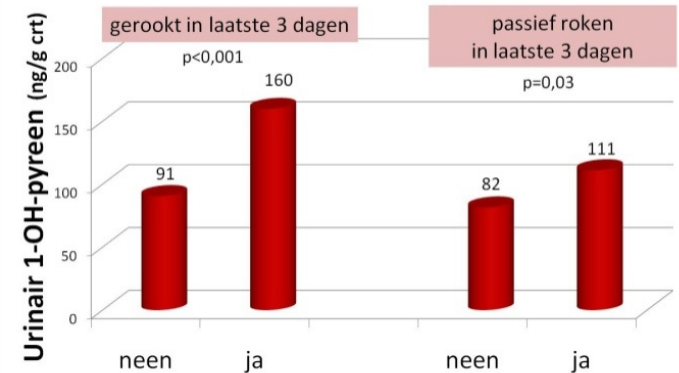
1- en 2-naphtol

- Detectable in 10/10 pools

B[a]P-tetrol

- Detectable in 2/10 pools

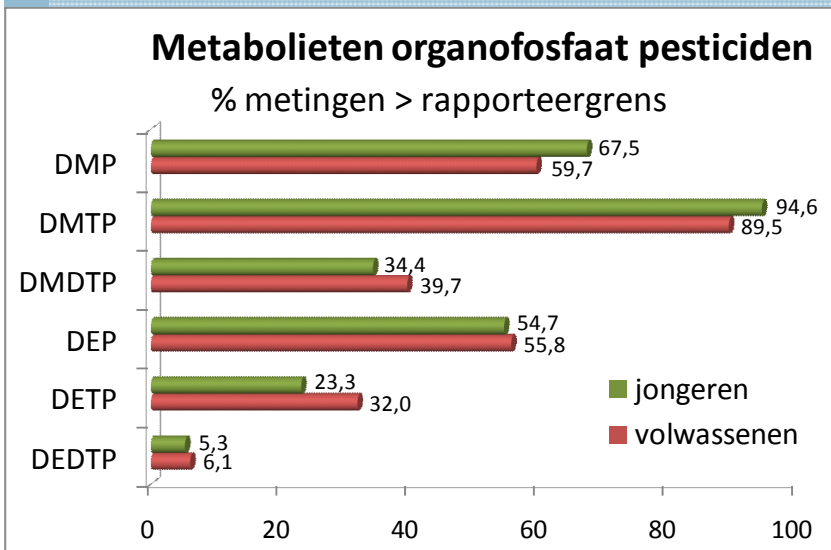
1-hydroxypyreen en recent roken - volwassenen



Organophosphate pesticides

e.g. chlorpyrifos, diazinon, malathion, parathion,...

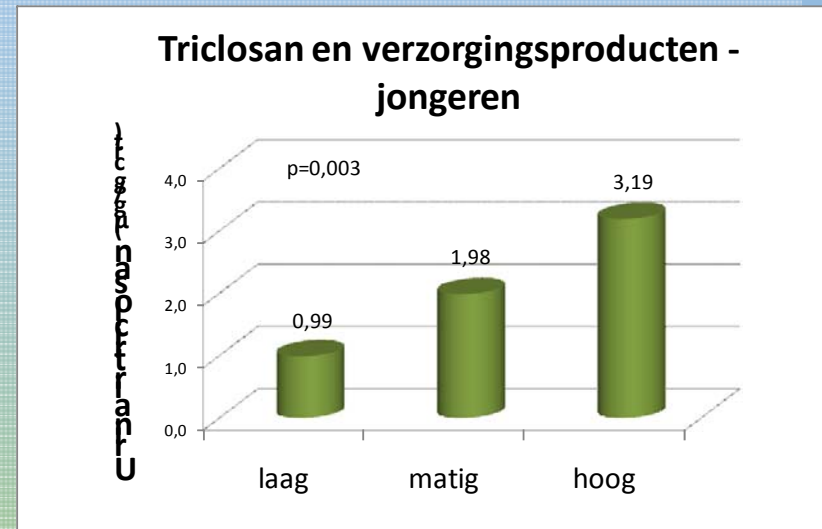
- Women > men
- No relation with use of pesticide (questionnaire)
- Comparison with literature:
 - Similar detection frequencies
 - Levels are comparable with European studies
 - Levels are higher than American studies



Personal care products

musks, triclosan, parabens (HBA)

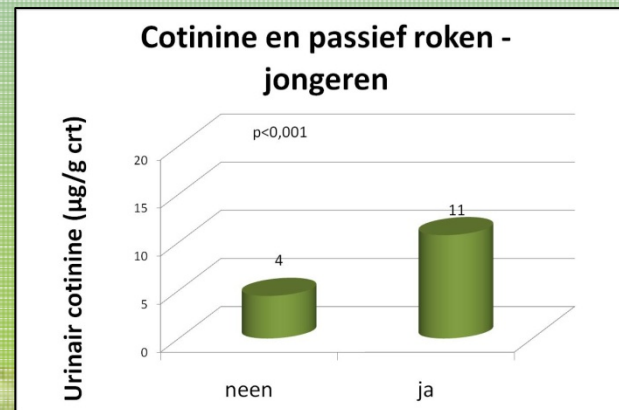
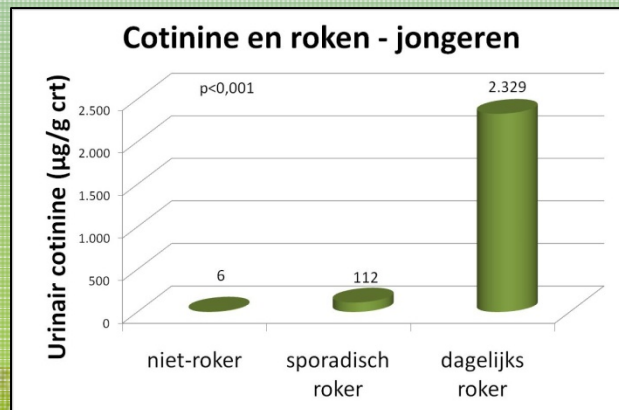
- **Musks, triclosan, HBA:** significantly related to use of personal care products (questionnaires)
- **Musks, triclosan:** girls > boys (\approx questionnaires)
- **Musks:** ASO > TSO > BSO (\neq questionnaires)
- **HBA:** students > adults
- Literature (limited): similar range



Tabacco smoke

Cotinine

- Detection frequency (>LOD: 10 µg/L):
 - Students:
 - non-smokers: 22%; sporadic smokers: 78%; daily smokers: 100%
 - Adults:
 - non-smokers: 24%; spordic smoker: 84%; daily smokers: 100%
- Levels: significantly associated with smoking and with passive smoking (questionnaire data)



Conclusions (1)

- Thanks to a well-defined sampling strategie, a population of 200-250 participants is sufficient to obtain **Flemish reference values** for **biomarkers of exposure**
- Comparison with previous campaign:
 - Decreasing trend for heavy metals and POPs; not for PAHs and benzene
 - Attention for sampling and analytical techniques
- Exposure markers:
 - Associations with personal factors (age, gender, BMI, ...)
 - Associations with life style and environmental factors (smoking, food intake, cosmetic use,)

Conclusions (2)

- Comparison with guidelines and international studies:
 - No alarming trends
 - Regional 'fingerprints', depending on legislation and production processes
- Pooled samples:
 - Evaluation of analytical methods - first estimates
- There is more...
 - Effect markers
 - Perception
- There is more to do...
 - Dose-effect relationships

Partners

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- Spokesmen: Prof. N. Van Larebeke; UGent
- Co-ordination biomonitoring: Prof. G. Schoeters, E. Den Hond, A. Colles, E. Govarts; Vito
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- Social sciences: Prof. I. Loots, B. Morrens, H. Keune; UA
- Nutrition: Prof. S. De Henauw, I. Sioen; UGent
- Statistics: Prof. G. Molenberghs, L. Bruckers; UHasselt
- Epidemiology: Prof. B. Nemery, T. Nawrot; KULeuven
- Neurology (follow-up): Prof. M. Viaene, G. Vermeir; OPZGeel
- Ministry of health: D. Wildemeersch, H. Chovanova
- Ministry of environment: K. Van Campenhout, C. Teughels

Report

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