European week on HBM, Workshop BPA

German Environmental Survey (GerES) IV
BPA in urine of German children

Marike Kolossa-Gehring, Kerstin Becker,
Federal Environment Agency - Toxicology, Health-related Environmental Monitoring

Thomas Göen, Mathias Wittassek
University of Erlangen-Nuremberg
Institute and Outpatient Clinic of Occupational, Social and Environmental Medicine
Outline

German Environmental Survey on Children

- GerEs study design
- BPA results
- Calculation of daily intakes
- Data comparison
- Conclusions
Objectives of GerES

• Generate representative data on exposure to environmental pollutants

• Identify relevant exposure pathways

• Propose strategies on prevention and reduction of exposure

• Evaluate environmental policy measures
Political commitments

WHO Europe

Action plan Environment & Health

UNCED Agenda 21

Ministry for Environment Ministry of Health

Environmental monitoring obligation to report

Health-related environmental monitoring

Environmental Survey

Environmental Specimen Bank
Study design of GerES IV

- 1,790 children (3 to 14 yrs.)
- from 150 sampling locations
- Representative with regard to
  - Age,
  - Gender,
  - Community size and
  - Region
- Field work: 2003 – 2006
- Subsample of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) conducted by the Robert Koch Institute (RKI)
Environmental exposure

Instruments

- Human Biomonitoring
- Ambient Monitoring
- Audiometry
- Questionnaires regarding exposures

Environmental factors

- chemical
- physical
- biological
Instrument: Human Biomonitoring

**Blood:** Cd, Pb, Hg
persistent organochlorines
(DDE, PCB, HCH, HCB)

**Urine:** As, Cd, Hg, Ni, U
nicotine, cotinine
PCP and other chlorophenols
PAH metabolites
pyrethroid metabolites
organophosphate metabolites
phthalate metabolites
Bisphenol A
**Instrument: Ambient monitoring**

**House dust:** DDT, HCH, HCB, PCB; PCP, chlorpyrifos (vacuum cleaner bags)

**Drinking water:** Pb, Cd, Cu, Ni, u

**Indoor air:** VOC and aldehydes (passive sampling)
Instrument: Questionnaires

- indoor and outdoor environment
- health information
- socio-economic status
- food consumption
- habits …

European week on HBM, Workshop BPA, December 1st, 2011, Brussels
Endocrine disruptors measured in GerES IV

Values above LoQ [%]

- Beta-HCH
- DDE
- PCB 138
- PCB 153
- PCB 180
- 2,4-DCP
- PCP
- 1-OH-Pyren
- 1-OH-Phenanthenren
- Bisphenol-A
- MnBP
- MbBP
- MBzP
- MEHP
- OH-MiNP
- Oxo-MiNP
- cx-MiNP

European week on HBM, Workshop BPA, December 1st, 2011, Brussels
Sampling and analysis of BPA

599 archived morning urine samples were measured.

Intensive check for blanks.

University of Erlangen-Nuremberg (Dr. Goeen)* according to the analytical method developed by Arakawa et al. (2004) employing GC-MS/MS.

*Institute and Outpatient Clinic of Occupational, Social and Environmental Medicine
Internal Quality control measures (GerES)

Mean: 3.28 µg/l
SD: 0.28 µg/l

VC: 8.7%

European week on HBM, Workshop BPA, December 1st, 2011, Brussels
Simple model for calculating daily intakes

DI [µg/kg\text{bw/day}] = BPA [µg/g\text{crea}] \times CE_{\text{ref}} [g/day] / bw [kg]

DI = daily intake of BPA
BPA = level of BPA in urine
CE = reference value for excretion of creatinine

DI [µg/kg\text{bw/day}] = BPA [µg/l] \times UV_{\text{ref}} [l/kg\text{bw/day}]

DI = daily intake of BPA
BPA = level of BPA in urine
UV = reference value for the urine volume excreted per day

Limitation:
short half life of BPA, but low intra-individual variation on the other hand
Daily intake of BPA (children aged 3-14 years, GerES)

TDI (tolerable daily intake) = 50 µg/kg\textsubscript{bw}/day (EFSA 2006, 2008, 2010)

<table>
<thead>
<tr>
<th>Basis</th>
<th>N</th>
<th>P90</th>
<th>P95</th>
<th>P98</th>
<th>MAX</th>
<th>GM</th>
</tr>
</thead>
<tbody>
<tr>
<td>volume</td>
<td>599</td>
<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
<td>7.0</td>
<td>0.06</td>
</tr>
<tr>
<td>creatinine</td>
<td>597</td>
<td>0.2</td>
<td>0.2</td>
<td>0.4</td>
<td>4.5</td>
<td>0.05</td>
</tr>
</tbody>
</table>

5 children had an intake higher than 1 µg/kg\textsubscript{bw}/day (volume based)

**NHANES data, children aged 6 to 11** (Lakind and Naiman, 2008)

GM: 0.06 µg/kg\textsubscript{bw}/day

P95: 0.31 µg/kg\textsubscript{bw}/day
BPA in urine in different countries

<table>
<thead>
<tr>
<th>Study</th>
<th>Median Level (µ/l)</th>
<th>Age Group</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>GerES IV (2003-2006)</td>
<td>2.7</td>
<td>aged 3 - 14</td>
<td>599</td>
</tr>
<tr>
<td>ESBs (2006)</td>
<td>1.2</td>
<td>aged 20 - 29</td>
<td>60</td>
</tr>
<tr>
<td>NHANES (2003-2004)</td>
<td>3.87</td>
<td>aged 6 - 11</td>
<td>314</td>
</tr>
<tr>
<td>NHANES (2003-2004)</td>
<td>2.7</td>
<td>aged 6 ≥ 60</td>
<td>2,517</td>
</tr>
</tbody>
</table>

European week on HBM, Workshop BPA, December 1st, 2011, Brussels
BPA in urine and age (GerES IV)

Level in urine (µ/l)

<table>
<thead>
<tr>
<th>Years of age</th>
<th>P. 95</th>
<th>GM with 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 5</td>
<td>3,6</td>
<td>2,7</td>
</tr>
<tr>
<td>6 - 8</td>
<td>2,7</td>
<td>2,2</td>
</tr>
<tr>
<td>9 - 11</td>
<td></td>
<td>2,2</td>
</tr>
<tr>
<td>12 - 14</td>
<td>2,4</td>
<td></td>
</tr>
</tbody>
</table>

European week on HBM, Workshop BPA, December 1st, 2011, Brussels
BPA in urine and socio-economic and migration status (GerES IV)

<table>
<thead>
<tr>
<th>socio-economic status (u.s.)</th>
<th>low</th>
<th>intermediate</th>
<th>high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level in urine (µ/l)</td>
<td>13</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>P.95</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>migrant status p ≤ 0.05</th>
<th>migrant</th>
<th>non migrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level in urine (µ/l)</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>GM with 95% CI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

European week on HBM, Workshop BPA, December 1st, 2011, Brussels
Conclusion

The level of BPA in urine of German children

- Is relatively low and comparable to data from other countries

- Is correlated to the age of children and higher than the levels of adults

- Daily intakes are far below the respective PTWI defined by EFSA
GerES website and ESB website

http://www.uba.de/gesundheit-e/survey

http://umweltprobenbank.de/en

European week on HBM, Workshop BPA, December 1st, 2011, Brussels
Thank you for your attention!