Health economic costs of diabetes and bone fractures caused by exposure to chemicals

Lars Drake
Former at Swedish Chemicals Agency
Former at Swedish Agricultural University
Coopted member of SEAC, ECHA
Why these two examples?

• Potential large costs.
• Data!
• No previous studies.

Calculations – combining existing information from different disciplines.
Health costs of Diabetes associated with exposure by some organic environmental toxic substances

- 365 000-400 000 Swedes have diabetes (4%) and it is increasing
- Estimate of economic costs of Diabetes: 8.55 Bln SEK
- Corresponding figure for Cardiovascular deceases: 61.5 Bln SEK
- Probability to get cardiovascular deceases if you have Diabetes is increased 3-4 times
- Life expectancy is reduced by 10 years for persons who have diabetes
- QALY 500 000 to 650 000 SEK/year

Hälsokostnader för Diabetes .... Bilaga 5 in Kemikalieskatt SOU 2015:30 by Lars Drake, Monica Lind and Lars Lind.
Relation between concentration in blood samples and diabetes

• PIVUS-study: 1000 men and women, around 70 years old.

• Significant relations between some environmental toxins and diabetes was shown after correction for impact of overweight and some other factors.
### Population attributable risk (PAR)

<table>
<thead>
<tr>
<th>Substance</th>
<th>PAR-value &gt;median</th>
<th>PAR-value &gt;75 perc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB153</td>
<td>13.0</td>
<td>16.6</td>
</tr>
<tr>
<td>p.p-DDE</td>
<td>34.1</td>
<td>19.4</td>
</tr>
<tr>
<td>MMP</td>
<td>15.2</td>
<td>6.3</td>
</tr>
<tr>
<td>PFNA</td>
<td>5.2</td>
<td>9.0</td>
</tr>
</tbody>
</table>
Cost of lost years

\[400\ 000 \times \frac{10}{80} \times 500\ 000 \times 0.5 \times \text{PAR} = \text{TC life}\]
Costs of hospital and other treatment

• PAR * TC diab = TC chem diab
• Work loss?
• Suffering?
• Includes hospital costs for cardiovascular deceases
Costs of Cardiovascular deceases as a result of having Diabetes

\[
\frac{\text{DIAB} \times \text{PROB}}{(\text{NonDIAB} \times 1 + \text{DIAB} \times \text{PROB})} = \text{SHARE } c,d
\]

\[
\text{SHARE } c,d \times \text{PAR} \times \text{TC card} = \text{TC chemcard}
\]

*Only informal treatment costs*
Sum of costs Bln SEK per year

<table>
<thead>
<tr>
<th>Substance</th>
<th>Diab + Cardio</th>
<th>including lost lifes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB153</td>
<td>1.16</td>
<td>2.78</td>
</tr>
<tr>
<td>P.p-DDE</td>
<td>3.24</td>
<td>7.51</td>
</tr>
<tr>
<td>MMP</td>
<td>1.36</td>
<td>3.26</td>
</tr>
<tr>
<td>PFNA</td>
<td>0.45</td>
<td>1.10</td>
</tr>
<tr>
<td><strong>Sum (PAR 0.5)</strong></td>
<td><strong>4.98</strong></td>
<td><strong>11.23</strong></td>
</tr>
</tbody>
</table>
Conclusion: Diabetes

✓ Pathways of exposure?
✓ Biological/chemical mechanisms causing Diabetes?
✓ Relation established.
✓ Low precision - indicates level of magnitude
✓ Changes over time
Bone fractures caused by Cadmium intake

Health effects of Cadmium
• Bone fractures
• Kidney damage
• Fertility (suspected)
• Genetic (suspected)

Flows of Cd in the agriculture and food system

• Concentration of Cadmium in P-ferilizers
  1970 ~ 150 mg Cd/kg P (» increase in soil concentration)
  2010 ~ 5 mg Cd/kg P (» reduction in soil concentration)

• Wet and dry deposition

• Manure

• Mineral fertilizers P

➢ Soil stock, i.e. slow process!
➢ Food import!
Content of cadmium in some food products

High: spinach, cereals, rice, potatoes
Low: milk, cheese, fish, meat
Cost of bone fractures due to Cadmium intake

• Two studies based on calculation of cadmium content in different food. One dissertation for women and one for men.
  • PAR women 13 %
  • PAR men, 7 %
  • (PAR, 11 %)
Cost calculation

Total costs for fractures in Sweden:
(hospital, other care, reduced life quality, death, but not work loss)

39 Bln SEK/year

39 * 0.11 = 4.2

Cost caused by intake of cadmium in food:
4.2 Bln SEK/year
Conclusions

One chemical and one effect for one country: 400 million euros.

(EU has 50 times the population of Sweden)

- Solution in the short run avoid food with high content of Cd.
- Solution in the long run 1. decadmiate the phosfate and 2. use less coal and improve abatement technology used.
Concluding discussion

• Diabetes and Bone fracture studies 0.2-0.5 % of GDP

• All health costs of chemical exposure ~~ 1 - 3 % of GDP

• Health impacts are larger than costs of chemicals policy