



IMPACT OF THE CHANGES IN WHO TEF VALUES FROM 1998 TO 2005 ON THE TOTAL TEQ VALUES IN SERUM, HOUSEHOLD DUST AND SOIL

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Introduction and Objectives

- The University of Michigan Dioxin Exposure Study (UMDES) previously calculated the toxic equivalency (TEQ) values based on WHO 1998 toxicity equivalency factors (TEFs) in blood, household dust, and soil from a sample of adults in Michigan, USA.
- In June 2005, the TEFs for the 29 dioxin-like compounds were reevaluated in a WHO expert meeting in Geneva, Switzerland and new WHO 2005 TEFs were presented. TEFs for 14 of the 29 congeners were changed (**Table 1**) causing an expected 10-25% decrease in calculated blood TEQ for a general population. All TEQ values in our study have been recalculated based on the WHO 2005 TEFs.
- The Objective of this presentation is to discuss the changes in TEQ values, after implementation of 2005 TEFs.

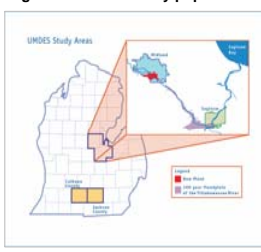
Methods

- A total of 946 blood samples, 764 household dust samples and 766 soil house perimeter top 1 inch samples were collected from 5 populations in Michigan (**Figure 1**) using a two-stage area probability household sample design:
 - Midland/Saginaw Floodplain:** within the 100-year floodplain of the Tittabawassee River;
 - Midland/Saginaw Near Floodplain:** within the census block of the Floodplain, but outside the Floodplain;
 - Other Midland/Saginaw:** the other Midland/Saginaw areas;
 - Midland/Saginaw Plume:** down wind of Dow Chemical Company;
 - Jackson/Calhoun counties** (reference population): located about 100 miles south of Dow Chemical Company.
- All statistical analyses accounted for sample weights that reflect selection and non-response probabilities.

Table 1: Changes in WHO TEF values

Compound	WHO 1998 TEF	WHO 2005 TEF	Change
OCDD	0.0001	0.0003	↑
1,2,3,7,8-PeCDF	0.05	0.03	↓
2,3,4,7,8-PeCDF	0.5	0.3	↓
OCDF	0.0001	0.0003	↑
PCB 81	0.0001	0.0003	↑
PCB 149	0.01	0.03	↑
PCB 105	0.0001	0.00003	↓
PCB 114	0.0005	0.00003	↓
PCB 118	0.0001	0.00003	↓
PCB 123	0.0001	0.00003	↓
PCB 156	0.0005	0.00003	↓
PCB 157	0.0005	0.00003	↓
PCB 167	0.00001	0.00003	↑
PCB 189	0.0001	0.00003	↓

Figure 1: UMDES study populations



Results

Table 2 presents the Median TEQ values (ppt) based on WHO 1998 TEFs and 2005 TEFs, respectively, and the % change after the implementation of new TEFs, for blood, household dust, and soil (house perimeter top 1 inch) in our study.

The TEQ values based on WHO 2005 TEFs were lower than the TEQ values based on WHO 1998 TEFs, across blood, dust and soil samples.

Table 2: Median TEQ values (ppt)

Population	Blood Median TEQs			Household Dust Median TEQs			Soil* Median TEQs					
	N	WHO 1998	WHO 2005	% Change	N	WHO 1998	WHO 2005	% Change	N	WHO 1998	WHO 2005	% Change
M/S Floodplain	243	31.5	23.3	-26%	205	17.1	16.4	-4%	203	12.6	11.4	-10%
M/S Near Floodplain	205	29.0	21.9	-24%	161	12.3	11.6	-6%	164	4.3	3.9	-9%
Other M/S	204	28.0	20.7	-26%	168	18.7	17.6	-6%	173	5.7	5.3	-7%
M/S Plume	43	24.0	18.7	-22%	32	35.2	34.2	-3%	32	59.2	58.2	-2%
Jackson/Calhoun	251	24.8	18.5	-25%	198	14.4	13.8	-4%	194	3.6	3.6	0%
Overall	946	26.4	19.6	-26%	764	17.3	16.2	-6%	766	4.8	4.5	-6%

Soil*: soil concentration for the house perimeter top 1 inch

Table 3 presents the percent contribution of PCDDs, PCDFs, and PCBs to total TEQ values based on WHO 1998 TEFs and 2005 TEFs, respectively.

Table 3: Percent contribution to TEQs for PCDDs, PCDFs, and PCBs.

Percent contribution to the TEQ (%)		WHO 1998	WHO 2005	Changes
Blood	PCDDs	48.65	64.72	+16.07
	PCDFs	16.83	16.43	-0.4
	PCBs	34.53	18.85	-15.68
Household Dust	PCDDs	59.51	66.79	+7.28
	PCDFs	16.95	15.62	-1.33
	PCBs	23.54	17.59	-5.95
Soil*	PCDDs	49.44	54.35	+4.91
	PCDFs	36.2	32.07	-4.13
	PCBs	14.36	13.58	-0.78

Soil*: soil concentration for the house perimeter top 1 inch

Due to the down-weighting of the majority of mono-ortho substituted PCBs (see **Table 4** for details).

Due to the down-weighting of 23478-PeCDF (1998 TEF=0.5, 2005 TEF=0.3), which accounted for 18% to the total TEQ based on 1998 TEFs (See **Table 5** for details)

Results, cont.

Table 4: Percent contribution to Blood TEQ

Percent contribution to the TEQ (%)	WHO 1998	WHO 2005
2378-TCDD	7.25	6.58
12378-PeCDD	20.59	27.29
123478-HxCDD	1.98	2.61
123678-HxCDD	14.63	19.49
123789-HxCDD	2.47	3.23
1234678-HpCDD	1.62	2.1
OCDD	0.11	0.42
2378-TCDF	0.23	0.3
12378-PeCDF	0.11	0.09
23478-PeCDF	10.86	6.69
123478-HxCDF	2.19	2.88
123678-HxCDF	2.11	2.77
123789-HxCDF	0.42	0.54
234678-HxCDF	0.5	0.64
1234678-HpCDF	0.37	0.47
1234789-HpCDF	0.84	0.85
OCDF	-0.005	-0.005
PCB 77	-0.005	-0.005
PCB 81	-0.005	-0.005
PCB 126	0.6	11.41
PCB 169	0.81	3.32
PCB 105	0.85	0.35
PCB 114	2.04	0.17
PCB 118	4.2	1.73
PCB 123	0.06	0.03
PCB 156	14.42	1.23
PCB 157	3.26	0.28
PCB 167	0.06	0.24
PCB 189	0.21	0.09

Table 5: Percent contribution to Soil TEQ.

Percent contribution to the TEQ (%)	WHO 1998	WHO 2005
2378-TCDD	14.56	15.4
12378-PeCDD	14.37	15.37
123478-HxCDD	1.78	1.9
123678-HxCDD	4.53	4.83
123789-HxCDD	3.79	4.04
1234678-HpCDD	9.59	10.19
OCDD	0.82	2.61
2378-TCDF	3.44	3.99
12378-PeCDF	1.12	0.77
23478-PeCDF	18.02	12.28
123478-HxCDF	3.14	3.49
123678-HxCDF	3.49	3.81
123789-HxCDF	0.74	0.82
234678-HxCDF	2.68	2.93
1234678-HpCDF	3.34	3.59
1234789-HpCDF	0.16	0.17
OCDF	0.07	0.21
PCB 77	0.04	0.05
PCB 81	-0.005	0.01
PCB 126	10.93	12.24
PCB 169	0.16	0.53
PCB 105	0.88	0.21
PCB 114	0.11	0.01
PCB 118	1.11	0.4
PCB 123	0.03	0.01
PCB 156	1.1	0.08
PCB 157	0.28	0.02
PCB 167	0.01	0.03
PCB 189	0.02	0.01

The orange-shaded values indicate the 7 congeners that had the highest contribution to the total TEQ.

Conclusions

- TEQ-2005 were recalculated
 - Compare to TEQ-1998
 - For blood, overall Median TEQ decreased by 26%;
 - For dust, overall Median TEQ decreased by 6%;
 - For soil, overall Median TEQ decreased by 6%.
- The percent contribution to TEQ-2005 for PCDDs, PCDFs and PCBs were recalculated
 - Compare to TEQ-1998
 - The contribution of PCDDs increased 16% for blood, 7% for dust and 5% for soil;
 - The contribution of PCDFs decreased a small percent (less than or around 1%) for blood and dust, but 4% for soil;
 - The contribution of PCBs decreased 16% for blood, 6% for dust and 1% for soil.
- Among the 7 congeners (2378-TCDD, 12378-PeCDD, 123678-HxCDD, 23478-PeCDF, PCB 126, PCB 118, PCB 156) that had the highest contribution to the blood TEQ-1998, PCB 118 and PCB 156 together contributed only 3% and were not among the top 7 contributed congeners to TEQ-2005.

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