

**RECALCULATION OF U.S. BACKGROUND
DIOXIN BLOOD SERUM LEVELS**

SIGNIFICANCE TO TITABAWASSEE RIVER RESIDENTS

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Introduction

A number of studies of dioxin blood serum levels have been or are being conducted in the Saginaw Valley of Michigan to determine the impact of wide-spread TCDD and dioxin contamination in the area as the result of historic manufacturing operations and waste management practices by The Dow Chemical Company, Midland, MI.

The studies generally reference Patterson DG, *et al*, Age Specific Dioxin TEQ Reference Range, *Organohalogen Compounds*, Vol 66 (2004) to provide a comparison against background levels of dioxins found in the blood serum of U.S. residents supposedly never knowingly exposed to known sources of dioxins, other than diet or normal background environmental levels in the soil, water and atmosphere.

Flaws in the Patterson Study

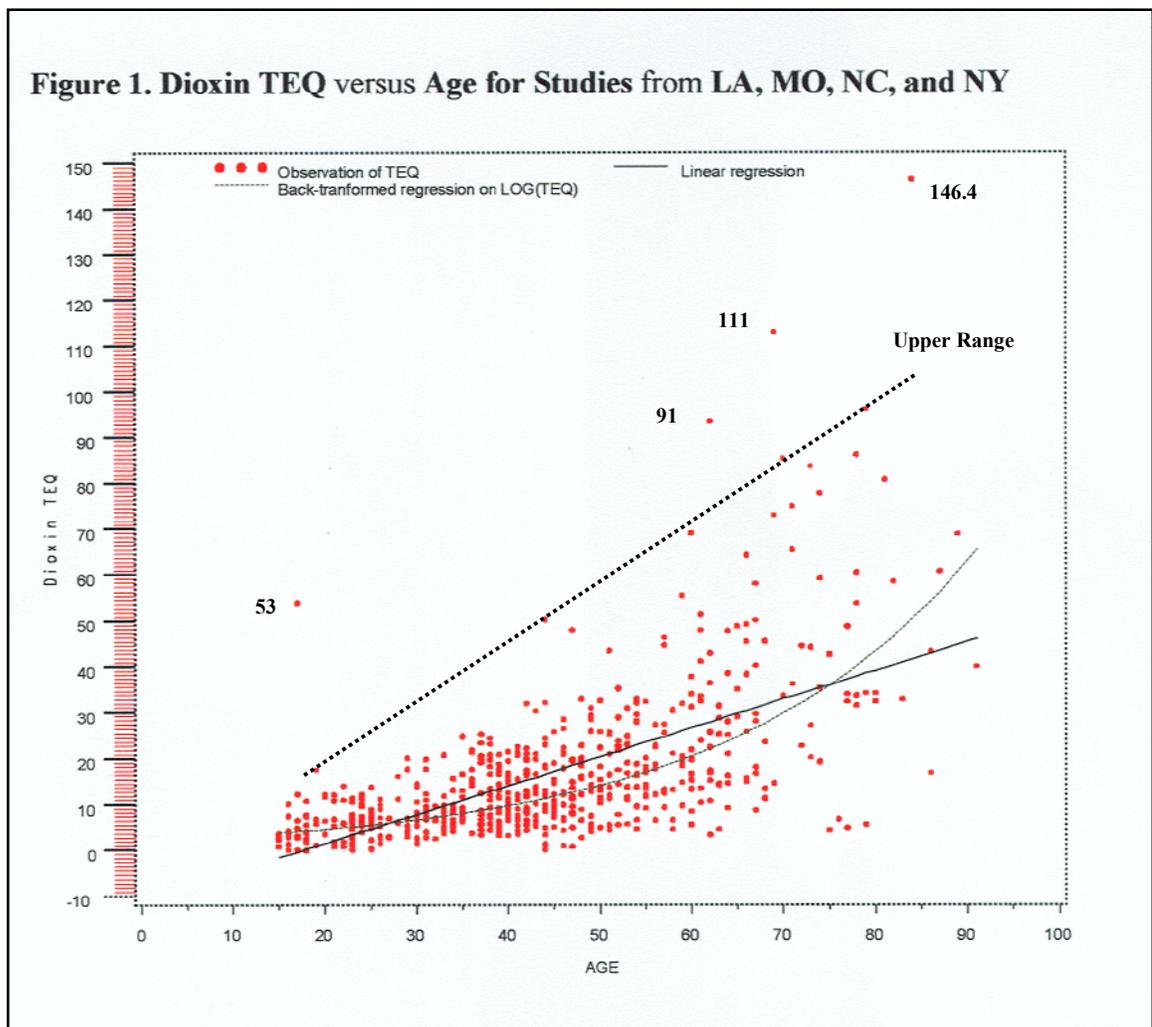
The *Patterson* study failed to exclude four (4) subjects that were found to have extremely high dioxin blood serum levels in comparison to the other 584 blood serum levels analyzed in the study. If the four abnormal blood levels had been excluded from the study, the ranges of background dioxin serum levels would have been significantly lower than reported.

Figure 1 on the following page is a chart of the data presented in *Patterson*. The four abnormal blood levels and their values are shown on the chart.

Dr. Patterson has indicated¹ that the four abnormal serum levels could be attributed to two main possibilities:

- a. The four subjects had been exposed to high levels of dioxins and were not aware of the exposure;
- b. The four subjects eliminate dioxins from their blood serum at a biological rate that is much slower than the normal U.S. population. Assuming that baseline

dioxin levels for the average subject and the four abnormal subjects are the same at birth, half life calculations suggest that the four abnormal subjects could have a dioxin elimination rate that is 60% of the average found in the U.S. population.



Patterson DG, Age Specific Dioxin TEQ Reference Range, Organohalogen Compounds, Vol 66, pg 2878-2883 (2004)

¹ Email response to DioxinSpin.com, July 22, 2005

Whatever the reason for the very high dioxin blood serum levels in the four subjects, there is sufficient justification to exclude the four subjects from the study.

Table 1 shows the impact of excluding the four abnormal blood serum levels from the range of serum levels found in the study. It should be noted that the various percentile ranges (P75, P90, P95) calculated in *Patterson* are not significantly impacted since the percentiles are based on the number of blood serum levels below a certain value and not the values themselves.

Patterson did not provide information on specific age groups older than 60 years of age even though the data that was collected did allow for greater detail. Table 1 also provides an estimate of the blood serum levels for the older age groups.

Table 1 – Recalculated Dioxin TEQ Reference Range By Age Group

<u>Year</u>	2000	2000	2004
	CDC/ATSDR (a)	Recalculated (b)	Recalc.
	<u>Range</u>	<u>Range</u>	(b)(c)
<u>Age Group</u>	(ppt-TEQ)	(ppt-TEQ)	(ppt-TEQ)
15-29	0 - 53.9	0 - 17.5	0 - 12.9
30-44	0.2 - 55.4	0.2 - 32.0	0.1 - 23.5
45-59	0.8 - 55.4	0.9 - 46.0	0.7 - 33.8
60+	3.4 - 146.4	3.4 - 97.5	2.5 - 71.6
60-69	nr	3.4 - 88.0	2.5 - 64.7
70-79	nr	4.0 - 97.5	2.9 - 71.6
80-90	nr	19.0 - 82.0	14.0 - 60.3

As can be seen, excluding the four abnormal dioxin blood serum levels has a profound effect on the background ranges of the U.S. population not exposed to high levels of dioxins other than in the diet or from background levels of dioxin in the environment.

In general, inclusion of the four abnormal dioxin serum levels can lead to an erroneous conclusion that background dioxin blood serum levels are much higher than they actually are.

Adjustment For Continued Degradation of Dioxin Serum Levels

The *Patterson* study was based on blood serum data obtained in three different years: 1996 (29 subjects), 1997 (144 subjects) and 2001 (414 subjects). *Patterson* did not provide any information if the blood serum levels were standardized to a common year to compensate for continued biological degradation in serum levels from 1996 to 2001. Since no information was provided, it is assumed that standardization was not carried out and blood serum levels were used “as is” regardless of the year in which blood samples were taken and analyzed.

Although an exact calculation can not be made without access to all the data used in *Patterson*, the “weighted average” date of the serum level data is “2000”.

Subsequent studies of the dioxin serum levels of various populations that referenced their findings to *Patterson* failed to compensate for the additional reduction in background serum levels that would be expected with time. For example, The Dow Chemical study of the dioxin serum levels of some of its chlorophenol workers was based on blood samples taken in 2004 while referencing the *Patterson* data with a sampling year of 2000. A more correct comparison would have been to adjust the *Patterson* findings to 2004.

Table 2 shows the expected reduction of U.S. background dioxin blood serums levels with time using an average TEQ half-life of 9 years.

Table 2 : Reduction of U.S. Background Dioxin Blood Serum Levels by Year

<u>Year</u>	2000	2000	2004	2006	2008	2010
	CDC/ATSDR (a)	Recalculated (b)	Recalc.	Recalc.	Recalc.	Recalc.
	<u>Range</u>	<u>Range</u>	(b)(c)	(b)(c)	(b)(c)	(b)(c)
	(ppt-TEQ)	(ppt-TEQ)	(ppt-TEQ)	(ppt-TEQ)	(ppt-TEQ)	(ppt-TEQ)
<u>Age Group</u>						
15-29	0 - 53.9	0 - 17.5	0 - 12.9	0 - 11.0	0 - 9.5	0 - 8.1
30-44	0.2 - 55.4	0.2 - 32.0	0.1 - 23.5	0.1 - 20.2	0.1 - 17.3	0.1 - 14.8
45-59	0.8 - 55.4	0.9 - 46.0	0.7 - 33.8	0.6 - 29.0	0.5 - 24.8	0.4 - 21.3
60+	3.4 - 146.4	3.4 - 97.5	2.5 - 71.6	2.1 - 61.4	1.8 - 52.7	1.6 - 45.1
60-69	nr	3.4 - 88.0	2.5 - 64.7	2.1 - 55.4	1.8 - 47.5	1.6 - 40.7
70-79	nr	4.0 - 97.5	2.9 - 71.6	2.5 - 61.4	2.2 - 52.7	1.9 - 45.1
80-90	nr	19.0 - 82.0	14.0 - 60.3	12.0 - 51.7	10.3 - 44.3	8.8 - 38.0

(a) *Patterson DG*, Age Specific Dioxin TEQ Reference Range
 (b) Excludes 4 abnormal blood serum levels
 (c) TEQ half-life = 9 yrs.

Comparisons between dioxin blood serum levels currently being found in Michigan residents and U.S. background levels are valid only when the study year and the reference population year are the same.

Re-examination of Dioxin Blood Serum Levels in Tittabawassee River Residents

Table 3 is a restatement of the comparison between dioxin blood serum levels found in Tittabawassee River residents that participated in the Pilot Exposure Investigation of serum levels conducted by the Michigan Department of Community Health (MDCH) and background blood serum levels as reported in *Patterson* and background levels adjusted to 2005 and excluding the four abnormal blood serum levels also reported in *Patterson*.

Table 3 : Comparison of Total Dioxin TEQ levels (pg/g of lipid, ppt-TEQ) from the MDCH Pilot Exposure Investigation (PEI) to Non-adjusted and Adjusted Background Estimates by Age Group.

Study	Age Group	Mean	Range
PEI	45 - 59	26.8	16.7 - 37.4
Background - Unadjusted (a)	45 - 59	16.9	0.8 - 55.4
Background - Adjusted (b)	45 - 59	16.9	0.6 - 31.3
PEI	60+	40.2	17.7 - 74.7
Background - Unadjusted (a)	60+	36.1	3.4 - 146.4
Background - Adjusted (b)	60+	36.1	2.3 - 66.3

(a) *Patterson*, as reported
(b) *Patterson* adjusted to 2005 and excluding 4 abnormal serum levels

Adjustment of the *Patterson* findings to 2005 and exclusion of the four abnormally high dioxin serum levels indicates that Tittabwassee River residents have dioxin blood serum levels that are higher than the estimated U.S. background serum levels. While the maximum serum levels found in the PEI are not appreciably different than the maximum levels found in the U.S. population, the minimum levels found are significantly higher. The increase in the lower range of serum levels indicates a greater exposure to dioxins of an extended period of time.

The impact on human health from industrial exposure levels of dioxins has been well established. What is less certain is the impact of lower exposure levels for longer periods of time that have been incurred by some Michigan residents.