

Agent Orange, dioxins and other chemicals of concern in Vietnam: Update 2005

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Abstract

This paper summarizes and updates our studies of blood levels in Vietnamese of TCDD from Agent Orange as well as of PCDDs, PCDFs, PCBs and of various pesticides (not from Agent Orange). These studies, begun in 1970, include more than 4,000 blood samples and are now augmented by 60 samples from three new postulated dioxin hot spots. We found 12 hot spots with elevated TCDD, possibly resulting from spillage or leakage of Agent Orange, rather than from the spraying alone which occurred during the years 1962 to 1971. Bien Hoa city was the most contaminated area with marked elevation of TCDD in people of various ages as well as in food, sediment and soil; one soil sample showed over one million ppt. Current levels in humans and foods were similar in Bien Hoa to those that had been measured in the 1970s when the spraying was still going on and spills of Agent Orange were still presumably occurring. In other locations HCH, HCB, dieldrin, oxychlorane, DDT, and DDT metabolites were found in human milk and in food. More recently we found areas with elevated dioxin TEQ from PCBs and, in another location, from PCDFs rather than from TCDD. Dioxin toxicity is still present in certain areas in Vietnam from Agent Orange but also from certain other contaminants, PCBs in one case and PCDFs in another. Health studies relating to Agent Orange and its TCDD contaminant must take into account total dioxin toxicity as measured by qualified World Health Organization certified laboratories, not only TCDD or indirect estimates of TCDD exposure based on spraying records.

Results

No Agent Orange or other herbicides were sprayed in North Vietnam. In the South spraying extended as far north as southern Quang Tri province in the middle of Vietnam. A summary of known areas of Agent Orange spraying and the results of pooled blood analyses by region for TCDD and total TEQ is presented on Table 1¹.

Location	Collection date	Number sampled	TCDD (ppt)	PCDD/F TEQ (ppt)	Range of TCDD/TEQ for each region
Northern Vietnam					
Hanoi Hospital 103	Mar-91	33	1.2	12	TCDD 1.2-2.9 TEQ 12-18
Tay Nguyen (veterans)	Nov-91	35	6.1	40.3	
Central Vietnam					
Thua Thien, Hue	Jan-91	30	11	57	TCDD 2.9-19 TEQ 23-118.2
Da Nang	Feb-91	49	18	77	
Thua Thien, A Luoi	Jan-91	35	15	23	
Da Nang (>40 y)	Aug-92	100	19	118.2	
Southern Vietnam					
Dong Nai, Tri An (Ma Da Forest)	Mar-91	50	12	19	TCDD 1-33 TEQ 8.7-104.6
Dong Nai, Bien Hoa	Mar-91	50	28	47	
Kien Giang, Go Quao	Aug-91	48	10.9	27.5	
Song Be, Tan Uyen	Mar-91	48	32	55	
Ho Chi Minh City, Cho Ray Hospital	Feb-91	48	10.8	30	
Minh Hai, Bac Lieu	Jan-91	50	10.3	34.8	
Can Tho, Tra Noc	Aug-92	102	33	104.6	
Song Be, Tan Uyen (18-40 y)	Aug-92	100	9.4	25.4	
Song Be, Ben Cat	Aug-92	100	12	49.8	

The highest level of TCDD (413 ppt) was found between 1999 - 2001 in a person born in 1973, two years after spraying ended in 1971. Bien Hoa also had findings of elevated TCDD from Agent Orange in food as recently as several years ago^{2, 3} and levels of TCDD in some soil as high as 1,000,000, or more, parts per trillion (ppt) in soil, the highest levels found to date in Vietnam. Findings between 1984-2004 showed certain pesticides in human milk and in food as shown in Table 2²⁻⁴.

	Food	Human milk
α-HCH	+	+
β-HCH	+	+
γ-HCH	+	+
Hexachlorobenzene	+	+
DDT	+	+
DDT metabolites	+	+
Dieldrin	n/a	+
Oxychlorane	n/a	+
n/a = not analyzed		

New data from 60 Vietnamese from three new potential hot spots are shown on Table 3 and Figures 1-3. Blood levels from An Tay Commune, Ben Cat District, Binh Duong Province; Phu My Hung Commune, Cu Chi District, Ho Chi Minh City Province; and Truong Dong Commune, Hao Thanh District, Tay Ninh Province are shown.

Table 3. Blood analysis of 60 Vietnamese persons (ppt, lipid)			
An Tay Commune, Ben Cat District, Binh Duong Province N=20			
	Minimum	Median	Maximum
2,3,7,8-Tetra-CDD (ppt lipid)	0.8	2.2	4.6
TEQ PCDD	3.9	9.9	15.7
TEQ PCDF	4.5	11.3	44.9
TEQ coplanar PCBs	0.9	1.8	5.0
TEQ mono-ortho PCBs	0.7	1.6	4.9
TEQ total	12.9	28.6	63.3
Phu My Hung Commune, Cu Chi District, Ho Chi Minh City N=20			
2,3,7,8-Tetra-CDD (ppt lipid)	2.4	7.3	13.2
TEQ PCDD	6.9	12.6	17.9
TEQ PCDF	6.1	8.5	27.4
TEQ coplanar PCBs	0.8	2.9	6.9
TEQ mono-ortho PCBs	1.3	2.3	4.8
TEQ total	20.5	34.1	53.7
Truong Dong Commune, Hoa Thanh District, Tay Ninh Province N=20			
2,3,7,8-Tetra-CDD (ppt lipid)	0.5	1.5	3.3
TEQ PCDD	2.7	7.5	19.4
TEQ PCDF	1.7	3.6	8.1
TEQ coplanar PCBs	0.9	2.2	5.4
TEQ mono-ortho PCBs	0.2	1.5	5.3
TEQ total	7.7	17.8	39.0

These samples came from three areas heavily sprayed with Agent Orange including Cu Chi where underground tunnels hid National Liberation Front, or NLF, troops. Yet the TCDD (TEQ) levels are not much elevated with the highest level being 13.2 ppt in the Cu Chi area and 4.6 ppt and 3.3 ppt in the other two areas. However in An Tay total TEQ is elevated to 63.2 ppt in Cu Chi to 53.7 ppt and in Truong Dong to 39 ppt. In An Tay and in Phu My Hung PCDF contributes significantly to the elevated TEQ. This is from an unidentified source but the pattern is consistent with metal reclamation somewhere nearby, possibly contaminating the food supply.

Summary and discussion

We added three new locations for evaluation as potential TCDD hot spots and the results of the analyses of 20 blood samples from each of the three are presented here. In these three sites, all heavily sprayed between 1962 and 1971 (but not known to be the site of spills) there was little or no significant elevation of TCDD from Agent Orange. Three more sites were identified and similar analyses are becoming available but are not presented here. We did, however, find elevated dioxin TEQ in some of our subjects which was not from Agent Orange and so these particular sites do not qualify as Agent Orange hot spots. PCBs or PCDFs or PCDDs other than TCDD contributed in some cases to elevated TEQ. Thus, although there are some areas in the south of Vietnam where elevated TCDD levels still persists in humans, food and the environment, other areas, even though heavily sprayed decades previously, show no significant elevation of TCDD in the blood of their inhabitants. Further research is needed to fully characterize areas of residual TCDD contamination from Agent Orange in various locales where it was used. The presence of other toxic compounds such as PCBs, PCDFs, other PCDDs, HCH, HCB, dieldrin, oxychlorane, DDT and DDT metabolites is also cause for concern. Toxicity from these compounds should not be confused with toxicity from Agent Orange.

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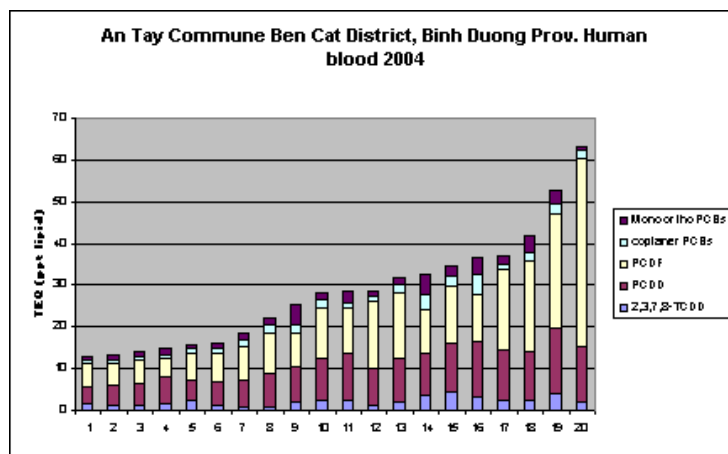


Figure 1. Blood TEQ of individuals in An Tay Commune.

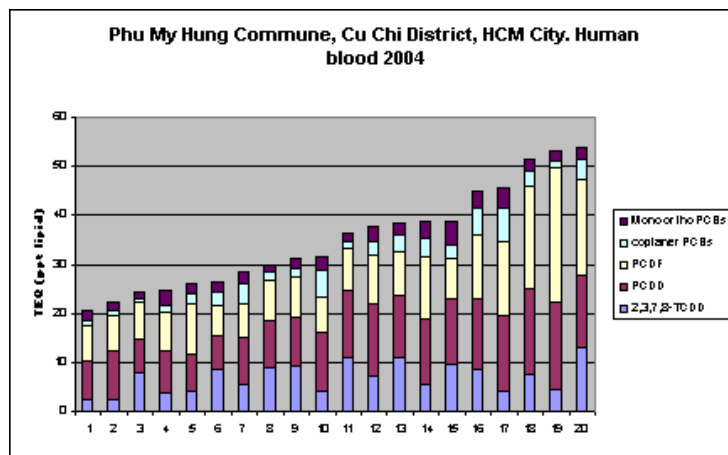


Figure 2. Blood TEQ of individuals in Phu My Hung Commune.

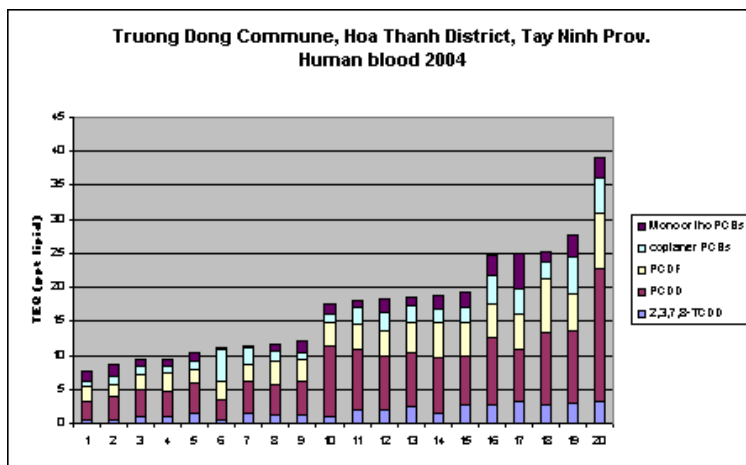


Figure 3. Blood TEQ of individuals in Truong Dong Commune.

References

1. Schechter A, Dai LC, Thuy LT, et al. Agent Orange and the Vietnamese: the persistence of elevated dioxin levels in human tissues. *Am J Public Health* 1995; 85:516-22.
2. Schechter A, Pavuk M, Constable JD, Dai LC, Pöpke O. A follow-up: high level of dioxin contamination in Vietnamese from agent orange, three decades after the end of spraying. *J Occup Environ Med* 2002; 44:218-20.
3. Schechter A, Quynh HT, Pavuk M, Pöpke O, Malisch R, Constable JD. Food as a source of dioxin exposure in the residents of Bien Hoa City, Vietnam. *J Occup Environ Med* 2003; 45:781-8.
4. Schechter A, Fuerst P, Kruger C, Meemken HA, Groebel W, Constable JD. Levels of polychlorinated dibenzofurans, dibenzodioxins, PCBs, DDT and DDE, hexachlorobenzene, dieldrin, hexachlorocyclohexanes and oxychlorodane in human breast milk from the United States, Thailand, Vietnam, and Germany. *Chemosphere* 1989; 18:445-454.