

DIOXIN LEVELS IN VIETNAMESE PEOPLE, FOOD, AND ENVIRONMENTAL SAMPLES: EVIDENCE OF CURRENT CONTAMINATION WITH 2,3,7,8-TCDD FROM AGENT ORANGE SPRAYED OVER 30 YEARS AGO

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Introduction

Agent Orange, a phenoxyherbicide mixture of half 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) was sprayed in massive amounts on about 10 % of southern Vietnam during the Vietnam war between 1962-1971. The mixture, usually sprayed from US Airforce fixed wing aircraft, was contaminated with approximately 3 parts per million (ppm) of 2,3,7,8-tetrachlorodibenzo-p-dioxin, also known as TCDD or "dioxin". The herbicide itself degraded rapidly, but the dioxin contaminant, TCDD, is especially toxic and very persistent. Concern exists about health effects of dioxin among Vietnamese and US veterans who served during the war ^{1,2}.

Beginning in 1970, studies of over 2,000 people living in Vietnam, found certain "hot spots" where TCDD levels in humans or environmental samples from Agent Orange were elevated, as well as studies reporting higher levels in US veterans than usually found in Vietnamese ³⁻⁷. In population based studies, it appeared that human levels of TCDD were declining over time. However, recent blood, soil and sediment samples from Vietnam strongly suggest a reversal of this trend, with current as well as previous exposure of Vietnamese people and the environment to TCDD from Agent Orange last sprayed in Vietnam over 30 years ago ⁸.

Methods and Materials

Between 1998-2000, blood samples were collected from 50 Vietnamese living in Bien Hoa City in southern Vietnam, and a pooled sample from 100 general population residents in the northern Vietnam city of Hanoi. Whole blood was stored in chemically-cleaned glass containers

with anticoagulant and frozen, and hand carried on dry ice from Vietnam to Germany for dioxin analysis. Grab samples of sediment and of soil were collected from the nearby Bien Hung Lake and from the Bien Hoa airbase, where Agent Orange had been stored, respectively. Congener-specific dioxin analysis was performed using high-resolution gas chromatography-mass spectroscopy, as described elsewhere.

Results and Discussion

The blood TCDD data for the first 21 analyses are shown in Table 1. Levels as high as 271 ppt, a 135-fold excess compared to background levels, are seen in one subsistence fish eater, whose family members all have elevated TCDD. Others, born after the spraying ended, or who moved from the north of Vietnam, also show elevated levels. The pooled blood sample from Hanoi and one southern sample have TCDD levels of 2 ppt, which we regard as baseline for Vietnamese.

In Table 2, some sediment samples from downstream of the airbase show elevated TCDD. The soil samples usually were N.D., but in one area on the Bien Hoa airbase over one million ppt of TCDD was found. Some elevation of TCDD can be noted in sediment samples taken downstream of the airbase where a spill of Agent Orange is believed to have occurred in 1970.

Three decades after Agent Orange spraying ended, the finding of elevated TCDD from Agent Orange in fish eaters, children born after Agent Orange spraying ended, and in northerners not previously exposed to Agent Orange who moved to this area where Agent Orange was stored and sprayed, strongly suggests current as well as previous exposure to TCDD from Agent Orange.

There is strong evidence of local TCDD contamination. It is not known how extensive this contamination is nor whether similar contamination exists elsewhere. Given that the potential health consequences of exposure remains to be determined, further research is indicated to document other potential TCDD "hot spots" in Vietnam in order to prevent further contamination of humans and the environment.

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Table 1.
Measured Vietnamese Blood Dioxin Levels, 1999

Sampler Number	Year of Birth	TCDD Level, (ppt lipid basis)
North Vietnam (pooled control, N=100)		
Hanoi	1959-1979	2.0
South Vietnam (Individual Samples)		
1	1942	68
2	1935	74
3*	1981	62
4*	1981	57
5	1945	164
6	1954	271
7*	1980	87
8	1962	101
9	1947	21
10	1962	6.0
11	1950	8.0
12	1942	7.0
13	1955	38
14	1963	103
15	1962	2.0
16	1962	70
17*	1988	67
18	1954	162
19	1952	5.0
20	1930	20

*Individuals born after Agent Orange spraying ended

Table 2.

Bien Hoa City, Vietnam Dioxin Sediment Data, Year 2000 ng/Kg. (ppt), related to dry matter

Congener	Hanoi†	Bien Hung Lake-1			Bien Hung Lake-2			Dong Nai River		Bien Hung Lake-3	
		A	B	C	A	B	C	A	B	1Km. Downstream	1Km. Upstream
2,3,7,8-TCDD	n.d.	10.4	14.5	1.6	177	114	98.2	.8	1.5	1.7	1
Total PCDD	403	199	291	532	1970	1413	1546	543	715	697	497
PCDD TEQ	1.4	11	15.6	3.3	185	120	103	1.6	2.5	3	2.7
Total PCDF	70	9	11	9.9	134	98.8	89.4	2	6.8	18.9	28.5
PCDF TEQ	5.1	0.5	0.77	0.6	8.2	6.05	5.2	0.1	0.4	0.9	1
Total PCDD/PCDF	473	208	302	542	2104	1512	1544	544.5	721	716	526
PCDD/PCDF TEQ	6.5	11.5	16.4	3.9	193	126	108	1.7	2.9	3.9	3.7

n.d.=not detected

TEQs calculated using international dioxin toxic equivalency factors

† Hanoi sample = Northern control sample

Bien Hung Lake-2 Sample : close to former airbase

Bien Hung Lake-3 : downstream and upstream of pipe coming from Bien Hung Lake