

Human Exposure II - Accidental and Occupational Exposure

ELEVATED TISSUE LEVELS FOLLOWING OCCUPATIONAL AND OTHER SPECIAL EXPOSURES TO DIOXINS AND RELATED CHEMICALS

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Introduction

Exposure assessment for dioxins and related compounds began in 1899. The first *indicator* used was skin reaction, especially acne caused by chlorinated organics (chloracne)^{1,2}. This indicator was not sensitive and was not specific to dioxins. In the early 1970's Robert Baughman at Harvard University developed methods for measuring dioxins in human tissue. He demonstrated elevated 2,3,7,8-TCDD (TCDD) in breast milk of Vietnamese women exposed to Agent Orange with levels as high as 200-1,850 ppt on a lipid basis³. He also measured TCDD in fish, the first time this had been accomplished. This work was followed in the early 1980's by the demonstration of TCDD from Agent Orange in adipose tissue of a few American Vietnam veterans by Michael Gross and colleagues at the University of Nebraska⁴; by measurement of various homologue groups in certain exposed workers by Christopher Rappe of the University of Umea in Sweden and Yoshito Masuda of Daiichi College of Pharmaceutical Sciences in Fukuoka, Japan^{5,6}; and by demonstration of dioxin and dibenzofuran congeners in blood and adipose tissue of exposed Binghamton State Office Building workers by Schecter and Tiernan, and later by Schecter and Ryan^{7, 8}. This study also was the first to document dioxins and dibenzofurans in tissues of the general (US) population.

Materials and Methods

We review elevated tissue dioxin, dibenzofuran or PCB findings from a selected number of incidents. These include:

- The Binghamton State Office Building PCB transformer fire of 1981⁷
- New York City municipal incinerator workers⁹
- German chemical workers from BASF^{10,11}
- The Massachusetts Vietnam veterans Agent Orange study¹²
- The Michigan Vietnam veterans Agent Orange study¹³
- Vietnamese exposed to Agent Orange³
- Chinese agricultural workers exposed to chlorophenols¹⁴
- Ufa, Russia chemical workers and their children¹⁵

- Japanese municipal incinerator workers and their spouses¹⁶

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- General US population contamination, compared to vegans¹⁷
- Russian firefighters potentially exposed to dioxins¹⁸
- Residents of two southern United States industrial towns^{19,20}
- Paper and pulp workers with cancers potentially related to dioxins²¹
- Women's breast milk from highly industrialized regions of Ukraine²²
- The Yusho rice oil poisoning in Japan⁶
- PCDD/F/PCB levels in various organs of Americans, 1980s²³
- Frozen ancient eskimo livers and modern liver levels^{24,25}
- Contaminated breast milk from Palestinian women, 1990s²⁶

At the present time, high resolution gas chromatography/mass spectrometry remains the method of choice, or "gold standard," for determining exposure to dioxins, dibenzofurans, and dioxin-like PCBs. Problems with interpretation include lack of toxicokinetic data for dioxin, dibenzofuran, and dioxin-like PCB congeners. They also include lack of toxic equivalency factors for each endpoint of concern, such as cancer, reproductive, developmental, endocrine, and immune system alterations. In addition, methods are not available to determine genetic sensitivity or lack of sensitivity to dioxins. Further, the toxicity of dioxins in mixtures with other toxic chemicals which sometimes are found in humans is not known.

Results and Discussion

The findings of each of these case studies which were performed between 1981 and 1998 showed different patterns of elevated dioxin and dibenzofuran congeners. The patterns can be compared with the pattern of the usual 7 chlorinated dioxin and 10 chlorinated dibenzofuran congeners as well as coplanar and mono-ortho PCBs found at the same time in comparison populations from the same country.

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