PCDD/PCDF LEVELS IN BREAST MILK FROM AN ETHNICALLY DIVERSE POPULATION NEAR A HAZARDOUS WASTE SITE IN STOCKTON, CALIFORNIA

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Introduction

Little is known about the pattern, extent, or levels of breast milk contamination in California. In the first comprehensive examination of body burdens of persistent dioxin-like organo-chlorine contaminants in a California population, a broad panel of analytes was measured in breast milk samples collected from an ethnically-diverse group of mothers from lower income families in Stockton, California. The study was initiated because of concerns about community consumption of PCDD/PCDF-contaminated fish from waterways adjoining a USEPA National Priorities List (NPL) site. The major pathway for exposure of a residential population to PCDD-PCDF mixtures is normally via the diet, chiefly through the consumption of contaminated fish, poultry, eggs, milk, or animal fat. Relationships between fish consumption and PCDD/PCDF levels in participants were examined in the study.

Materials and Methods

Study design. Procedures from our earlier studies (exposure assessment questionnaire, informed consent, WHO/EURO protocol for breast milk sample collection, and statistical analysis) were followed *(1-5)*. Congener-specific measurements of polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and 3 dioxin-like co-planar polychlorinated biphenyls (PCBs 77, 126, 169) were made in breast milk samples collected in 1998 according to the WHO/EURO protocol *(6)* from first-time mothers ("primiparae") who were participants in two Supplemental Nutrition Programs for Women, Infants, and Children (WIC) in Stockton, California. The participants have low family incomes, which qualified them for the supplemental nutrition benefits of WIC. The two clinics were located 1 and 3 miles from an NPL site (Clinics A and B, respectively) with documented PCDD/PCDF contamination. Breast milk samples (100 ml) were collected from 40 participants recruited from the WIC Clinics (20 each from A and B) following the selection criteria set out in the WHO protocol: donors were healthy first-time (primiparae) or first-lactation mothers, with healthy infants ages 2-8 weeks of age at time of sample collection *(6)*. Preference was given to those women who were long-time (≥ last 10 years) residents of Stockton or who consumed fish regularly.An Informed Consent Form and an Exposure Assessment Questionnaire (EAQ) were administered in the native languages of the Asian/Pacific Islander, Latino, and Filipino populations. The EAQ queried residential and occupational histories, food frequency patterns, smoking status, medication use, and breast-feeding

patterns. Food frequency emphasized fish, querying the source (local vs commercial), preparation (fillet vs whole), and cooking method.

Analytical methods. Breast milk samples were analyzed for the 17 2,3,7,8-substituted PCDD/PCDFs and three selected dioxin-like, co-planar PCBs (PCBs 77, 126, 169) by HRGC/HRMS (5*)*. Residue levels are expressed as pg/g milk lipid. For all reported data, I-TEQs for PCDDs/PCDFs are based upon the WHO-TEQ system *(7)*. Because of the large number of non-detects, an ***adjusted*** I-TEQ (I-TEQ(Adj)) was calculated from the 8 major congeners by assigning one-half MDL values to any of the 8 congener with levels below the MDL

Statistical analysis. Analytical data were stored in EXCEL 5.0 (Microsoft, Redmond, WA) and ACCESS 97 (Microsoft, Redmond, WA), and questionnaire data were stored in ACCESS 97. All statistical analyses were conducted in STATA 5.0 (Stata Corp, College Station, TX). The Wilcoxon rank-sum test was used to compare congener concentrations among primiparae.

Results and Discussion

The ethnic composition of the study population was similar to that of the WIC program participants: 45% Latino, 18% African American, 10% Filipino, 8% American Indian, and 8% Caucasian. Most (65%) breast milk donors had lived most (75%) of their lives in Stockton, and most (75%) of the study participants ate fish, usually catfish or striper, averaging about one fish meal per week. The mean TCDD level (1.54 pg/g) and mean levels of other PCDD/PCDF congeners (I-TEQ(Adj) = 8.2 pg/g) were low in breast milk samples from Stockton, and were one-half of the mean TCDD levels found in samples from the U.S. (3.0 pg/g fat) or from 33 other countries (3.4 pg/g fat), and one-third the mean I-TEQ values (about 20 pg/g) (Table 1) *(8)*. The contribution of TCDD (16.6%) to the I-TEQ was similar to that (17%) found in milk samples from 33 countries *(8)*. Levels of PCDD/PCDF congeners were significantly correlated with one another, and more strongly in Clinic A than B, where levels of OCDD did not correlate with other congener levels. PCDD/PCDF levels in local Stockton fish were 2-5-fold higher than mean levels of miscellaneous fish sampled worldwide *(8-9)*.

Table 1. Mean levels (pg/g fat) of PCDDs and PCDFs in breast milk

Congener	Clinic A	Clinic B	33 countries
TCDD	2.09 0.92		3.4
PentaCDD	5.36	2.41	7.2
123678-HexaCDD	22.67	13.19	26
1234678-HeptaCDD	42.71	18.57	39
OctaCDD	172.1	95.84	180
23478-PentaCDF	4.36	3.10	15
123478-HexaCDF	3.30	3.42	8.4
123678-HexaCDF	2.64	2.32	6.6

Fish consumption was associated with PCDD/PCDF levels in breast milk. In Clinic A, striper consumption correlated with levels of all 8 of the major PCDD/PCDF congeners found in breast milk samples (mean r=0.58), and catfish consumption correlated with 7 of the 8 major congeners (mean r=0.53) (Table 2). I-TEQ(Adj) levels were higher among women who had “ever

eaten" fish (catfish or striper) than among women who had "never eaten" these fish.

Table 2. Correlation coefficients between fish consumption and PCDD/PCDF levels.

	All		Clinic A		Clinic B	
	Catfish	Striper	Catfish	Striper	Catfish	Striper
TCDD	NS*	0.44	0.49	0.68	NS	0.49
PentaCDD	NS	0.40	0.54	0.64	NS	NS
123678-HexaCDD	0.33	0.37	0.62	0.66	NS	NS
1234678-HeptaCDD	0.40	NS	0.58	0.56	NS	NS
OctaCDD	0.34	NS	0.51	0.46	NS	NS
23478-PentaCDF	NS	0.62	NS	0.65	NS	0.65
123478-HexaCDF	NS	0.58	0.44	0.58	NS	0.67
123678-HexaCDF	NS	0.58	0.55	0.57	NS	0.57

*no significant correlation

Some data suggested that eating PCDD/PCDF-contaminated fish was associated with higher levels in breast milk. The correlations between fish consumption and breast milk levels were much stronger in donors from Clinic A, near the NPL site and contaminated fish, than in donors from Clinic B, distant from the site (Table 2). Some data argued against this association. Donors consuming non-river fish had significantly higher I-TEQ(Adj) levels than those consuming river fish (this was also true when looking at donors only from either Clinics A or B, but the differences were not significant). This would not be expected if river fish were a significant source of the PCDD/PCDF contaminants in breast milk.

Congener-specific analysis also detected a distinct difference in levels and patterns of PCDD/PCDF congeners between the cohorts of Clinics A and B. PCDD/PCDF levels in Clinic B were significantly lower (7 of the 8 major congeners) than in Clinic A (Table 1), and congener patterns were more heterogeneous (Figure 1). One donor, a Vietnamese woman who had lived most of her life in Vietnam, had a congener pattern that was quite different (higher levels of 23478-penta- and 123478- and 123678-hexaCDFs) from the pattern of the other donors who had spent most (70-100%) of their lives in Stockton.

The assessment of PCDD/PCDF body burdens in participants is a first step toward a fuller characterization of contaminant levels of persistent organochlorine chemicals in ethnically-diverse populations of California.

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Figure 1a. I-TEQ (Adj) and PCDD/PCDF congener patterns for donors from clinic A

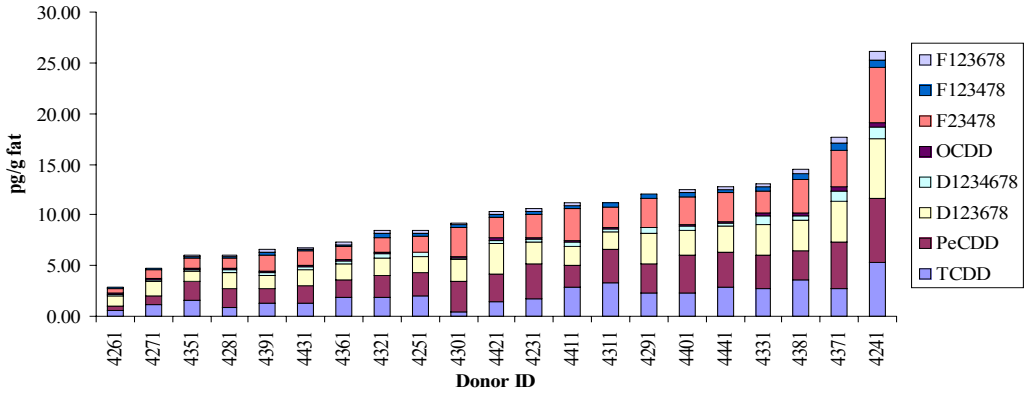

Figure 1b. I-TEQ (Adj) and PCDD/PCDF congener patterns for donors from clinic B