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Organochloride Pesticide Residues in Human Milk in Hawaii, 1979–80

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A number of studies on levels of organochlorine pesticides and polychlorinated biphenyls (PCBs) in human milk have been reported (GRACA et al. 1974, POLISHUK et al. 1977, SAVAGE 1977, STRASSMAN 1977). This paper describes a survey of pesticide residues and PCBs in human milk of residents of Hawaii during 1979-1980.

SAMPLING

All civilian hospitals in Hawaii were ranked according to number of livebirths in 1977; the hospitals were partitioned into four strata containing equal number of hospitals. From each stratum, one hospital was selected at random and samples were allocated proportionally according to the number of births in 1977. Nursing mothers who agreed to participate in the study were selected until the quota for the participating hospital was filled. Ten samples were selected from the Hilo Hospital, two from the Kauai Veterans Memorial Hospital, two from the Wahiawa General Hospital and 36 samples from the Kapiolani-Children's Medical Center.

SAMPLE COLLECTION

From January 1979 to February 1980, milk samples were collected from 50 donors by manual expression into small, pesticide-free, glass bottles. Hind milk, those occurring after several minutes of feeding, were obtained from the mothers. The milk samples were obtained 3-46 days after delivery with a median postpartum time of 16 days. Samples were immediately frozen after collection and stored until analysis. The lipid content of the milk samples averaged 3.2%.

A short questionnaire was completed for each donor, and information on age, race, residence, weight of mother, occupation of household members, interval between birth and sample collection, number of children breastfed, smoking habits, dietary habits, occupational and household exposure to pesticides and use of commercial pest control services were obtained.

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SAMPLE ANALYSIS

The lipids were extracted from the milk by a modification of procedures described by GUIFFRIDA et al. (1966) and CURLEY & KIMBROUGH (1969). Identification and quantification of the pesticides and PCBs were accomplished by electron capture (Ni-63 detector) gas chromatography (THOMPSON 1974). The results of the analyses are reported on extractable lipid basis.

The project laboratory participated in an EPA sponsored quality assurance program as part of the National Study to Determine Chlorinated Hydrocarbon Insecticide Residues in Human Milk. The quality control program consisted of intra- and inter-laboratory components, including confirmation of organochlorine pesticide and PCB residues by gas chromatography-mass spectrometry.

STATISTICAL ANALYSIS

Analysis of the data was accomplished by nonparametric techniques (HOLLANDER & WOLFE 1963). All statistical tests were performed using an error rate of 0.05.

RESULTS AND DISCUSSION

All participants were residents of Hawaii; only two individuals lived Hawaii for less than three years. The donors were predominantly middle class. The average age of the participant was 29 years, and the weight of the mothers ranged from 102 to 175 pounds with a mean of 122 pounds. Only three donors smoked cigarettes. None of the mothers was exposed to pesticides at work, but seven spouses were occupationally exposed to pesticides. All but three of the households used nonpersistent pesticides at home. Seventeen of the homes had been treated by professional control operators.

All milk samples contained p,p'-DDT, p,p'-DDE, heptachlor epoxide, oxychlordane, hexachlorobenzene (HCB) and PCBs. trans-Nonachlor was found in 98%, dieldrin in 92% and alpha and beta isomers of hexachlorocyclohexane (HCH) in 82% of the samples. The mean residue level for p,p'-DDT was 160 parts per billion (ppb) and the mean value for p,p'-DDE was 2000 ppb. Mean levels for HCH, dieldrin, heptachlor epoxide, oxychlordane, HCB, trans-nonachlor and PCBs were 86, 42, 35, 59, 40, 81 and 780 ppb, respectively.

A comparison of pesticide levels in the milk of donors living on Oahu and the Neighbor Islands is presented in Table 1.

Table 1. Distribution of pesticide residue levels in extracted lipids of human milk from women living on Oahu and the Neighbor Islands

Residue	Oahu Residents (n=38)				Neighbor Island Residents (n=12)			
	Mean[1]	Extreme Values		% Positive Samples	Mean[1]	Extreme Values		% Positive Samples
		Minimum	Maximum			Minimum	Maximum	
p,p'-DDT	170	32	520	100	150	32	290	100
p,p'-DDE	2,000	260	5,700	100	1,800	540	3,700	100
HCH	81	0	480	82	74	0	150	83
Dieldrin	41	0	95	95	46	0	79	83
Heptachlor epoxide	36	1	67	100	31	15	52	100
Oxychlordane	61	11	160	100	53	14	110	100
trans-Nonachlor	83	27	210	100	76	0	150	92
HCB	42	18	63	100	33	20	56	100
PCBs	770	16	1,400	100	830	130	1,800	100

[1]Means are ppb on extractable lipid basis.

The mean levels of pesticide residues were generally higher for Oahu residents than the Neighbor Island residents, but the differences were not statistically significant (Mann-Whitney U Test).

The distribution of pesticide residue levels in human milk according to age of donor is shown in Table 2. A standard test of homogeneity of proportions indicated that the level of pesticides was not associated with age of mother.

The relationship between levels of pesticides excreted in milk and the number of children previously nursed was examined, because some investigators have reported that residue levels decrease as the number of children nursed increases (KROGER 1972, SAVAGE 1977, BRADT & HERRENKHOL 1976). The results revealed that the proportion of mothers with high levels of pesticides was not linearly related to the number of children previously breastfed. Variations in excretion of pesticides in milk with sampling period (interval between birth and date of sample collection) were observed, but no apparent trend was evident. The weight of the mothers did not appear to affect the excretion of pesticides in milk.

An inquiry into the dietary habits of the nursing mothers revealed that meat (beef, pork, poultry) and dairy products were the most important foods in their diet. No significant correlation (Spearman's rho) was observed between the intake of meat and dairy products and residues in milk, but individuals who reported higher frequency of meat consumption tended to have higher levels than those who ate meat products less frequently.

Higher residue levels in milk were found among donors living in homes treated by professional pest control operators than in those living in untreated homes, but these differences were not significant. No significant difference was found in residue levels in the milk of women whose spouses were occupationally exposed to pesticides compared to those whose spouses were not exposed. The frequency of household use of non-persistent pesticides did not affect the concentration of pesticides in milk.

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Table 2. Distribution of pesticide residue levels in extracted lipids of human milk according to age of donor

Age Group	18–24		25–29		30–34		35–37	
No. of Donors	9		17		16		8	
Pesticide	Mean, ppb[1]	SD	Mean, ppb[1]	SD	Mean, ppb[1]	SD	Mean, ppb[1]	SD
p,p'-DDT	160	62	140	79	200	140	150	66
p,p'-DDE	1,500	850	1,700	940	2,300	1,200	2,300	1,700
HCH	51	24	74	43	78	41	140	150
Dieldrin	45	27	37	20	43	16	46	19
Heptachlor epoxide	35	11	31	13	37	12	40	15
Oxychlordane	57	10	53	25	59	29	71	48
trans-Nonachlor	71	13	76	39	79	31	100	54
HCB	37	9	34	10	43	21	51	23
PCBs	860	180	820	410	630	410	910	580

[1]On extractable lipid basis.

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