SERUM DDT/DDE LEVELS IN WOMEN OF CHIAPAS, MEXICO

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Introduction

1,1,1-Trichloro-2,2-bis(*p*-chlorophenyl)ethane (DDT), an organochlorine pesticide, has been used to control agricultural pests and disease-bearing vectors since 1943. Extremely effective and inexpensive, DDT was used liberally worldwide until its negative impact on the environment was revealed, prompting the United States and other countries to ban its use in the early 1970s[1]. DDT use continued, however, in malarial endemic areas such as the coastal region of Mexico. Since the early 1990s, severe restrictions have been implemented significantly limiting DDT use in Mexico. Today, the Mexican Ministry of Health uses alternative pesticides in place of DDT [2].

DDT is chemically stable and highly lipophilic, allowing it to persist in the environment where it accumulates in the food chain and the fatty tissues of humans. As a result, human exposure to DDT can be assessed by measuring the level of DDT or its metabolite, 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethylene (DDE), in human tissues or serum [3]. Concern regarding reproductive health effects of exposure to DDT has grown in recent years due to evidence suggesting that it may act as an endocrine disruptor[4]. Some studies suggest that DDT/DDE may affect reproductive health by altering duration of lactation[5, 6] and maintenance of pregnancy[7].

Previous studies in Mexico have indicated that although considerable DDT exposure is expected in rural areas where aerial spraying might still be occurring, additional lower level indirect exposure is occurring throughout Mexico through consumption of contaminated foodstuffs. Few studies have measured DDT exposure among Mexican women of reproductive age. In Table 1, we summarize the levels of DDT and DDE measured in selected studies of Mexican women.

The purpose of this study was to determine the extent of DDT exposure among female residents of Tapachula, in Chiapas, Mexico. Because the last areas of the greatest spraying were the jungles of Chiapas and Oaxaca, we hypothesized those living in Tapachula might still be receiving relatively high exposure to DDT compared to those living in Mexico City. We attempted to measure DDT/DDE in sera collected from pregnant women who resided in the more heavily exposed areas as well as the relatively less exposed areas.

Material and Methods

Data collection took place at two hospitals in the town of Tapachula, Chiapas, from May to August 1997. The first hospital, Mexican Institute for Social Security (IMMS) hospital provides care for employed people and their families. The second hospital, Ministry of Health hospital provides care for the uninsured and low-income families.

All pregnant women attending the prenatal clinic at either IMSS or Ministry of Health hospital for a prenatal visit were informed of the study and invited to participate. Informed consent was obtained from all study participants. Participation included a blood draw and personal interview. The blood was collected as part of the prenatal blood draw that is typically done for pregnant women. Thus, no additional venipuncture was necessary. For the interview, a standardized questionnaire was administered in-person by a trained nurse-interviewer. The interview gathered information on sociodemographic characteristics, personal habits, pregnancy history, and pesticide use.

When data collection was complete, serum specimens were transported on dry ice to the Hazardous Materials Laboratory of the California Department of Toxic Substances Control for analysis[8]. Briefly, serum was thawed, spiked with surrogate standards, denatured with acetic acid and extracted with hexane/methylene chloride. The organic layer was concentrated and cleaned up through a glass column custom-packed with Florisil, eluted with three rounds of hexane/methylene chloride, concentrated, and internal (recovery) standards were added. Analysis was performed by GC-ECD equipped with DB-XLB and Rtx-5MS columns. Elution orders and analyte identification were confirmed by gas chromatography with mass spectrometry detection (GC/MS). Total cholesterol and triglycerides were measured in serum by enzymatic determination and values were reported on a lipid-weight basis in parts per billion (ng/g)[9]. Those responsible for laboratory analysis were blind to the exposure status of the women.

Statistical analyses were performed using STATA 7.0[10]. We examined the relationship of serum DDT/DDE and covariates including age, parity, lactation, and residence in an area of regular pesticide use. Because the distribution of exposures was skewed, we transformed the exposure variables using the logarithm base 10 (log) of serum DDT/DDE. We performed univariate regression analyses using the log of serum DDT/DDE as the dependent variable and the covariates described above as the explanatory variables.

Results and Discussion

A total of 52 women (26 per hospital) agreed to participate in the study. The average age of the women in this study was 24 years and ranged from 15 to 37 years. Forty-four percent (n=23) of women were nulliparous. Among parous women (n=29), 90 percent (n=26) reported a history of lactation. Of these, the average length of breastfeeding reported was 20 months, and ranged from 2 to 60 months.

Lipid-adjusted serum levels of DDT and DDE were measured for all 52 women. The geometric mean DDT and DDE levels for all women were 0.8 mg/kg (95%CI: 0.6-1.2) and 4.3 mg/kg (range: 3.1, 6.0), respectively. These levels are higher than those reported in studies in Mexico City[11-13], but in the range of those reported in Veracruz[14]and Cuernavaca[15].

DDT and DDE levels are presented by selected covariates in Table 2. DDT and DDE levels did not vary with age or hospital of participation. DDT and DDE levels decreased with parity and lactation, and increased with current residence in an area of regular pesticide use. In univariate regression, serum levels of DDT or DDE were significantly associated with parity, lactation history, and current residence in an area of regular pesticide use. Results of multivariate regression analyses including the interaction between parity and lactation will be presented.

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Table 1. Summary of DDT/DDE levels reported in Mexican Women

	Location	Date	Media sampled	N	DDT (mg/kg, lipid) Geo mean (95% CI)		DDE (mg/kg, lipid) Geo mean (95% CI)	
[15]	Mexico City	1989-1990	breast	81	0.4	(0.2, 0.6)	3.0	(2.3, 3.9)
	Cuernavaca		milk	26	1.0	(0.5, 1.6)	5.3	(0.3, 3.5)
	Rural Morelos			42	3.6	(2.1, 5.9)	15.8	(10.4, 23.9)
[11]	Mexico City	1990-1995	serum	126	0.2 [a]	(0.04-0.3)	2.0 [b]	(0.9-6.1)
[16]	Coastal States[c]	1994-1996	adipose	56	-----		0.9	(0.5-1.5)
	Central States			149			0.4	(0.3-0.5)
[12]	Mexico City	1994-1996	serum	198	-----		0.3	(0.01-4.7) [d]
[13]	Mexico City	1995	serum	133	-----		0.2 [b]	(0.01-2.0) [d]
[14]	Veracruz	1997-1998	serum	64	0.7 [b]	(0.0-11.3) [d]	2.9	(0.2-20.9) [d]

[a] arithmetic mean
[b] median
[c] Coastal states (Chiapas, Michoacan, Oaxaca, Veracruz); Central states (Hidalgo, Morelos, Guanajuato, Puebla, Federal District)
[d] range

Table 2. Lipid-adjusted serum DDT and DDE levels by selected covariates

Covariate	n (%)	DDT (mg/kg) Geo mean (95% CI)		DDE (mg/kg) Geo mean (95% CI)	
Total	52 (100)	0.8	(0.6-1.2)	4.3	(3.1- 6.0)
Age[b]					
15-20	9 (17)	1.2	(0.4-4.2)	6.2	(2.8-13.8)
20-25	16 (31)	0.6	(0.3-1.1)	2.7	(1.3- 5.6)
25-30	16 (31)	0.7	(0.3-1.4)	4.2	(2.3- 7.6)
30+	6 (11)	1.2	(0.4-4.1)	4.8	(2.0-11.6)
Parity					
No	23 (44)	1.1	(0.6-2.0)	7.1[a]	(5.0-10.4)
Yes	29 (56)	0.6	(0.4-1.0)	2.9	(1.8- 4.7)
Lactation (total months)					
0	26 (50)	1.3 [a]	(0.7-2.2)	7.9 [a]	(5.5-11.5)
1-12	9 (17)	0.5	(0.2-1.4)	3.1	(1.1- 8.5)
12+	17 (33)	0.5	(0.3-0.9)	2.0	(1.2- 3.4)
Residence in regular pesticide use area					
No	31 (60)	0.8 [a]	(0.5-1.3)	4.4	(2.8- 6.9)
Yes	18 (34)	1.1	(0.6-2.1)	5.4	(3.3- 8.9)
DK	3 (6)	0.1	(0.0-0.6)	1.0	(0.4- 2.5)

[a] ANOVA $p<0.05$
[b] numbers do not add up to 100% due to missing data