

EXPOSURE ASSESSMENT TO DIOXINS FROM THE USE OF TAMPONS AND DIAPERS

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Introduction

Recently there has been concern over the role of dioxin exposure through tampon use in the development of endometriosis. The basis for this concern stems from two lines of data. First, there have been several reports on the presence of dioxins in tampons^{1,2}. The second is that in several experimental systems, dioxins increase the incidence and/or severity of endometriosis³⁻⁵. In the present study, the potential exposure to dioxins through tampon use was compared to exposure through other routes, in particular dietary exposures, in order to examine the contribution of tampon use to dioxin exposure. In addition, some diapers are also made from the same material as tampons and exposure to dioxins through the use of disposable diapers was also compared to the total dioxin exposure in infants.

METHODS:

Sampling and Dioxin Analysis:

The sampling and analysis have been previously described. Briefly, in 1997, tampons and diapers were purchased in San Francisco, California by volunteers from the environmental organization Mothers & Others for a Livable Planet. Four brands (A-D) of tampons and three brands of disposable diapers (E-G) and one brand of all cotton diapers were purchased. Tampon brand A were available either in rayon or cotton and both were purchased and analyzed separately for dioxins and dibenzofurans. The products were shipped in their commercial containers to ERGO research company in Hamburg, Germany where PCDDs and PCDFs analyses were performed using previously described methods².

Exposure Estimates:

In order to determine dioxin exposure from the tampons and to compare these exposures to dietary intakes, the concentrations of the individual PCDDs and PCDFs were converted to TEQs using the WHO TEF values⁷. It was assumed that women use 6 tampons/day for 5 days per month. Exposure was averaged over a period of 30 days in order to estimate average daily exposure. The weight of the average women is estimated at 50 kg. A value of 1 pg TEQ/kg/d was used as the average daily dietary intake for adults based on estimates from the USEPA⁷. It was assumed that all of the dioxins on the tampons were completely bioavailable.

Infant and toddler exposure to dioxins from diapers was estimated using several assumptions. Infants (0-6 months) were assumed to use 10 diapers/day. Toddlers (6 - 24 months) were assumed to use 6 diapers/day. The average weight of a diaper was estimated at 40 g. Infants were assumed to nurse from 0-6 months at a rate of 0.7L/day and have an average body weight of 6.75 kg from birth to 6 months. Based on these assumptions, estimates of the average intake for nursing infants is 980 pg/d or approximately 145 pg TEQ/kg/d⁷. Average body weight for

toddlers from 6 to 24 months old was estimated at 11 kg. Average body weights were adapted from Ludwig and Kettrick⁸. Dietary intake for toddlers (6-24 months) was estimated at 40 pg TEQ/d⁷. Based on these estimates, dietary intake for toddlers was assumed to be 3.6 pg TEQ/kg/d.

Estimates of the dermal absorption fraction for 2,3,7,8-tetrachlorodibenzo-p-dioxin from soil range from 0.1-3% depending on the organic content of the soil¹⁰. In soils with high organic content, dioxins are tightly bound and are less available for release and a value of 0.1% is used for dermal absorption fraction. Because rayon is highly organic, it is likely that the dioxins are tightly bound to the fibers and are not readily bioavailable. However, because the extent of the bioavailability is uncertain, an absorption fraction of 3% was used based on USEPA estimates of dermal absorption from soil with low organic content¹¹. Dermal exposures of dioxins through diapers were estimated using the following equation:

$$\text{Dermal exposure (pg/kg/d)} = \frac{Cd * Wd * Abs * Nd}{BW}$$

Where Cd is the concentration of dioxins in the diaper (pg/g); Wd is the weight of the diaper (g); Abs is the absorption fraction; Nd is the number of diapers used per day; BW is the body weight of the infant (6.75 kg) or toddler (11 kg).

RESULTS and DISCUSSION

Tampons. Analysis for all 17 of the 2,3,7,8-chloro substituted PCDDs and PCDFs included in the TEF methodology was performed. The detection limit for the PCDDs and PCDFs was 0.1-0.2 parts per trillion (ppt). The total concentration of PCDDs and PCDFs in the tampons ranged from 1.5-23.6 pg/g. OCDD accounts for 48-88% of the total mass of dioxins in the tampons. The remaining dioxins make up from less than 1% to 16% of the total mass. The concentrations of TEQ in the tampon Brands A (rayon and cotton), B and C range from 0.013 – 0.034 pg/g tampon. Brand D tampons had considerably greater concentrations of TEQ (0.24 pg/g) compared to the other brands. Brand A tampons had similar TEQ's with the rayon product slightly less than the cotton, 0.013 and 0.015 pg/g tampon respectively. TCDF and the HpCDDs account for approximately 90% of the TEQs found in tampon brands A, B and C. It should be noted that the concentration of TCDF is equal to the detection limit for tampon brands A, B and C. These values should be viewed cautiously. The HxCDFs, TCDF and 2,3,4,7,8-PeCDF account for over 90% of the TEQs present in Brand D tampons. With the exception of Brand D, as total dioxins increase in the tampon so does the TEQ. Brand D has similar concentrations of dioxins as Brand C, but has more than 10 times the TEQ. In contrast Brand B has three times the dioxin as brand D but it has 1/7 the TEQ of Brand D.

Average daily intake of dioxins from tampon brands A, B and C range from 0.00059 - 0.0014 pg/kg/d. Compared to the daily intake of dioxins from these tampons, dietary intake of dioxins of 1 pg TEQ/kg/d is approximately 730 to 1700 times that from tampons (Table 3). Daily intake of dioxins from Brand D tampons is approximately 10 times higher compared to that from the other brands of tampons. Compared to dietary intake, Brand D tampons account for approximately 1.3% of total daily dioxin intake.

Diapers Only five of the 17 dioxins were detected in the diapers. Concentrations of dioxins in disposable diapers were similar between the rayon and the cotton diapers and concentrations ranged from 1.6-3.0 pg/g diaper. Two of the disposable diapers had lower concentrations of dioxins than did the cotton diaper. OCDD accounted for 67-76% of the total dioxins in the

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diapers. OCDF and the HpCDDs accounted for 5-21% of the remaining dioxins. TCDF accounted for approximately 2-6% of the total dioxins. Similar to the tampons, most of the analytes were observed at or near their limits of detection. The TEQ of the diapers ranges from 0.0042 pg/g in the cotton diaper to 0.23 pg/g in brand E disposable diaper (Table 2). The difference between the disposable and the cotton diapers is that TCDF was not detected in the cotton diaper. Thus while there is little difference between the total dioxin concentrations there is a greater difference in the TEQ concentrations between the samples. It should be noted that the detection limit for TCDF is 0.1 pg/g diaper and in the three disposable diapers the concentrations range from 0.1-0.2 pg/g diaper.

Daily exposures to dioxins from diapers ranged from 0.0075 to 0.024 pg/kg/d for nursing infants (Table 2). Dietary intakes in nursing infants (145 pg TEQ/kg/d) are approximately 6,000 to 19,000 times greater than the daily exposures from the diapers. In toddlers, dioxin exposure through diapers ranges from 0.0023 to 0.0072 pg/kg/d. Dietary exposures (3.6 pg TEQ/kg/d) are approximately 300 to 1600 times greater than exposures through diaper use in toddlers (Table 2).

These data indicate that dioxin exposure through tampon or disposable diaper use is minimal compared to dietary exposures. In addition, the data indicate that switching to cotton products does not result in significant differences in exposures to dioxins from these products.

This abstract does not reflect USEPA policy

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Table 1. Comparisons Of Dioxin Exposure From Tampons And Dietary Ingestion.

Brand	Concentration of Dioxins in Tampon (TEQ ppt)	Tampon Weight (g)	Intake From Tampons (pg/kg/d)	% Intake From Tampons Compared To Dietary Intake	Ratio Of Intake (Diet/Tampon)
A (cotton)	0.014	3.15	0.00059	0.059	1700
A (rayon)	0.017	4.73	0.0011	0.11	933
B	0.054	1.9	0.0014	0.14	731
C	0.027	3.4	0.0012	0.12	817
D	0.247	4.04	0.013	1.3	75

Table 2. Comparisons Of Dioxin Exposure From Diapers To Dietary Ingestion.

Brand	Concentration of Dioxins in Diaper (TEQ ppt)	Intake from Diaper (pg TEQ/kg/d)		%Intake from Diaper Compared to Dietary Intake		Ratio of Intake (Diet/Diaper)	
		0-6 months	6-24 months	0-6 months	6-24 months	0-6 months	6-24 months
E	0.023	0.041	0.012	0.029	0.35	3498	286
F	0.015	0.023	0.0072	0.015	0.2	6188	506
G	0.014	0.023	0.0072	0.015	0.2	6207	509
Cotton	0.006	0.0075	0.0023	0.0049	0.2	19374	1585