LEVELS OF DIOXINS AND DIBENZOFURANS IN BREAST MILK OF WOMEN RESIDING IN TWO TOWNS IN THE IRKUTSK REGION OF RUSSIAN SIBERIA

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Introduction

In 1986 a collaborative international project involving the former USSR, Finland, and the USA, was established to study dioxin levels in the Soviet Union. Previous research had established the presence of dioxins and dibenzofurans in Russian human blood and milk, food, and certain wildlife. Lower dioxin body burdens were generally found in Russians than in Europeans and North Americans[1]. But Ufa Khimprom chemical workers and their children, other workers in the factory, and the general population in the city of Ufa, had elevated dioxin levels compared to other Russian populations[2-5].

In this new Siberian study, we, and our colleagues in separate papers, report levels of dioxins, dibenzofurans and PCBs in human blood and milk in the Irkutsk region, of Siberia. Volunteers were found in cities near sites of heavy industries, including chemical factories.

Materials and Methods

Milk was collected in chemically cleaned containers and frozen. It was shipped frozen to dioxin laboratories in Münster and Hamburg, Germany and Ottawa Canada. These laboratories have been certified by the WHO for dioxin analysis of human tissues[6]. High resolution gas chromatography/mass spectrometry was used to analyze the specimens. Data is reported in parts per trillion (ppt) on a lipid normalized basis.

Results and Discussion

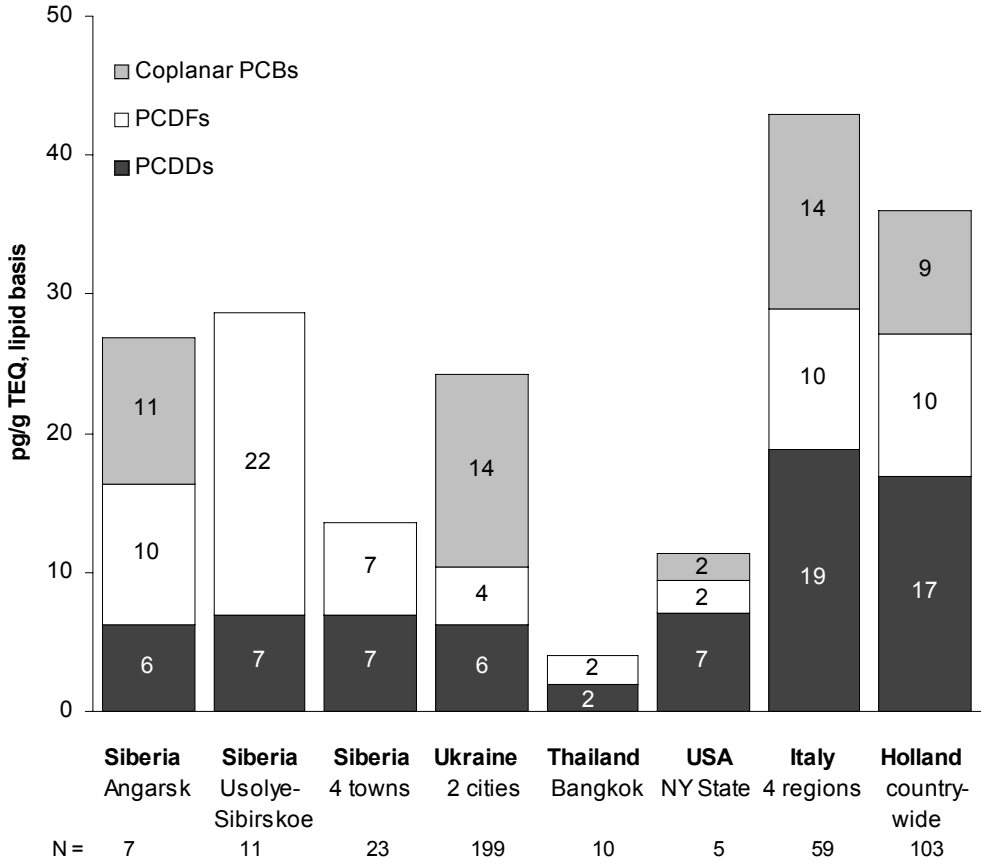
Results of dioxin analyses of milk collected from nursing mothers in Angarsk and Usolye-Sibirskoe are presented in Table 1 in dioxin toxic equivalents (TEQ). Previous results from four less industrial towns of Siberia, from Ukraine, and from the USA are also given. Figure 1 depicts the dioxin, dibenzofuran and coplanar PCB TEQ in these studies and additionally in Thailand, Italy, and the Netherlands. Results for coplanar PCBs are not available from Usolye-Sibirskoe or from the previous studies in Siberia and Thailand.

Table 1. Mean TEQ levels in human milk from two towns in Irkutsk region, Siberia compared with previous results from Siberia, Ukraine and the USA
pg/g (ppt) lipid basis

	Angarsk 1998	Usolye-Sibirskoe 1998	Siberia 1989	Ukraine 1993-94	USA 1996
N =	7	11	23	199	5
Means of:	individual analyses	individual analyses	pooled samples from 4 towns	4 pooled samples from 2 cities	individual analyses
PCDDs					
2,3,7,8-TCDD	3.3	3.6	2.7	3.3	1.5
1,2,3,7,8-PnCDD	2.3	2.7	3.3	2.4	2.5
1,2,3,4,7,8-HxCDD +1,2,3,6,7,8-HxCDD	0.5	0.4	0.7	0.4	2.3
1,2,3,7,8,9-HxCDD	0.1	0.1	0.1	0.0	0.4
1,2,3,4,6,7,8-HpCDD	0.1	0.0	0.1	0.0	0.3
OCDD	0.0	0.0	0.0	0.0	0.0
PCDFs					
2,3,7,8-TCDF	0.2	0.4	0.3	0.0	0.1
1,2,3,7,8-PnCDF	0.0	0.1	0.1	0.0	0.0
2,3,4,7,8-PnCDF	7.4	16.7	5.2	3.0	1.4
1,2,3,4,7,8-HxCDF +1,2,3,6,7,8-HxCDF	2.3	4.4	1.0	0.9	0.6
1,2,3,7,8,9-HxCDF	0.0	0.0	0.0	0.0	0.0
2,3,4,6,7,8-HxCDF	0.1	0.1	0.1	0.0	0.1
1,2,3,4,6,7,8-HpCDF	0.0	0.0	0.0	0.0	0.1
1,2,3,4 ,7,8,9-HpCDF	0.0	0.0	0.0	0.0	0.0
OCDF	0.0	0.0	0.0	0.0	0.0
Coplanar PCBs					
77 3,3',4,4'-TCB	0.0			-	0.0
126 3,3',4,4',5-PCB	10.2			13.6	2.0
169 3,3',4,4',5,5'-HCB	0.4			0.4	0.1
Total PCDDs	6.4	6.8	6.9	6.1	7.0
Total PCDFs	10.0	21.7	6.7	3.9	2.3
PCDD/Fs	16.4	28.5	13.6	10.0	9.3
Coplanar PCBs	10.5			14.0	2.1
Total TEQ	26.9			24.0	11.4

1998 WHO TEFs; non-detects = 1/2 limit of detection
Milk samples from Angarsk were analyzed by Health Canada Laboratory, Ottawa, Canada. Samples from Usolye-Sibirskoe were analyzed by the Federal State Control Laboratory of North Rhine-Westphalia, Münster, Germany. All previous analyses were by ERGO Laboratory, Hamburg, Germany.

Figure 1. Mean TEQ Levels of Dioxins, Dibenzofurans, and Coplanar PCBs in Human Milk
pg/g (ppt), lipid basis



1998 WHO TEFs; non-detects = 1/2 limit of detection

All TEQs were calculated using the 1998 WHO TEFs[7]. TEQ results for the previous studies had been reported using I-TEFs[1,8-11].

TEQ levels of PCDDs in these milk specimens from the Irkutsk region were similar to levels found previously in Siberia, Ukraine, and the USA, but lower than found in Italy and the Netherlands. Dibenzofuran TEQ levels, however, were higher than found previously in Siberia, Ukraine, and the United States.

These results from a highly industrialized area of Siberia add to the data regarding human tissue levels of dioxins, dibenzofurans, PCBs and other persistent organic chemicals (POPs) worldwide. The United Nations Environmental Program (UNEP) has a program underway to

reduce or eliminate POPs worldwide. These and other data will help to determine efficacy of the UNEP project and of similar projects in individual countries.

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References

1. Schecter A, Fürst P, Fürst C, Päpke O, Ball M, Dai LC, Hoang TQ, Phoung NTN, Beim A, Vlasov B, Chongchet V, Constable JD, and Karan C. Dioxins, dibenzofurans and selected chlorinated organic compounds in human milk and blood from Cambodia, Germany, Thailand, the USA, the USSR, and Vietnam. *Chemosphere* 23: 1903-12, 1991.
2. Schecter AJ, Ryan JJ, Päpke O, Ball M, and Lis A. Elevated dioxin levels in the blood of male and female Russian workers with and without chloracne 25 years after phenoxyherbicide exposure: the Ufa "Khimprom" incident. *Chemosphere* 27:253-58, 1993.
3. Schecter A, Ryan JJ, and Päpke O. Elevated dioxin blood levels in Russian chemical workers and their children following maternal exposure. *Chemosphere,* 29:2361-2370, 1994.
4. Ryan JJ, Schecter A, and Amirova Z. Russian phenoxy herbicide production workers: exposure to and elimination of dioxins. *Organohalogen Compounds* 33: 390-93, 1997.
5. Smirnov AD, Schecter AJ, Päpke O, and Beljak AA. Conclusions from Ufa, Russia drinking water dioxin cleanup experiments involving different treatment technologies. *Organohalogen Compounds* 19:499-502, 1994.
6. World Health Organization. Levels of PCBs, PCDDs and PCDFs in human milk and blood: second round of quality control studies. *Environment and Health in Europe* #37, 1-76. Denmark: FADL Publishers, 1991.
7. Van den Berg M, Birnbaum L, Bosveld ATC, Brunström B, et al. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. *Environ Health Perspect* 106:775-92, 1998.
8. Gladen BC, Schecter AJ, Päpke O, Shkyryak-Nyzhnyk ZA, Hryhorczuk DO, and Little RE. Polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, and coplanar polychlorinated biphenyls in breast milk from two cities in Ukraine. *J Toxicol. Environ. Health*, 1999 (accepted).
9. Schecter A, Päpke O, and Fürst P. Is there a decrease in general population dioxin body burden? A review of German and American data. In van den Berg M *et al*. (eds.) Short Papers from Dioxin '96, *Organohalogen Compounds* 30. Amsterdam, the Netherlands, 57-60, 1996.
10. Schecter A, di Domenico A, Turrio-Baldassarri L, and Ryan JJ. Dioxin and dibenzofuran levels in the milk of women from four geographical regions in Italy as compared to levels in other countries. In: Extended Abstracts from Dioxin '92, *Organohalogen Compounds* 9. Helsinki: Finnish Institute of Occupational Health, 227-230, 1992.
11. Liem AKD and Theelen RMC. *Dioxins: chemical analysis and risk assessment*. PhD Thesis, Utrecht University, The Netherlands, 1997.