Dietary exposure to persistent organochlorines and pituitary, thyroid and testosterone hormone levels in male adults

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Introduction

Several groups of persistent organochlorine contaminants (POC), such as polychlorinated biphenyls (PCBs), 1,1,1-trichloro-2,2,-bis(4-chlorophenyl)-ethane (p,p'-DDT), 1,1-dichloro-2,2-bis(4-chlorophenyl)-ethene (p,p'-DDE), polychlorinated dibenzo-p-dioxins and dibenzofurans have been found to disrupt thyroid, retinoid and steroid-related metabolism and function in both *in vitro* and *in vivo* experiments.[1,2] For the population living in the coastal areas around the Baltic Sea, consumption of fatty fish from the Baltic sea is the most important source of exposure for POC.[3-5] High consumers of contaminated fatty fish from the Baltic Sea might thus constitute a risk population for endocrine adverse effects of POC.

The aim of the present study was to assess whether a high dietary exposure to POC would affect circulating hormone levels in male adults.

Material and Methods

Venous blood samples were in 1991 drawn from 43 volunteering Swedish (median age 42 years, range 27-79), and in 1993 from 68 Latvian (median age 48 years, range 23-69) men. They were recruited in order to obtain a large inter-individual contrast in consumption of Baltic Sea fish. Some of them were professional fishermen at the Baltic Sea and had a high dietary fish intake, whereas others infrequently or never ate fish. Their estimated intake of fatty fish from the Baltic Sea is given in **Figure 1**. None of the participants had any known endocrine disease, or were on any drug affecting the endocrine system. In all cases the sampling was made in the morning before the subjects had performed any major physical activity. Plasma and serum samples were stored frozen until analysis.

Using gas chromatography with electron capture detector (GC-ECD) the plasma samples were analyzed with respect to 14 specific PCB congeners (CB-105, 118, 129, 138, 146, 153, 156, 157, 167, 170, 177, 180, 183, 187), five of the most abundant hydroxy-PCBs, pentachlorophenol (PCP), p,p'-DDT, p,p'-DDE, and hexachlorobenzene (HCB).

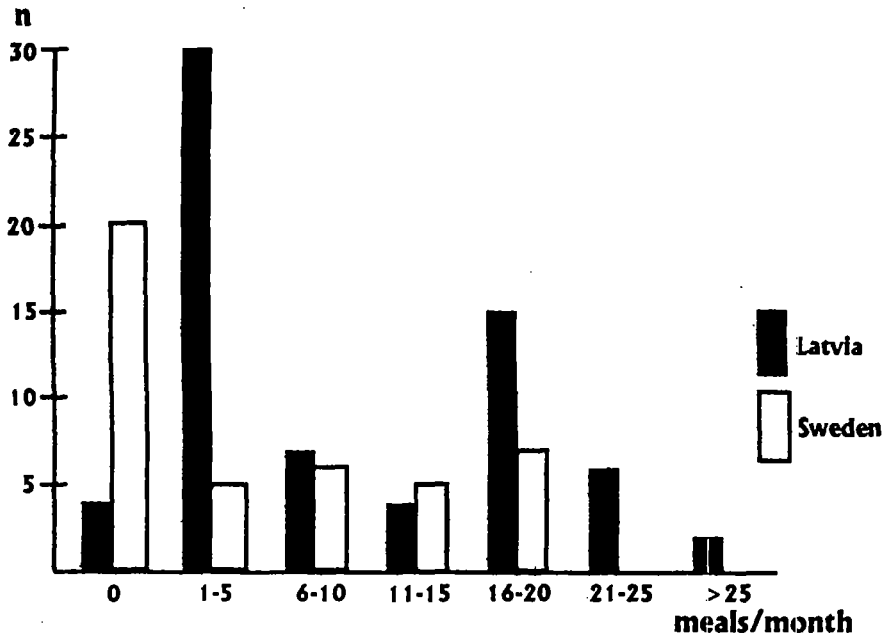

Figure 1. Estimated average consumption of fatty fish from the Baltic Sea among 44 Swedish and 68 Latvian males.

Serum levels of prolactin, thyroid stimulating hormone (TSH), follicular stimulating hormone (FSH), luteinizing hormone (LH), free and total thyroxin (FT4, TT4), free and total triiodothyronine (FT3, FT3), sexual hormone binding globulin (SHBG) and total testosterone, were analyzed employing routine RIA-techniques. Free testosterone was estimated using the ratio between total testosterone and SHBG.

The correlation's were assessed by Spearman's rank correlation test. Age adjustments were performed employing multiple linear regression models. Log-transformed POC-variables were used in the multivariate models. The term "significant" refers to $p<0.05$.

Results and Discussion

For all the measured POCs, the inter-individual variations in plasma levels were substantial (50-500 times; **Table 1**). With the exception of PCP, the estimated fish consumption was highly correlated with the plasma levels of the POC.

Weak univariate positive correlation's were observed between FSH and p,p'-DDT, p,p'-DDE, and HCB, while a weak negative correlation was seen with PCP (**Table 2**). However, after adjusting FSH for the age effect in a multiple linear regression model, no significant associations remained. Nine out of 14 specific PCB-congeners, as well as the sum of PCBs, displayed weak, but statistically significant, negative correlation's with TSH. As age was not correlated with the TSH levels, no age adjustment was performed. There were slight, positive correlations between

PCP and both TT3 and TT4. The TT3, but not the TT4, level decreased with age and after adjustment no significant correlation between PCP and TT3 remained. Univariate negative correlation's were seen between free testosterone and several of the POCs, but no significant associations remained after age adjustment. None of the POCs were significantly correlated with the serum levels of LH, prolactin, free T3 or free T4.

Table 1. Plasma levels (μg/g lipid) of some POC in 44 Swedish and 68 Latvian males.

Compound	Median	Range
p,p'-DDT	0.05	0.003-1.61
p,p'-DDE	0.83	0.03-6.48
HCB	0.08	0.02-1.94
PCP	0.64	0.09-5.93
Sum PCB (14 congeners)	1.19	0.19-7.55
CB-153	0.33	0.02-2.34
Sum OH-PCB (5 congeners)	0.26	0.04-4.20

Table 2. Associations between hormone levels in serum and various POCs in plasma in univariate analyses and after adjustment for age employing a multiple linear regression model.

Hormone	Univariate analysis			Age adjusted analysis
	POC	r_s	p	p
FSH	p,p'-DDT	0.26	0.007	>0.3
	p,p'-DDE	0.23	0.02	>0.3
	PCP	-0.19	<0.001	0.09
LH	-[a)]			
Prolactin	-[a)]			
TSH	sum PCB	0.19	0.05	not relevant
TT3	PCP	0.20	0.04	0.26
FT3	-[a)]			
TT4	PCP	0.21	0.03	not relevant
FT4	-[a)]			
Free testosterone	p,p'-DDE	-0.23	0.04	>0.3
	HCB	-0.24	0.04	>0.3
	sum PCB	-0.26	0.006	>0.3
	sum OH-PCB	-0.20	0.04	>0.3

a) No significant univariate correlation's.

This study has contributed only very weak arguments for that dietary exposure to POC might affect hormone levels in male adults. What remained after age

adjustments was only a weak negative correlation between the sum of PCBs and TSH, and a similarly weak, but positive, correlation between PCP and TT4. It should be remembered that a very large number of univariate correlation's were performed between various POC and hormones, which means that some significant correlation's were expected to occur from multiple comparisons. On the other hand, the high inter-correlation's between all the POCs, except PCP, makes the problem with simultaneous inference less important.

Based on our results it seems very unlikely that even a high consumption of fish polluted with POCs will cause any disturbances of circulating levels of pituitary, thyroid or testosterone hormone levels, in male adults. Whether such an exposure will affect the hormone status of women, children or fetuses, is out of the scope of the present study.

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