SERUM LEVELS OF 2,2´, 4,4´,5,5´, - HEXACHLORBIPHENYL IN RELATION TO SEMEN QUALITY AND QUANTITY AMONG SWEDISH FISHERMEN

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Introduction

During the last few decades, there has been concern that exposure to endocrine disruptors such as certain persistent organochlorine compounds (POC), may contribute to an impairment of semen quality and male reproductive function [1].

There is evidence from animal studies that POC can affect the male reproductive function [2,3]. A few small human studies concerning male reproduction have indicated an association between exposure to PCBs and abnormal sperm count and motility [4,5,6].

In Sweden the consumption of fatty fish from the Baltic Sea (at the Swedish east coast) is the single most important source of exposure to POC. Fishermen from the east coast have averagely higher plasma levels of PCBs and total-TEQ than both west coast fishermen and men from the general population [7,8,9].

The aim of the present study was to investigate the hypothesized negative association between PCB and semen quantity and quality. To ensure contrasts in the exposure we selected fishermen from both the Swedish east and west coasts.

Materials and methods

The study included 96 east coast and 99 west coast fishermen from Sweden. The investigation included a telephone interview on lifestyle habits and medical, reproductive and occupational history.

We established a mobile laboratory unit and collected blood and semen samples at the subjects habitation. In this way we were able to conduct initial semen analysis within one hour after ejaculation. The semen samples were analysed in accordance with the World Health Organisation guidelines [10]. The blood samples were centrifuged and the serum was frozen at –80°C. Also semen samples were prepared for later analysis.

We choose to analyse 2,2´, 4,4´, 5,5´-hexachlorbiphenyl (CB-153) in serum as a proxy exposure biomarker. Briefly, the CB-153 was extracted from the serum by solid phase extraction (Isolute ENV+; IST, Hengoed, UK) using on-column degradation of the lipids and analysis by gas chromatography mass spectrometry. $^{13}C_{12}$-labeled CB-153 was used as an internal standard. The CB-153 concentrations were adjusted for total serum lipid concentration determined by enzymatic methods and expressed as ng/g lipids.

Age, smoking, body mass index, abstinence time, season for sampling and number of ejaculations the month before sampling were, in multiple regression models, regarded as potential confounders (Table 1).

Results
In a univariate model there was a negative effect of CB-153 on semen volume but it disappeared after adjustment for age (Table 2). We found no associations between CB-153 and sperm concentration and total count, respectively. However the quintile of subjects with the highest CB-153 level (327-1459 ng/g lipid) had significantly impaired sperm motility. A+B motile (progressive) sperms were 14 % (95 % CI 4.2-23.2) fewer than in the lowest CB-153 quintile (< 112 ng/g lipid). Correspondingly D-motile (immotile) sperms were 12 % (95 % CI 3.3-20.6) more frequent in the highest quintile. Adjustment for the potential confounders changed these estimates only marginally.

Discussion
In this present study, semen analysis revealed significant differences in the rates of progressive motile and immotile sperms, respectively between subjects with the highest and lowest levels of CB-153. This indicates that a high exposure to POC, for which CB-153 serves as a proxy marker, might have an effect on sperm motility. In a Swedish population with lower CB-153 levels as compared with the present study population, Richthoff et al. found a weak, but significant, negative correlation between serum levels of CB-153 and sperm motility [11]. Moreover, results from an American pilot study shows that the mean serum levels of PCBs were higher among individuals with below normal motility compared to subjects with normal motility [6].
In conclusion, the results indicate that high levels of PCBs could have an affect on male spermatozoa that leads to impaired sperm motility.

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Table 1. Background characteristics for the Swedish fishermen with respect to serum levels of CB-153.

		CB-153 levels in serum (ng/g lipids)					
		39-112 n=38	112-167 n=38	167-231 n=37	231-327 n=37	327-1459 n=38	Total n=189
Age	Mean (SD)	39 (6.55)	44 (7.84)	48 (9.31)	53 (6.79)	53 (6.92)	47 (9.31)
	Median (5-95)	37 (31-54)	44 (32-59)	48 (27-66)	54 (39-66)	54 (39-66)	48 (32-63)
Body mass <30	N (%)	32 (84)	34 (90)	31 (82)	28 (76)	34 (89)	156 (84)
index >30	N (%)	6 (16)	4 (10)	7 (18)	9 (24)	4 (11)	30 (16)
Civil status							
married	N (%)	17 (46)	14 (37)	16 (43)	23 (62)	25 (67)	95 (51)
co-habitee		9 (24)	14 (37)	12 (32)	4 (11)	6 (16)	45 (24)
single		8 (22)	5 (13)	6 (16)	7 (19)	4 (11)	30 (16)
widower		0 (0)	0 (0)	1 (3)	0 (0)	1 (3)	2 (1)
other		3 (8)	5 (13)	2 (6)	3 (8)	1 (3)	14 (8)
Biological father	N (%)	23 (62)	30 (79)	28 (76)	31 (84)	33 (89)	145 (78)
Current smokers	N (%)	8 (21)	9 (24)	11 (29)	6 (16)	10 (26)	44 (23)
Ex smokers	N (%)	20 (53)	29 (76)	25 (66)	25 (68)	22 (58)	121 (64)
Abstinence time	Mean (SD)	3.7 (2.8)	3.7 (2.4)	4.0 (2.7)	4.2 (3.5)	3.3 (1.4)	3.8 (2.6)
(days)	Median (5-95)	3.0 (1-14)	3.0 (1.0-10)	3.0 (1-13)	3.0 (1-18)	3.0 (0.8-7)	3.0 (1-9)
Season for sampling	N (%)						
March to May		6 (16)	14 (37)	18 (47)	15 (41)	13 (34)	66 (35)
June to August		10 (26)	14 (37)	11 (29)	10 (27)	19 (50)	64 (34)
September to November		22 (58)	10 (26)	9 (24)	12 (32)	6 (17)	59 (31)

Table 2. CB-153 levels in serum in relation to semen volume, sperm concentration, total sperm count and sperm motility.

	CB-153 levels in serum (ng/g lipids)					
	39-112 n= 38	112-167 n=38	167-231 n=38	231-327 n=37	327-1459 n=38	Total n=189
Semen volume ml						
mean	3.5	3.3	3.5	3.2	3.0	3.3
SD	1.5	1.5	1.9	1.7	1.6	1.7
median	3.5	3.3	3.3	3.1	2.5	3.2
5-95 percentile	0.8-6.0	0.9-5.9	0.8-7.6	0.7-7.9	1.1-7.6	0.9-6.0
Sperm concentration milj /ml						
mean	52.4	59.6	57.7	64.1	60.5	58.8
SD	40.5	47.8	42.4	44.9	44	43.9
median	44.9	47.1	48.9	59.2	53.9	49.1
5-95 percentile	5.33-174	6.5-198	12-183	7.8-201.6	16-200	10-170
Total sperm count						
mean	195.5	186.9	188.9	206.4	163.8	187.8
SD	201.9	162.0	151.7	174	110.9	160
median	143.3	135.7	174.5	163.7	131.2	141
5-95 percentile	11.7-894	22.7-681	23-641	14-691	35-420	23-535
A+B motile, progressive						
mean	64	58	59	57	50	57
SD	21	20	21	19	22	21
median	69	63	66	62	52	63
5-95percentile	23-92	22-88	13-88	15-81	10-86	17-85
D-motile, immotile						
mean	23	28	27	27	35	28
SD	17	19	19	16	22	19
median	19	23	21	24	29	23
5-95 percentile	3-69	5-68	6-77	4-63	7-88	5-66