APPENDIX 3: TECHNICAL ANALYTICAL REPORT AND RESULTS

ANALYSIS OF MAN-MADE CHEMICALS IN HUMAN BLOOD SAMPLES FROM 17 EUROPEAN COUNTRIES

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EXECUTIVE SUMMARY

Objectives of the study:

1) To determine the concentrations of a range of man-made chemicals in human blood in MEPs (members of the European Parliament) and other volunteers.
2) To investigate links between chemical concentrations and life history or lifestyle parameters.

Blood samples were taken from 47 volunteers (MEPs, former MEPs, observers and WWF staff members), from 17 European countries, in Brussels in December 2003. Each sample was analysed for 45 PCBs, 12 organochlorine pesticides, 23 brominated flame retardants, 8 phthalates and 13 perfluoroalkyl chemicals (PFOS/PFOA).

The highest concentration of TBBP-A (Tetrabromobisphenol A) was roughly a factor 10 higher than found in previous studies in Europe, and was found in 27 of the volunteers. HBCD (hexabromocyclododecane) has not been reported in human blood (although it has been found in human milk) to date but was found in one sample in this study.

PCBs were found in all volunteers. Total PCB concentrations ranged from 23 to 930 ng/g lipid, with a median of 390 ng/g lipid. HCB, p,p'-DDE, p,p'-DDT and b-HCH were the most commonly detected organochlorine pesticides. The median, maximum and minimum concentrations of b-HCH were very close to those found in the recent WWF UK survey, whilst the median concentrations of p,p'-DDE and HCB were almost double the medians found in the UK survey. p,p'-DDE concentrations found in this study are somewhat lower than recently found in Belgium.

PBDEs (polybrominated diphenyl ethers) were also found in all volunteers. Seven PBDE congeners were regularly detected in the serum samples. The median concentration of BDE153 (which can be derived from both the octaBDE and pentaBDE commercial products) was higher than the median concentration of BDE47 (which can be derived from the pentaBDE commercial product), as was found in the recent WWF UK survey. BDE209 was found in 16 samples (i.e over 30% of volunteers), ranging in concentration from close to the detection limit (8 samples) to a maximum of 2400 ng/g lipid. The two highest concentrations of BDE209 measured were 5 and 10 times higher than the third highest, which itself was equivalent to the highest concentration found in the WWF UK survey and levels in occupationally exposed people in Sweden.

Seven PFOS/PFOA (perfluorooctane sulfonate/perfluorooctanoic acid and related chemicals) chemicals were found in all samples and an eighth in most samples. The sum of the nine most common PFOS/PFOA chemicals ranged between 12 and 71 (ng/g whole blood). PFOS and PFOA were dominant in all samples. The average concentrations of PFHxS (perfluorohexane sulfonate) found in this study correspond well with those found in serum from the general population of the United States.

Traces of phthalates were detected in all samples. Di(ethylhexyl)phthalate was the most abundant phthalate, with a mean concentration of 155 ng/g blood, ranging from 37 to 1200 ng/g blood. The other phthalates were only detected at lower concentrations.

This study was, we believe, the most comprehensive survey of blood concentrations of HBCD, TBBP-A, Phthalates, PFOS/PFOA, PCBs, organochlorine pesticides and PBDEs in concurrent samples using participants from across Europe. There may be differences in chemical exposure patterns between different European countries, but the small number of samples representing each nationality preclude firm conclusions being drawn. There are indications of a possible difference in PFOS concentrations between the sexes. The correlation between PCB concentrations and age seen in the recent WWF UK survey is also valid for this group of people drawn from a number of countries.

BACKGROUND

A study was performed to investigate the concentrations of a range of chemicals in human blood taken from volunteers, from a range of European countries, in Brussels in December 2003.

The objectives of the study were:
To investigate the concentrations of a range of chemicals in human blood around Europe.
To investigate links between chemical concentrations and life history or lifestyle parameters.

METHODS

Previously, a pilot study was performed to determine the best sampling and analytical methods, and media for PCB, organochlorine pesticides and PBDEs. This is detailed in the report of a study of these chemicals in human blood from UK volunteers (WWF 2003).

SAMPLING

Blood samples were taken by trained medical professionals from 47 volunteers in Brussels, Belgium, in December 2003. Approximately 80 ml whole blood was taken from each volunteer.

The BD Vacutainer® system was used to take all samples, and blood samples were taken into serum tubes (with clotting agent and polymer separator). Samples were mixed by inverting the tubes immediately after blood collection. After an appropriate time for coagulation to occur samples were either (1) frozen and packaged for transport to the laboratories undertaking the analysis (TBBP-A, HBCD, phthalate and perflouroalkyl acid analyses) or (2) centrifuged at 3000 rpm for 10 min, to separate the serum from the blood cells (for PCB, organochlorine and PBDE analyses) before being frozen and packaged for transport to the laboratories undertaking the analysis.

Frozen samples were sent to four analytical laboratories, where they were received still frozen. The laboratories undertaking the analyses were: ITM, Stockholm, Sweden; Lancaster University, UK; Netherlands Institute for Fisheries Research, Ijmuiden, The Netherlands; Research Institute for Chromatography, Kortrijk, Belgium. Samples received at Lancaster University were defrosted and the serum transferred to clean glass containers before being frozen to –20 °C until analysis. Samples received at the other participating laboratories were stored frozen, as received, until analysis.

ANALYSIS

Samples were analysed by four laboratories using the following analytical methods.

HBCD and TBBP-A

Soxhlet extraction, GPC and GC-MS analysis

Blood samples (excluding the silica gel contents of the vacutainer vials) were weighed and dried by mixing with sodium sulphate and then extracted by Soxhlet extraction with hexane:acetone as solvent. Following Soxhlet, internal recovery standards were added to the blood extracts. For TBBP-A the internal standard was ^{13}C-TBBP-A, for HBCD, BDE116 was used. To ensure that TBBP-A was in the protonated form and retained in the organic phase before proceeding with the next steps, the Soxhlet extract was treated with a sulphuric acid solution (pH 2).

Extracts were then purified with the gel permeation chromatography (GPC) technique to remove large biomolecules such as lipids before injecting into analytical apparatus, as these would interfere with the analysis. The organic layer was further cleaned with silica gel to remove other matrix compounds. Finally, the purified extracts were transferred to vials for analysis with GC/MS.

TBBP-A and HBCD in blood extracts were measured by gas chromatography/mass spectrometry (GC/MS) in four series. Each series included two blanks, an internal reference material sample (eel), and a recovery standard. Due to limitations of the blood sample volume, no duplicate extraction of a blood sample was performed. Quantification was performed using external standards. Final concentrations were corrected for percent recovery determined by recovery standards. No LC-MS analysis of the extracts was performed because TBBP-A was analysed with GC-MS, and HBCD concentrations were too low to detect the separate HBCD diastereomers in an LC-MS chromatogram.

PCBs, PBDEs and organochlorine pesticides

Sample analysis was performed at Lancaster University using methods based on those developed by Hovander *et al.* (2000), briefly entailing modification of the sample with HCl and Isopropanol, followed by extraction with a hexane:MTBE mixture. Samples were then cleaned using concentrated sulphuric acid, followed by gel permeation chromatography, before analysis by GC-MS.

Samples were analysed for 45 PCBs (PCBs 18, 22, 28, 31, 41/64, 44, 49, 52, 54, 60/56, 70, 74, 87, 90/101, 95, 99, 104, 105, 110, 114, 118, 123, 138, 141, 149, 151, 153, 155, 156, 157, 158, 167, 170, 174, 180, 183, 187, 188, 189, 194, 199 and 203) using a GC-quadrupole MS system (Finnigan TRACE) in EI mode. 12 organochlorine pesticides (α-chlordane, γ-chlordane, HCB, o,p'-DDD, p,p'-DDD, o,p'-DDE, p,p'-DDE, o,p'-DDT, p,p'-DDT, α-HCH, β-HCH and γ-HCH) were also analysed using the Finnigan TRACE GC-MS in EI mode. 21 PBDEs (BDEs 17, 28, 32, 35, 37, 47, 49, 71, 75, 77, 85, 99, 100, 119, 138, 153, 154, 166, 181, 183 and 190) were analysed using a GC-quadrupole MS system (Fisons MD800 or Finnigan TRACE) in NCI mode, using ammonia as the reagent gas. BDE209 was analysed using a GC-high resolution MS (Micromass Autospec Ultima) in EI mode, using a resolution of at least 10,000.

Quality control

All samples were spiked with ^{13}C-labelled recovery standards before extraction. The standards used included ^{13}C-labelled PCBs 28, 52, 101, 138, 153, 180 and 209 and ^{13}C-labelled BDE209. Concentrations were not corrected for the recoveries of these standards, but the recoveries were monitored to assess the effectiveness of the analytical methods. ^{13}C-labelled PCB recoveries averaged 79-84 % and ^{13}C-labelled BDE209 recovery averaged 107%.

Laboratory blanks, consisting of purified water, were analysed at a ratio of 1 for each ten samples analysed, and blank concentrations were subtracted from the concentrations found in each sample before application of the detection limit.

Control samples, consisting of the BD Vacutainer® tubes used for sample collection were prepared using purified water. After drawing the water into the tube the water was decanted and treated as a normal sample for analysis. At least 1 control sample was prepared for each 25 blood samples analysed.

At least one in-house reference material, consisting of homogenised seal blubber, was analysed for each 25 blood samples. Concentrations of selected analytes were compared to a control chart based on previous analyses of the reference material, and did not exceed the specified upper or lower action limit concentrations. The seal blubber used to prepare the reference material was taken from a stranded seal which had been found dead on a UK beach, and collected by a sea mammal research centre in the UK as part of their ongoing stranded sea mammal collection programme.

Detection limits

For chemicals detected in the blank samples the method detection limit was defined as three times the standard deviation of the blank value. In the absence of detectable concentrations in the blank samples the method detection limit was defined as the instrument detection limit (the amount of chemical required to achieve a signal to noise ratio of at least 10). PCB and OC pesticide detection limits were in the range 25-500 pg per sample, whilst PBDE detection limits were typically around 60 pg per sample for the less brominated congeners and 2 ng per sample for BDE209.

PFOA/PFOS

The blood was homogenized using high-speed homogenisation equipment in the tubes prior to the preparation of aliquots for analysis. Additional human blood samples were included as Q/A samples with each batch of analysis. These samples were used to check the performance of the entire procedure i.e. method replicates. Furthermore one extract was repeatedly injected with each batch on the instrument to check instrument performance. Method blank samples consisting of ultra-pure labwater (MilliQ) were also included with each batch.

Analytes

13 perfluoroalkyl acids were screened for using authentic reference substances. Two additional acids were monitored for which no reference substances are available as yet. These acids represent a range of compounds either industrially produced as e.g. surfactants by various manufacturers or formed through degradation of other perfluorinated industrial products, e.g. performance chemicals for water and stain repellancy treatment of leather and textile. The following perfluoroalkyl acids were analysed; perfluorohexanoic acid (PFHxA), perfluoroheptanoic acid (PFHpA), perfluorohexane sulfonate (PFHxS), perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorooctane sulfonamide (PFOSA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), perfluorodecane sulfonate (PFDS), perfluoroundecanoic acid (PFUnA), perfluorododecanoic acid (PFDoA), perfluorotetradecanoic acid (PFTDA), 1H,1H,2H,2H-tetrahydro-PFOS (THPFOS).

Methodology

Aliquots of the whole blood samples were extracted by ion-pair extraction using tetrabutylammonium (TBA) and methyl tertiary butyl ether (MTBE) according to a method published by Hansen *et al.* (2001). The extracts were reduced in volume and an internal volume reference added. The final extracts were filtered using a 0,45µm PP-filter before analysis on an LC-tandem MS equipment. Instrumental type and parameters were similar to those used by Hansen *et al.*

Detection limits and reproducibility

Traces of PFOA were occasionally encountered at concentrations at or slightly above the detection limit in the blank samples. These trace concentrations were corrected for. Instrument repeatability varied between 7 –24 % relative standard deviation for all substances. Method repeatability varied between 9 and 24% relative standard deviation for most of the substances. PFOSA, PFDA and PFUnA showed considerably higher variation mainly due to exceptionally low concentrations in one of the replicate extracts.

Phthalates

Blood samples were sent (frozen and on dry ice) to RIC. The samples were stored at –18°C until extraction and analysis.
The blood samples were extracted by liquid-liquid extraction and the analyses were performed by GC-MS in SIM mode.

The thawed blood samples were first homogenated and 1 g sample was transferred into a pre-cleaned extraction tube. 2 mL water was added, followed by 10 µl of a 10 ppm solution of deuterated DEHP (ring D4-DEHP). The resulting internal standard concentration in the extract corresponds to 100 ppb (100 ng/g). Then 1 mL acetonitrile was added. The sample was vortexed and placed in an ultrasonic bath at room temperature for 15 min. This treatment is used to disrupt the blood cells. It should be noted here that the measured phthalate concentrations correspond to whole blood concentrations (not serum or plasma). To the extraction tube, 1 mL cyclohexane is added and the sample is extracted for 30 min on a horizontal shaking machine. After extraction, the tube is centrifuged for 5 min and finally an aliquot of the upper organic phase is transferred to a pre-cleaned autosampler vial.

Using this sample preparation method, the risk for contamination is minimized. All reagents were checked for blank levels. The solvents used were pesticide residue analysis grade. The water was bottled drinking water (Vittel) since we experienced that lower blank levels can be obtained using this water in comparison to distilled water or MilliQ type laboratory waters.

The analysis is performed under the following conditions:

Instrument:	Agilent 6890 GC – Agilent 5973 MSD
Column:	30 m x 0.25 mm i.d. x 0.25 µm HP-5MS
Injection:	1 µL in splitless mode, 280°C
Carrier gas:	1 mL/min helium, constant flow
Oven program:	50°C – 1 min – 10°C/min – 330°C – 10 min
MS:	SIM mode, ions: see Table 1, 100 ms dwell time.

Table 1: Target compounds and measured ions in GC-MS analysis.

Phthalate	Abbreviation	Retention time (min)	Quantification Ion	Confirmation Ion
Dimethyl-	DMP	12.50	163	194
Diethyl-	DEP	14.28	149	177
Di-isobutyl-	DiBP	17.25	149	223
Dibutyl	DBP	18.20	149	223
Butylbenzyl	BBzP	21.85	149	91
Di(ethylhexyl)-	DEHP	23.24	149	279
D4-DEHP	IS	23.17	153	
Di(isononyl)	DiNP	23 - 27	293	149
Di(isodecyl)-	DiDP	24 - 27.5	307	149

Calibration curves were prepared for concentration levels at 10, 50, 100, 200 and 500 ppb, with the internal standard at 100 ppb for all single isomer phthalates. Di(isononyl)phthalate and di(isodecyl)phthalate consist of several isomers and consequently the response in GC-MS analysis is lower. For these mixed isomer phthalates, the calibration levels were ten times higher (100, 500, 1000, 2000 and 5000 ppb). The correlation coefficient for all calibration curves were better than 0.9950, except for DiNP (0.9916), due to more difficult integration.

The concentrations of the phthalates in the blood samples were calculated using the internal standard method. In the blank analyses (water only), some traces of DEP, DiBP, DBP and DEHP were detected. The values were all below 20 ppb. The reported values are corrected for the blank values.

The recovery of the method was tested by spiking a pooled blood sample with phthalates at 100 ppb concentration level (1000 ppb for DiNP and DiDP). The obtained concentrations, corrected for the measured concentrations in the non-spiked sample, were compared to the added concentrations. The results, expressed as % recovery, are included in Table 2. The repeatability of the method was determined by analysing the spiked pooled blood sample 3 times. The relative standard deviations (RSD) are also included in Table 2.

Table 2: Recovery and repeatability obtained for the target compounds.

Phthalate	Recovery (%)	RSD (%)
DMP	58	12
DEP	117	8
DiBP	97	5
DBP	107	4
BBzP	57	5
DEHP	99	5
DiNP	129	13
DiDP	136	15

RESULTS

The chemical concentrations found in the serum samples are summarised in Tables 3-6. The entire data set is shown in Appendix 1, Tables 1-21. It should be noted that the PCBs, organochlorine pesticides and PBDEs were analysed using a method which required the use of blood serum, whereas for HBCD, TBBP-A, the phthalates and the perfluoroalkyl acids whole blood was analysed. There is evidence, as is usual for pollutant concentrations in humans, that the concentrations of chemicals in the blood samples do not conform to a Normal distribution, so the data has been summarised using the median, ranges and quartile values (rather than using the mean and standard deviation, which require that the data conform to a Normal distribution). Note that values below the detection limit were excluded when calculating the minimum, median and quartile values and that quartile values were not calculated for chemicals found in less than 10 samples.

Table 3 – Summary of detected HBCD, TBBP-A, PFOA/PFOS and phthalate concentrations found in whole blood (N = Number of detected values)

Chemical	Minimum ng/g blood	Maximum ng/g blood	Median ng/g blood	25th Percentile *Only for N>10*	75th Percentile *Only for N>10*	N (out of 47)
TBBP-A	0.0019	0.33	0.036	0.0038	0.17	27
HBCD	0.063	0.063	0.063			1
DMP	34	34	34			1
DEP	3.0	340	5.0			5
DiBP	1.0	65	7.0	4.0	14	38
DBP	22	27	25			2
BzBP	6.0	29	18			4
DEHP	37	1200	160	89	260	45
DiNP	16	140	31	24	49	17
DiDP	32	550	95			4
PFHxA (1)	0.10	0.24	0.11	0.10	0.12	12
PFHpA (2)	0.10	0.39	0.13	0.11	0.25	29
PFHxS (3)	0.51	8.4	1.6	1.1	2.3	45
PFOA (4)	1.5	9.8	3.2	2.4	4.7	45
PFNA (5)	0.26	1.8	0.77	0.64	1.0	45
PFOS (6)	5.0	55	17	13	25	45
PFOSA (7)	0.23	2.0	0.61	0.46	0.99	45
PFDA (8)	0.05	1.4	0.46	0.34	0.66	45
PFUnA (9)	0.03	1.7	0.38	0.24	0.53	45
Sum1-9	12	71	24	20	35	45
PFDoA	0.10	0.17	0.12	0.10	0.12	5
PFTrDA	0.15	0.27	0.15	0.15	0.19	11
PFDS						0
THPFOS						0
Total Phthalates	**nd**	**1200**	**170**	**100**	**310**	**45**
SumPFOx	**12**	**71**	**24**	**20**	**35**	**45**

Table 4 – Summary of detected PCB concentrations found in blood serum (N = Number of detected values)

PCB	Minimum pg/g serum	Maximum pg/g serum	Median pg/g serum	25th Percentile *Only for N>10*	75th Percentile *Only for N>10*	N (out of 47)
18	6.1	28	8.9	7.6	12	25
22	6.3	71	8.9	7.2	19	19
28	17	76	30	24	42	37
31	14	59	24	19	29	15
41 + 64						0
44	2.5	26	3.7	3.2	4.7	23
49	8.8	21	11	10	14	20
52	3.2	27	6.7	5.4	7.9	47
54						0
70	3.6	39	5.2			5
74	7.7	190	55	38	78	47
87	3.4	16	5.1			5
90 + 101	13	78	19	16	22	13
95	11	61	16	13	19	15
99	9.1	120	42	29	60	44
105	3.1	84	20	11	32	32
110	4.4	29	5.5			8
114	3.0	21	7.2	5.2	9.9	36
118	14	390	110	72	150	45
123			4.1			1
138	62	1500	480	350	730	42
141	14	29	22			2
149	39	150	49			4
151	16	73	24			6
153	80	2000	720	530	1000	41
156	5.4	260	86	56	130	46
157	4.3	42	15	8.7	20	35
158	3.2	22	8.4	5.6	12	43
167	5.1	120	34	26	52	41
170	17	970	280	190	420	40
174	31	34	32			2
180	43	1900	640	400	900	43
183	17	140	52	29	83	41
187	51	490	150	96	200	41
189	3.7	13	8.5			5
194	31	320	100	56	150	40
203	30	200	73	45	100	34

Table 5 – Summary of detected PBDE concentrations found in blood serum (N = Number of detected values)

Chemical	Minimum pg/g serum	Maximum pg/g serum	Median pg/g serum	25th Percentile *Only for N>10*	75th Percentile *Only for N>10*	N (out of 47)
BDE17						0
BDE28	2.2	4.6	3.9			4
BDE32	2.5	45	14			6
BDE35						0
BDE37						0
BDE47	3.4	51	8.7	5.6	13	24
BDE49						0
BDE66	1.3	4.3	2.1			5
BDE71						0
BDE75						0
BDE77						0
BDE85						0
BDE99	3.1	32	6.8	4.7	10	16
BDE100	1.6	260	5.7	2.8	8.8	16
BDE119						0
BDE138						0
BDE153	3.0	34	10	8.0	17	47
BDE154	2.0	9.3	4.5	3.3	6.5	42
BDE166			3.2			1
BDE181						0
BDE183	1.8	17	3.3	2.5	4.4	27
BDE209	230	18000	410	280	780	16
Total PBDE	**6.5**	**18000**	**61**	**21**	**310**	**47**
Total PCB	**160**	**8200**	**2800**	**1800**	**4200**	**47**

Table 6 – Summary of detected organochlorine pesticideand total chemical group concentrations found in whole blood or blood serum (N = Number of detected values)

Chemical	Minimum ng/g serum	Maximum ng/g serum	Median ng/g serum	25th Percentile *Only for N>10*	75th Percentile *Only for N>10*	N (out of 47)
HCB	0.079	1.1	0.2	0.14	0.33	47
o,p'-DDD						0
o,p'-DDT	0.0058	0.0075	0.0063			4
o,p'-DDE	0.0058	0.0058	0.0058			1
p,p'-DDD	0.0049	0.033	0.0073	0.0062	0.0096	13
p,p'-DDE	0.25	8.0	1.3	0.77	2.2	47
p,p'-DDT	0.0071	0.65	0.026	0.016	0.040	39
a-HCH	0.0081	0.0081	0.0081			1
b-HCH	0.0072	0.570	0.097	0.047	0.16	44
g-HCH						0
All OCPs analysed	**0.45**	**9.7**	**1.7**	**0.94**	**2.7**	**47**
Total HCH	**nd**	**0.57**	**0.087**	**0.042**	**0.150**	**47**
Total DDT†	**0.25**	**8.1**	**1.3**	**0.79**	**2.2**	**47**
All chemicals	**11**	**1300**	**370**	**220**	**540**	**47**
No. chemicals found	**25**	**54**	**41**	**36**	**47**	

† = including metabolites; nd = not detected

DISCUSSION

We believe this to be the most comprehensive survey of this range of chemicals in concurrent human blood samples using participants from across Europe.

HBCD AND TBBP-A

Tetrabromobisphenol-A

Earlier studies published in the literature have reported TBBP-A to be detectable in humans (Klasson Wehler *et al.*, 1997; Thomsen *et al.*, 2001). Investigating an occupationally exposed group, Jakobsson *et al.*, (2002) quantified TBBP-A in four serum samples from Swedish computer technicians and reported TBBP-A concentrations between <1 and 3.4 pmol/g lipid weight (equivalent to approximately <0.001 ng/g whole blood to 0.005 ng/g whole blood, assuming approximately 0.25% lipids in whole blood). The highest concentration measured in whole blood in this current study (0.33 ng/g whole blood) is roughly a factor 100 higher than these value, (after correction for the different units). In Norway, TBBP-A concentrations measured in a larger number of human blood plasma samples from different occupation groups were determined to be between 0.3 and 1.8 ng/g lipid (Thomsen *et al.*, 2001). The highest concentration measured in whole blood in this current study is, again, roughly a factor 100 higher than these values (after correction for the different units).

The differences between previous studies of plasma and serum and this study, using whole blood, may have to do with some difference in the distribution of TBBP-A among the different blood compartments. TBBP-A may be, for example, to some degree sequestered in red blood cells, which are not present either in plasma or serum.

In a study of occupationally exposed workers in Sweden, Hagmar *et al.* (2000) estimated the halflife of TBBP-A in blood serum to be about 2 days. TBBP-A is known to be quickly metabolised in other mammals, such as the rat. One study showed that the half-life after oral administration in rat was <3 days (WHO/IPCS, 1995). Rapid metabolism of TBBP-A has been reported in more recent studies in rats (Meerts *et al.*, 1999) and quail (Halldin *et al.*, 2001).

A known possible metabolite of TBBP-A is tetrabromobisphenyl-A (Me-TBBP-A) (Hakk & Letcher 2003). This compound was also screened in the same GC/MS chromatograms generated for the other analytes, although none of this possible metabolite was detected in any samples above the level of blanks. Because this is more lipophilic than the parent compound, it probably would have a longer half-life in the body than the parent compound, and thus we suspect this is not a metabolic route in the individuals tested. Debromination is another possible metabolic pathway.

Hexabromocyclododecane

HBCD has not been reported in human blood to date, therefore it was interesting to observe it in one individual in the current study (Table 3). HBCD has been found in all samples analysed in a study of Norwegian human mother's milk, at concentrations between 250 and 2000 ng/kg lipids (Thomsen *et al.*, 2003). This is considerably higher than found in the single positive result in this study (0.063 ng/g blood), which can be at least party due to the higher lipid content in milk than whole blood. The higher lipid content means that the milk has a larger capacity to contain this lipophilic compound.

Exposure and Toxicology

What do these data mean from a toxicological standpoint? Levels of TBBP-A and HBCD were either undetectable or low in the blood of the individuals tested. The occupation of the blood donors does not belong to a high-risk category. The exposure for subjects in the current study was either low, or a high rate of elimination from the body must have been taking place. There are indications that TBBP-A can be eliminated quickly, as mentioned above.

Because the main uptake route for TBBP-A is probably inhalation (Sjödin *et al.*, 2003), the type of diet in this case may not be correlated to TBBP-A levels in blood. BFR concentrations are believed to be independent of age of the adult e.g. (Thomsen *et al.* 2002).

The toxicology of these chemicals is not yet sufficiently elucidated. Legler & Brouwer (2003) have reviewed the literature for evidence of endocrine disruption of TBBP-A. While it is sometimes suggested that TBBP-A may act as an endocrine disruptor (at least in vitro), a cytotoxicant and an immunotoxicant, there is currently somewhat more evidence that it disrupts thyroid system functioning (Birnbaum & Staskal 2004) as for example was demonstrated in two recent articles (Meerts *et al.*, 2000; Kitamura *et al.*, 2002).

This is one of the few studies to date to present data on the levels of TBBP-A or HBCD in human blood.

PCBS, PBDES AND ORGANOCHLORINE PESTICIDES

To aid comparison with the other chemical concentrations reported here the PCB, PBDE and organochlorine pesticide concentrations have been reported in the previous tables on a ng or pg/g serum basis. For comparison with the recent WWF UK human serum survey the concentrations on a ng/g lipid basis are summarised in Appendix 2. In this section we compare the ng/g lipid concentrations to previous studies.

PCBs

The total PCB concentrations (defined as the sum of all congeners detected) ranged from 23 to 930 ng/g lipid, with a median of 390 ng/g lipid (equivalent to 160-8200 pg/g serum, median 2800 pg/g serum). PCBs 153, 180 and 138 (in that order) were the dominant congeners, each contributing more than 10% to the median total PCB concentration as has regularly been seen in the past.

Some previously published concentrations of PCBs in the western European population are summarised in Table 7. The main criterion for inclusion of data in the table was the comparability of data presentation (i.e. range and median or geometric mean, as the arithmetic mean concentration alone is little use for comparative purposes). The surveys of PCBs in the UK population were the only ones found in the scientific literature. The median and range of total PCB concentrations are similar to concentrations previously reported in serum from the Netherlands and Belgium since 1991, and similar to concentrations found in Welsh milk-fat in 1990-1. The median is almost double the median found in the recent WWF UK survey, although the maximum and minimum values are only approximately 50% higher than in the UK survey.

Table 7 – PCB concentrations previously found in samples from the European population

Region	Year	Sample Type	Total PCB concentration ng/g lipid median (*range*)	Reference
Wales	1990-1	Adipose	850 (260-2600)	Duarte-Davidson *et al.*, 1994a
Wales	1990-1	Milk	440 (140-1700)	Duarte-Davidson *et al.*1994b
Netherlands	1991	Serum	550†‡	from Covaci *et al.*, 2002
Netherlands	1995	Serum	450†‡	from Covaci *et al.*, 2002
Belgium	1999	Serum	350 (110-1000)†	Covaci *et al.*, 2002
Belgium	1999	Serum	530 (450-680**)	Koppen *et al.*, 2002
London & Lancaster	2001-3	Milk	120* (2.6-530)	Kalantzi *et al.*, 2003
Belgium	2002	Adipose	480‡ (190-1100)	Chu *et al.*, 2003
UK	2003	Serum	170 (14-670)	WWF, 2003
EU (17 countries)	2003	Serum	390 (23-930)	This study

* = Geometric mean; ‡ = Arithmetic mean; † = Calculated assuming 0.5% lipid in blood; ** = 95th Percentiles

Organochlorine pesticides

a-Chlordane and g-chlordane were not detected in any of the samples analysed, and of the other organochlorine pesticides analysed HCB, p,p'-DDE, p,p'-DDT and b-HCH were most commonly detected and were dominant in almost all samples.

The median, maximum and minimum concentrations of b-HCH were very close to those found in the recent WWF UK survey, whilst the median concentrations of p,p'-DDE and HCB were almost double the medians found in the UK survey. Organochlorine pesticide concentrations found in other studies of western Europeans are summarised in Table 8. It can be seen that p,p'-DDE concentrations found in this study are somewhat lower than recently found in Belgium.

The pesticides o,p'-DDD, o,p'-DDT, o,p'-DDE, p,p'-DDD, a-HCH and g-HCH were detected in few samples. In most cases the p,p'-DDE concentration greatly exceeded (by more than an order of magnitide) the p,p'-DDT concentration, indicating that exposure to the DDT pesticide was either through the indirect route (e.g. through the diet) or some time in the past. In four cases, however, the concentration of p,p'-DDE was close to or less than ten times the concentration of p,p'-DDT, which may indicate more recent exposure. Only one of these volunteers had ever spent time in areas where malaria is prevalent (DDT is in current use in some malarial areas).

Table 8 – Organochlorine pesticide concentrations previously found in samples from the European population

Region	Year	Sample Type	Concentration (ng/g lipid) Median (Range)			Reference
			p,p'DDE	HCB	b-HCH	
Wales	1990-1	Adipose	990 (110-6400)			Duarte-Davidson *et al.* 1994a
Wales	1990-1	Milk	310 (35-6000)			Duarte-Davidson *et al.*, 1994b
UK	1997-8	Milk	280 (<60-4000)	250 (<12-330)	50 (<8-750)	Harris *et al.*, 1999
Belgium	1999	Serum	310 (110-4100)†	36 (12-100)†		Covaci *et al.*, 2002
Belgium	1999	Serum	870 (730-1200**)	110 (90-132**)		Koppen *et al.*, 2002
Belgium	2002	Adipose	480‡ (84-1800)			Chu *et al.*, 2003
London & Lancaster	2001-3	Milk	110*(1.7-1600)	14*(0.3-180)	16*(0.1-1500)	Kalantzi *et al.*, 2003
UK	2003	Serum	100 (15-2600)	14 (5.4-72)	12 (1.9-80)	WWF, 2003
EU (17 countries)	2003	Serum	200 (32-1200)	27 (11-150)	13 (1.1-86)	This study

* = Geometric mean; ‡ = Arithmetic mean; † = Calculated assuming 0.5% lipid in blood; ** = 95th Percentiles

PBDEs (polybrominated diphenyl ethers)

BDE153 was found in all samples analysed, BDE154 was found in 42 samples out of the 47 analysed, BDE183 and BDE47 were found in approximately half (27 and 24 samples, respectively) of the samples, and BDE99, BDE100 and BDE209 were each found in 16 samples. The seven PBDE congeners most regularly detected in the serum samples were BDEs 47, 99, 100, 153, 154, 183 and 209. BDEs 47, 99, 100, 153 and 154 are present as the major constituents of the pentaBDE commercial flame retardant product, BDEs 153 and 183 are the dominant constituents of the octaBDE commercial flame retardant product and BDE209 is the dominant constituent of the decaBDE commercial flame retardant product. The median concentration of BDE153 was higher than the median concentration of BDE47, as was found in the recent WWF UK survey, in Belgian adipose samples by Covaci *et al.*, 2002 and in serum from some occupational groups in Sweden between 1997 and 2000 (Jakobsson *et al.*, 2003).

The average PBDE congener pattern, calculated as the mean of the percentage contribution of BDEs 47, 99, 100, 153, 154 and 183 to the sum of those six congeners in each sample, is shown in Figure 1. Only approximately 13% of the individual samples had congener patterns similar to those seen in other human studies (BDE47 dominating, followed by BDEs 153, 99, 100 and 154, usually in that order) but no common factor could be found in the personal data available to explain this finding.

Only one sample in this study had a total PBDE (excluding BDE209) concentration higher than 30 ng/g lipid, which had been noted for the highest 5% of samples in the recent UK survey.

BDE209 was found in 16 samples, ranging in concentration from close to the detection limit (approximately 2 ng/g lipid) - 8 samples - to a maximum of 2400 ng/g lipid. (Note that the concentration in ng/g lipid should be divided by 0.958 to give the concentration expressed in pmol/g lipid, used in some publications). The samples with detectable levels of BDE209 came from Nationals from 11 EU countries: Austria, Belgium, the UK, Denmark, the Netherlands, France, Germany, Ireland, Italy, Spain and Sweden. The highest two concentrations of BDE209 measured were 5 and 10 times higher than the third highest, which was equivalent to the highest concentration found in the WWF UK survey. These high levels were 10 times higher than found in occupational studies & these results represent the highest results found in any study of human media/blood to date, that we are aware of ?

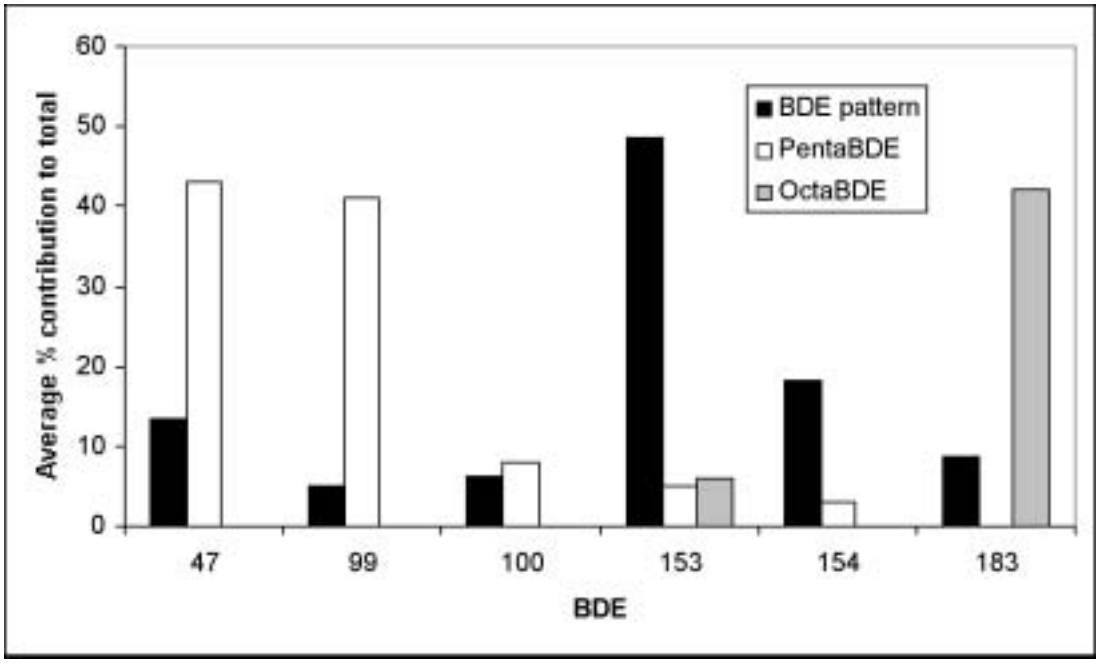

Figure 1 – PBDE congener profile for serum in this study ('BDE pattern' on figure) and the PentaBDE (Huber and Ballschmitter, 2001) and OctaBDE (European Union, 2003) products (NB. individual Br_8DE and Br_9DE congeners also make large contributions to the OctaBDE product).

PBDE concentrations in humans in western Europe have been summarised in Table 9. It can be seen that the total PBDE (congeners 47, 99, 100, 153, 154 – representing the pentaBDE technical product) concentrations found in this study are very similar to concentrations found in several European countries in recent years, including the recent WWF UK survey. Of the two large (highly brominated) BDE congeners analysed, which are indicative of octaBDE and decaBDE usage, respectively, BDE183 was found in this study at a similar median concentration, and with a similar range, as found in the UK survey and in recent studies in Sweden. BDE209 was found at a somewhat higher median concentration than found in Sweden, and with a much greater overall range of concentrations. It should be noted that the highest BDE209 concentrations reported in the Swedish study were samples taken from occupationally exposed people (workers in the flame retarded rubber industry).

PFOA/PFOS

Seven acids were found in all samples and an eighth in most samples. Several samples contained additional acids at trace concentrations. The sum of the nine most common acids ranged between 12 and 71 parts per billion (ng/g of whole blood). Perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) were the dominant acids found in all samples. One sample (sample 23) displayed a different profile with more of the long chain acids (9-13 carbons). Samples 15 and 43 had more than twice the average concentration of all samples.

The average concentrations of PFHxS (1.9ppb); PFOS (20ppb) and PFOA (3.8ppb) found in these blood samples correspond well with those found in serum; 2.9ppb; 43.5ppb and 5.6ppb respectively (factor of two: whole blood/serum) of the general population of the United States. The highest concentration found in these samples is almost one fifth of the highest concentration found in the US samples. The individuals investigated in the present study appear to have had a similar exposure to these compounds as the general population of the USA (3M, *year unknown*).

Table 9 – PBDE concentrations previously found in samples from the European population

Region	Year	Sample Type	Concentration (ng/g lipid) Median (Range)			Reference
			TotalBDE^	BDE183	BDE209	
Finland	1994-8	Milk	2.1‡			Strandman *et al.*, 2000
Germany	1985	Blood	3.1‡[d]			Schröter-Kermani *et al.*, 2000
	1990		3.6‡[d]			
	1995		3.7‡[d]			
	1999		3.9‡[d]			
Norway	1977	Serum	0.44‡			Thomsen *et al.*, 2002
	1986		1.1‡			
	1995		3.1‡			
	1999		3.1‡			
Sweden	1972	Milk	0.07‡			Summarised in Sjödin *et al.*, 2003
	1980		0.45‡			
	1990		1.2‡			
	2000		2.6‡			
Belgium	2000	Adipose	4.8‡			Covaci *et al.*, 2002
Sweden	1997	Serum		11 (3.0-25) ED	4.8 (<0.29-9.5) ED	Jakobsson *et al.*, 2003
	1998			<0.38 (<0.38-1.6) CB	2.3 (<0.96-5.6) CB	
	2000			<0.48 (<0.48-1.1) RM	28 (1.2-140) RM	
	2000			<1.9 RW	34 (6.7-280) RW	
	1999			1.2 (0.23-6.1) CT	1.5 (<0.96-6.8) CT	
	1997			0.23 (<0.02-1.3) C	<0.67 (<0.67-7.7) C	
	1997			0.15 (0.029-0.37) CL	<0.67 (<0.67-3.7) CL	
	2000			<0.38 AB	2.4 (0.92-9.3) AB	
Sweden	2001-2	Blood	4.9‡[c]			Van Bavel *et al.*, 2002
London & Lancaster	2001-3	Milk	6.6* (0.3-69)			Kalantzi *et al.*, 2003
UK	2003	Serum	4.6 (0.52-420)	0.59 (0.19-1.8)[a]	83 (35-240)[b]	WWF, 2003
EU (17 Countries)	2003	Serum	2.7 (0.5-43)	0.4 (0.2-2.2)	57 (28-2400)	This study

^ = sum of BDEs 47, 99, 100, 153 and 154 unless otherwise indicated; * = Geometric mean; ‡ = Arithmetic mean; † = Calculated assuming 0.5% lipid in blood; ** = 95th Percentiles; [a] = only detected values used (N = 85); [b] = only detected values used (N = 11); [c] = sum of BDE47, 99, 153; [d] = BDE47 only; ED = Electronics dismantlers; CB = Circuit board recycling workers; RM = Rubber mixers; RW = Rubber wire production; CT = Computer technicians; C = Clerks; CL = Cleaners; AB = Abattoir workers

PHTHALATES

Traces of phthalates were detected in all samples analysed. Di(ethylhexyl)phthalate is the most abundant phthalate and was present in all 45 samples analysed, with a median concentration of 155 ng/g (range 37-1200 ng/g, mean 235 ng/g). The other phthalates were only detected at trace levels.

The authors could only find two previous reports of phthalate concentrations in human blood in the literature. DEHP was reported to be present in cord blood taken from Italian newborns at a mean concentration of 1,190 ng/ml serum (range 930-1,440 ng/ml) (Latini *et al.*, 2003). DEHP was found at similar median and range of concentrations to this study in a control group of women in an endometriosis study (median 180 ng/ml, range nd-1,030 ng/ml) (Cobellis *et al.*, 2003).

STATISTICAL ANALYSIS

The questionnaire results were transferred into a spreadsheet and, where appropriate, the answers were divided into a small number of discrete bands. The entire data-set, formed by the chemical concentration data and the questionnaire data, was transferred into SPSS (a statistical software package) for statistical analysis.

As is common in surveys of chemical pollutants in animals, there was evidence that the chemical concentrations did not conform to the Normal distribution, but were closer to the log-Normal distribution. Chemical concentration data were therefore transformed to their natural logarithms (ln) for some of the statistical analyses (this is stated when performed). To reduce the complexity of the analysis one PCB was chosen to represent each chlorination level represented in the PCBs analysed (PCBs 28, 52, 118, 153, 180 and 194). Six PBDEs were also chosen as representative of the technical flame retardant products used in the UK (BDEs 47, 99, 100, 153, 154 and 183). Only the OC pesticides, phthalates, PFOS/PFOA and other flame retardant chemicals which were most commonly detected (total HCH, p,p'-DDE, p,p'-DDT, HCB, TBBP-A, DiBP, DEHP, PFHpA, PFHxS, PFOA, PFNA, PFOS, PFOSA, PFDA and PFUnA) were included in the analysis.

Descriptive statistics

47 volunteers provided samples, one of whom did not complete a questionnaire. The questionnaire results showed that 23 volunteers were male and 23 female. The volunteers were aged from 35 to 66 years, with a median of 52 years. The body mass index (BMI) of the volunteers ranged between 19.7 and 35.5, with a median of 24.8. 5 volunteers reported that they were gaining weight, 3 that they were losing weight, and the remainder had a stable weight. The volunteers identified themselves as being of the following nationalities (with the number of volunteers of each nationality in brackets): Austrian (1), Belgian (3), British (11), Danish (4), Dutch(4), Estonian (1), French(3), German (3), Greek (3), Hungarian (1), Irish (2), Italian (1), Lithuanian (1), Luxembourg (1), Polish (1), Spanish (3), Swedish (4). The volunteers identified their main current residence as: Belgium (10), Denmark (3), France (2), Germany (3), Greece (3), Hungary (1), Ireland (2), Lithuania (1), Luxembourg (1), Netherlands (2), Spain (3), Sweden (4), UK (7). 32% of volunteers had bought a new carpet, mattress, sofa or car in the last year, 47% between 1 and 3 years ago, 17 % between 4 and 10 years ago and the remainder more than 10 years ago. 1 volunteer classed themself as a vegetarian who eats fish, and the remainder as omnivores. 40% of the volunteers estimated that between 1 and 25% of their diet was organically produced, 28% said between 25 and 50%, 9 % between 50 and 75%, and 4% said greater than 75%. 9 of the female volunteers had not had a child, 7 had had one, 7 had had 2 children and 1 had 4 or more children. All of the women who had given birth to 1 or 2 children had breastfed each child.

Correlation of chemical concentrations

To investigate the correlation of different chemicals they were grouped, according to historic usage pattern, as Total DDT and metabolites (TotDDX), Total PCBs (TotPCB), HCB, Sum BDEs 47, 99, 100, 153, 154 (PenBDE), Sum BDEs 153, 183 (OctaBDE) and BDE209. PFOS was found to correlate well (>95% significance) with all other PFOA/PFOS chemicals except PFHPA, so PFHPA and PFOS were used as illustrative chemicals for this group of chemicals. The phthalates DiBP and DEHP were used separately, as was TBBP-A. All correlations were tested at the 95% confidence level.

It was found that DEHP correlated well with TBBP-A and that PFOS correlated well with b-HCH, TotPCB and TotDDX. TotDDX also correlated well with b-HCH, HCB and OctaBDE, and HCB correlated well with TotPCB and OctaBDE. Finally, OctaBDE correlated well with DIBP. From this it appears that PFOS (representing all PFOA/PFOS chemicals analysed except PFHPA) and OctaBDE, although only just becoming chemicals of environmental concern, correlate with some 'old use' chemicals. As seen in the recent WWF UK survey, the 'old use' chemicals (banned for some decades in the most EU countries) tend to correlate well with each other.

Effect of lifestyle and personal data on chemical concentration

Each of the selected chemicals (log transformed) was split into groups defined by the coding of each question in the questionnaire. The means of these groups were compared using a one-way ANOVA function to see whether the lifestyle or personal data may have an impact on the chemical concentration. The significant results are presented in Table 10.

Table 10 – Significant (at the 95% confidence level) differences between chemical concentrations for personal or lifestyle groupings

Lifestyle parameter	Chemicals with significant differences between groupings
Sex	PFOS
Age	b-HCH
Weight change	DEHP
Visits to malarial countries	TotDDX
Flame retarded products purchased	BDE209
Nationality	HCB, b-HCH, TotDDX, PenBDE, OctBDE, BDE209
Current location	HCB, b-HCH, TotDDX, OctBDE

It should be noted that some of the groups for some parameters represented few volunteers, and that some of the questions asked may give answers which correlate to some degree with other parameters, but are otherwise unrelated (e.g. as age increases it will be more likely that women will have had more children, so the impact of age may be seen in the significance of difference in groups for the number of children carried, and *vice versa*). We will concentrate on the parameters which had the most complete data-sets (i.e. all, or most, groups with reasonable numbers of volunteers) – excluding those that had insufficient data – and which may be expected to have the greatest impact on chemical concentrations.

PFOS and Sex

The boxplot shown in Figure 2 shows that there may be an effect of sex on PFOS concentration. The median PFOS concentrations were similar for both males and females, but the minimum and maximum values are somewhat higher for males than females. A t-test of the logged data showed that the difference between males and females is significant at the 95% confidence level.

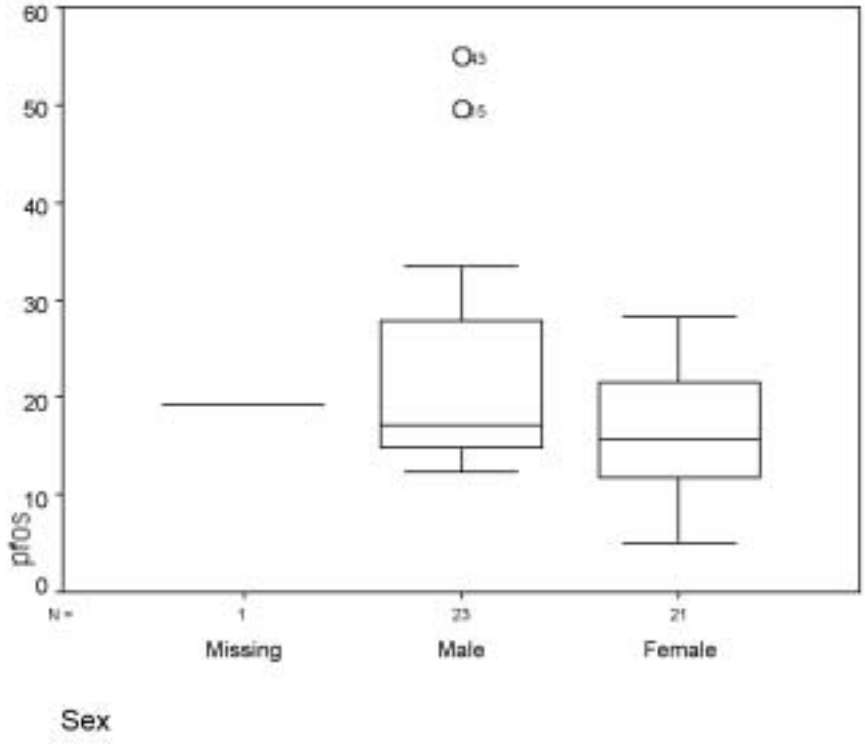

Figure 2 – Boxplot of PFOS concentration (ng/g blood) for males and females

Correlations with age

Linear models of logged chemical concentrations against age, with sex differentiation showed that b-HCH and the tetra-, penta- and hepta-chlorbiphenyls correlated well (at the 95 % significance level) with age. No effect of sex or number of children breastfed could be found.

Flame retarded products purchased

A boxplot of the logged BDE209 concentrations, differentiated by the time since the volunteer last purchased an article that was likely to be flame retarded is shown in Figure 3. It can be seen that there may be an effect of recent (<1 year ago) flame retarded goods pur chase on the BDE209 concentration. However, this was not seen for the other flame retardants PentaBDE, OctaBDE, and TBBP-A. Two BDE209 concentrations stand out as being very much higher than the others – one of these came from a volunteer who had recently bought goods that were probably flame retarded, the other said that they had never bought goods that were likely to have been flame retarded. It should be noted that the questionnaire did not include questions specific to particular types of flame retardant uses, for which particular technical flame retardant products are used, and did not include questions on the purchase of household electrical goods which may be flame retarded.

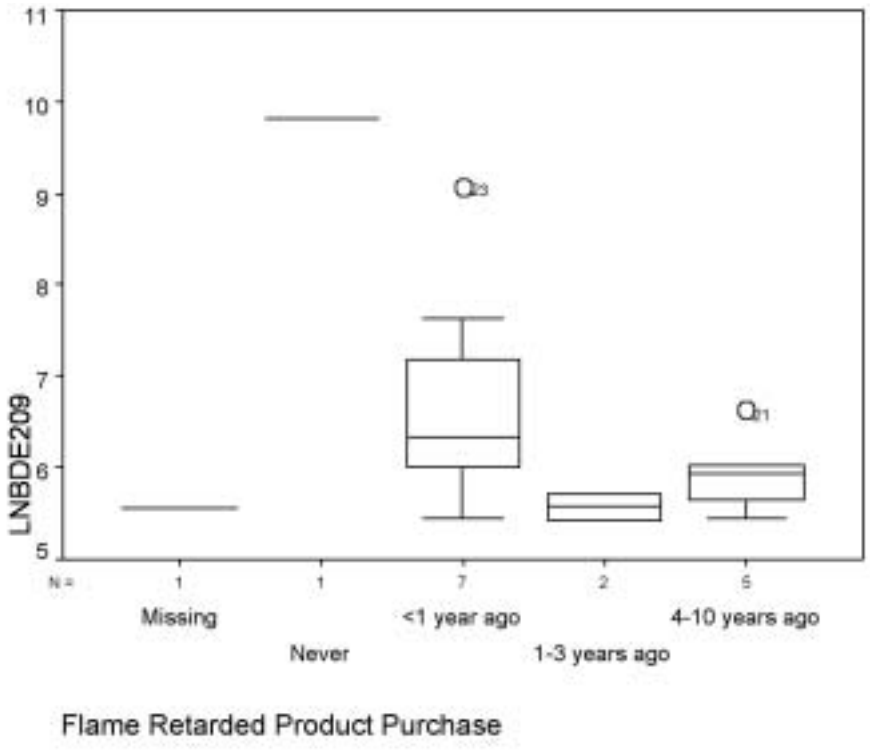

Figure 3 – Boxplot of logged BDE209 concentrations, differentiated by the length of time since new goods which were likely to have been flame-retarded had been purchased.

Nationality

In order to ensure that the volunteers' confidentiality is not comprised, concentrations of chemicals found in their blood are not presented alongside their nationality. It should be noted that each nationality are represented by a very small number of volunteers, and that the results should therefore be treated with caution. Spanish and Greek volunteers had the highest median concentrations for HCB and b-HCH, with German volunteers also having relatively high concentrations of HCB and French having relatively high concentrations of b-HCH. Greek volunteers showed the highest median concentration of Total DDX. British volunteers had the highest median concentrations of PentaBDE (but not the highest individual concentration), and British and Danish volunteers had the highest concentrations of OctaBDE.

Principal Components Analysis

In another attempt to find patterns in the data which might be used to elucidate effects of particular lifestyle or personal parameters principal components analysis (PCA) was performed on the data but did not produce any informative results.

CONCLUDING REMARKS

This study was, we believe, the first survey of human blood concentrations of HBCD, TBBP-A, Phthalates, PFOS/PFOA, PCBs, organochlorine pesticides and PBDEs in concurrent samples in Europe. The study indicates that there may be differences in chemical exposure patterns between different European countries. We have shown that there may be an impact of gender on PFOS concentration and that the correlation between PCB concentrations and age seen in the recent WWF UK survey is true for this group of people drawn from a number of countries. This is the first report of HBCD in human blood that we are aware of, and we have found higher concentrations of TBBP-A and BDE209 than has previously been reported, even in occupationally exposed people. Finding comparatively high concentrations of TBBP-A and BDE209 in some samples leads us to conclude that the sources of human exposure to these chemicals should be further explored.

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APPENDIX 1 - CONCENTRATIONS OF CHEMICALS IN BLOOD SAMPLES

Appendix 1, Table 1 – PCB concentrations in blood samples

Sample	EU2	EU3	EU4	EU5	EU6	EU7	EU8
PCB	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
18	<5.4	<5.8	9.2	8.6	12	8.9	8.2
22	71	7.4	<6.4	<6.2	6.4	15	8.9
28	76	42	38	28	25	47	29
31	49	<15	<15	<14	15	23	23
41+ 64	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
44	3.9	3.4	3.7	3.2	3.7	4.7	4.7
49	<7.1	<7.6	<7.6	9.0	13	9.6	<9.1
52	6.4	9.5	7.5	6.8	7.8	9.7	7.6
54	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
60 + 56	<84	<90	<90	<88	<85	<98	<110
70	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
74	110	77	88	66	16	70	32
87	<2.5	<2.7	<2.7	<2.6	3.4	<2.9	<3.2
90 + 101	16	29	22	<13	19	16	<17
95	11	30	17	11	15	15	<12
99	52	73	52	28	9.4	120	29
104	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
105	24	37	27	21	<2.5	43	4.1
110	5.3	8.0	4.5	<3.7	6.2	<4.1	<4.6
114	11	16	5.3	11	<2.5	11	3.5
118	150	200	140	140	24	180	61
123	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
138	750	490	390	440	150	660	390
141	<10	<11	<11	<11	14	<12	<13
149	39	50	<42	<41	48	<45	<50
151	20	30	26	<16	21	<18	<20
153	1000	570	460	610	200	730	510
155	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
156	160	130	60	170	22	110	71
157	21	27	6.3	20	<2.5	16	8.2
158	11	7.9	5.5	4.7	5.1	17	8.8
167	59	42	25	52	7.5	31	26
170	540	150	150	390	88	190	230
174	<13	<14	<14	<13	31	<15	<16
180	980	290	300	860	220	400	490
183	96	29	46	32	25	54	36
187	160	91	99	150	62	140	98
188	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
189	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
194	140	31	41	190	45	49	68
199	<2.5	<2.7	<2.7	<2.6	<2.5	<2.9	<3.2
203	92	28	34	87	30	38	41

Appendix 1, Table 2 – PCB concentrations in blood samples

Sample	EU10	EU11	EU12	EU13	EU15	EU16	EU17
PCB	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
18	7.2	7.6	7.1	<5.3	<7.9	<5.3	12
22	<6.5	<6	<6.8	<5.8	15	6.3	6.8
28	20	24	20	29	39	18	30
31	<15	<14	<16	<13	<20	<13	16.1
41+ 64	<2.7	<2.5	<2.8	<2.4	<3.7	<2.4	<2.6
44	<2.7	<2.5	<2.8	3	4.1	2.5	3.5
49	10	10	9	11	14	<7	<7.5
52	6.8	4.8	5.4	8.7	7.2	5.9	9
54	<2.7	<2.5	<2.8	<2.4	<3.7	<2.4	<2.6
60 + 56	<92	<84	<96	<82	<120	<82	<89
70	<2.7	<2.5	<2.8	<2.4	<3.7	<2.4	4.2
74	39	62	56	86	140	28	188
87	4.3	<2.5	<2.8	5.8	<3.7	<2.4	<2.6
90 + 101	<14	<13	<15	12.8	<19	<13	<14
95	<10	<10	<11	<9	<14	<9	12
99	57	76	39	63	111	20	74
104	<2.7	<2.5	<2.8	<2.4	<3.7	<2.4	<2.6
105	21	28	20	35	84	3	39
110	<3.9	<3.6	<4.1	<3.5	<5.2	<3.5	<3.7
114	6.2	7.9	6.8	10.5	17.7	3	20.6
118	110	160	130	180	390	31	190
123	<2.7	<2.5	<2.8	<2.4	<3.7	<2.4	<2.6
138	580	790	640	950	1500	380	1100
141	<11	<11	<12	<10	<15	<10	<11
149	<43	<39	<45	<38	<57	<38	<41
151	<17	<15	<17	<15	<22	<15	<16
153	720	1100	800	1300	1800	580	1700
155	<2.7	<2.5	<2.8	<2.4	<3.7	<2.4	<2.6
156	90	120	110	210	250	93	270
157	12	20	15	28	41	8	42
158	12	15	8	11	22	3	12
167	35	58	51	63	122	21	64
170	280	490	320	630	720	400	920
174	<14	<13	<14	<12	<19	<12	<13
180	660	1100	640	1300	1400	820	1900
183	65	120	56	83	140	48	130
187	200	190	180	310	400	150	260
188	<2.7	<2.5	<2.8	<2.4	<3.7	<2.4	<2.6
189	<2.7	<2.5	<2.8	11.5	<3.7	<2.4	13.4
194	130	210	70	210	180	140	320
199	<2.7	<2.5	<2.8	<2.4	<3.7	<2.4	<2.6
203	110	130	51	120	150	76	200

Appendix 1, Table 3 – PCB concentrations in blood samples

Sample	EU18	EU19	EU20	EU21	EU22	EU23	EU24
PCB	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
18	11	8.9	7.0	7.2	<5.1	9.1	13
22	<5.9	30	8.1	6.9	<5.7	<7.7	7
28	30	51	42	31	18	32	27
31	<14	27	14	<15	<13	<18	16
41+ 64	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
44	4.8	3.4	3.2	4.4	2.7	<3.2	2.8
49	14	11	11	12	11	15	15
52	14	6.8	6.6	8.1	5.4	6.8	7.5
54	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
60 + 56	<84	<85	<84	<95	<80	<110	<82
70	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
74	58	44	110	59	70	60	80
87	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
90 + 101	20	15	<13	20	<12	<17	<13
95	16	13	<10	20	<9	<12	<9
99	66	29	68	73	27	40	55
104	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
105	17	7	31	10	10	33	18
110	4.4	<3.6	<3.6	5.6	<3.4	<4.6	<3.5
114	5.7	6.4	7.6	7.5	9.8	7.8	8.2
118	100	70	170	97	110	190	130
123	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
138	590	410	610	900	530	860	990
141	<10	<11	<11	<12	<10	<14	<10
149	<39	<39	<39	<44	<37	<50	<38
151	<15	<15	<15	<17	<15	<20	<15
153	790	630	790	1200	770	1200	1500
155	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
156	85	100	100	130	160	130	190
157	15	10	15	15	29	24	27
158	13	7	15	15	6	5	13
167	34	31	43	45	55	89	67
170	280	350	340	420	440	620	640
174	<13	<13	<13	<14	<12	<16	<12
180	700	700	750	920	900	1500	1300
183	84	43	83	110	36	110	110
187	200	110	210	180	170	490	220
188	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
189	<2.5	<2.5	<2.5	<2.8	3.7	<3.2	6.6
194	120	120	130	99	130	240	150
199	<2.5	<2.5	<2.5	<2.8	<2.4	<3.2	<2.4
203	110	66	110	73	72	150	100

Appendix 1, Table 4 – PCB concentrations in blood samples

Sample	EU25	EU26	EU27	EU28	EU29	EU31	EU32
PCB	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
18	<6.2	<7.1	<5.8	<7	6.1	<7	<5.7
22	<6.9	<7.9	<6.4	<7.7	11.8	<7.7	42.6
28	23	<21.4	20	26	30	22	51
31	<16	<18	<15	<18	<13	<18	31.5
41+ 64	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
44	3	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
49	<8.2	<9.4	<7.7	<9.2	<6.9	<9.2	<7.5
52	5.4	5.4	5.1	4.9	5.4	7.3	4.9
54	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
60 + 56	<97	<110	<91	<110	<82	<110	<88
70	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
74	50	48	40	54	84	77	83
87	<2.9	<3.3	<2.7	<3.2	<2.4	5.1	<2.6
90 + 101	<15	<17	<14	<17	<13	<17	13.5
95	<11	<13	<10	<12	<9	<12	<10
99	52	37	22	34	30	53	<2.6
104	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
105	15	21	<2.7	<3.2	11	15	36
110	<4.1	<4.7	<3.8	<4.6	<3.5	<4.6	<3.7
114	6.8	4.6	5.6	<3.2	8.3	10	12
118	98	150	79	60	97	<4.3	290
123	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
138	580	560	350	240	320	<47	<38
141	<12	<14	<11	<14	<10	<14	<11
149	<45	<52	<42	<50	<38	<51	<41
151	<18	<20	<16	<20	<15	<20	<16
153	770	730	580	<51	460	<51	<41
155	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
156	94	74	65	28	87	<3.2	120
157	12	9.1	8.4	<3.2	16	<3.2	16
158	12	8.2	5.5	5.6	5.5	12	11
167	39	54	30	<3.2	26	<3.2	<2.6
170	350	270	290	<20	160	<20	<16
174	<15	<17	<14	<16	<12	<16	<13
180	810	620	690	210	340	<30	<24
183	77	65	50	<15	24	<15	<12
187	180	170	200	<22	82	<22	<18
188	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
189	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
194	150	70	120	<4.3	52	<4.3	<3.5
199	<2.9	<3.3	<2.7	<3.2	<2.4	<3.2	<2.6
203	99	48	69	<33	38	<34	57

Appendix 1, Table 5 – PCB concentrations in blood samples

Sample	EU33	EU34	EU35	EU36	EU37	EU38	EU39
PCB	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
18	<6.1	<7.3	17	<8.3	<7.6	<7.4	<5.4
22	<6.7	<8.1	24	34	<8.4	<8.2	<6
28	<18	<22	65	33	<23	<22	17
31	<16	<19	44	<21	<19	<19	<14
41+ 64	<2.8	<3.4	<3.2	<3.8	<3.5	<3.4	<2.5
44	<2.8	<3.4	26	<3.8	4.6	<3.4	<2.5
49	<8.1	<9.7	19	<11	<10.1	<9.8	<7.1
52	4.4	5.0	27	9.0	6.6	6.7	5.6
54	<2.8	<3.4	<3.2	<3.8	<3.5	<3.4	<2.5
60 + 56	<95	<110	<110	<130	<120	<120	<84
70	<2.8	<3.4	39	<3.8	<3.5	<3.4	<2.5
74	27	36	110	25	55	91	39
87	<2.8	<3.4	16	<3.8	<3.5	<3.4	<2.5
90 + 101	<15	<17	78	<20	<18	<18	<13
95	<11	<13	61	<15	<14	<13	<10
99	34	30	100	30	43	59	<2.5
104	<2.8	<3.4	<3.2	<3.8	<3.5	<3.4	<2.5
105	<2.8	<3.4	41	<3.8	<3.5	<3.4	11
110	<4	<4.8	29	<5.5	<5	<4.9	<3.6
114	<2.8	4.7	8.3	<3.8	3.6	8.3	3.5
118	72	77	210	50	92	89	<3.4
123	<2.8	<3.4	4.1	<3.8	<3.5	<3.4	<2.5
138	270	460	790	320	380	810	<36
141	<12	<14	29	<16	<15	<14	<11
149	<44	<53	150	<60	<55	<54	<39
151	<17	<21	73	<24	<22	<21	<15
153	390	760	1100	430	560	1400	<39.5
155	<2.8	<3.4	<3.2	<3.8	<3.5	<3.4	<2.5
156	31	71	62	49	55	130	56
157	<2.8	4.5	<3.2	<3.8	4.3	20	6.7
158	5.7	6.1	13	8.5	8.8	11	<2.5
167	17	27	31	15	23	37	<2.5
170	110	360	<20	160	170	450	<16
174	<14	<17	34	<20	<18	<18	<13
180	250	910	610	310	390	1000	<23
183	26	56	97	24	39	73	<12
187	57	260	240	63	77	220	93
188	<2.8	<3.4	<3.2	<3.8	<3.5	<3.4	<2.5
189	<2.8	<3.4	<3.2	<3.8	<3.5	<3.4	<2.5
194	31	150	91	36	53	130	<3.3
199	<2.8	<3.4	<3.2	<3.8	<3.5	<3.4	<2.5
203	<29	89	<33	<40	40	83	<26

Appendix 1, Table 6 – PCB concentrations in blood samples

Sample	EU40	EU41	EU42	EU43	EU44	EU45	EU46
PCB	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
18	18	21	<6.0	<7.4	<6.6	6.5	<7.3
22	<7.9	8.7	<6.6	<8.2	<7.3	<6.2	<8.1
28	36	45	<18	<22	22	<17	<22
31	24	25	<15	<19	<17	<14	24
41+ 64	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
44	11	11	<2.8	<3.4	<3.1	<2.6	<3.4
49	<9.4	9	<7.9	<9.8	<8.8	<7.4	<9.6
52	15	15	3.2	5.3	4.6	4	7
54	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
60 + 56	<110	<84	<94	<116	<100	<88	<110
70	<3.3	3.6	<2.8	<3.4	<3.1	<2.6	5.3
74	44	62	51	28	49	7.7	24
87	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
90 + 101	<17	23	<14	<18	<16	<13	<17
95	<13	20	<11	<13	<12	<10	<13
99	36	47	54	28	23	9.1	<3.4
104	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
105	<3.3	7.1	17	<3.4	<3.1	<2.6	<3.4
110	<4.7	4.6	<4	<4.9	<4.4	<3.7	<4.8
114	<3.3	5.7	4.5	4.1	6.4	<2.6	<3.4
118	47	110	130	75	120	14	42
123	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
138	300	460	460	280	390	62	<49
141	<14	<11	<12	<14	<13	<11	<14
149	<52	<39	<44	<54	<48	<41	<53
151	<20	16	<17	<21	<19	<16	<21
153	530	690	710	510	650	80	<53
155	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
156	49	67	56	52	130	5.4	40
157	<3.3	13	8	5.3	16	<2.6	<3.4
158	6.2	8.1	10	5.8	5.4	<2.6	<3.4
167	13	27	33	18	39	<2.6	<3.4
170	210	200	180	190	340	17	<21
174	<17	<13	<14	<17	<16	<13	<17
180	480	480	400	450	760	43	<31
183	26	42	52	27	19	<12	19
187	96	140	110	54	110	<17.6	<23
188	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
189	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
194	86	76	38	57	110	<3.5	<4.5
199	<3.3	<2.5	<2.8	<3.4	<3.1	<2.6	<3.4
203	44	55	30	<36	44	<27	<35

Appendix 1, Table 7 – PCB concentrations in blood samples

Sample	EU47	EU49	EU52	EU53	EU54
PCB	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
18	8.1	9.8	28	8.9	14
22	<7.6	<7.8	12	<6.4	8.7
28	24	25	46	<17	49
31	<17	<18	37	<15	21
41+ 64	<3.2	<3.3	<3.8	<2.7	<3.3
44	<3.2	<3.3	8.9	<2.7	<3.3
49	<9.1	12	21	<7.7	11
52	6.1	6.7	16	4.5	8
54	<3.2	<3.3	<3.8	<2.7	<3.3
60 + 56	<110	<110	<130	<91	<110
70	<3.2	<3.3	5.2	<2.7	<3.3
74	35	81	30	16	46
87	<3.2	<3.3	<3.8	<2.7	<3.3
90 + 101	<16	<17	<20	<14	18
95	13	<13	17	<10	17
99	30	71	19	15	54
104	<3.2	<3.3	<3.8	<2.7	<3.3
105	16	22	<3.8	<2.7	5.1
110	<4.5	<4.7	<5.4	<3.8	<4.7
114	3.7	<3.3	<3.8	<2.7	<3.3
118	120	170	57	22	100
123	<3.2	<3.3	<3.8	<2.7	<3.3
138	<46	1410	300	160	520
141	<13	<14	<16	<11	<14
149	<50	<51	<60	<42	<52
151	<19	<20	<23	<16	<20
153	<50	1950	460	270	790
155	<3.2	<3.3	<3.8	<2.7	<3.3
156	82	220	72	28	50
157	9.4	21	<3.8	<2.7	<3.3
158	<3.2	9.9	3.9	3.2	7.5
167	35	62	24	5.1	30
170	<20	970	230	95	210
174	<16	<17	<19	<14	<17
180	580	1850	490	240	560
183	<15	140	21	17	52
187	<21.6	430	81	51	140
188	<3.2	<3.3	<3.8	<2.7	<3.3
189	<3.2	8.5	<3.8	<2.7	<3.3
194	<4.2	290	65	36	79
199	<3.2	<3.3	<3.8	<2.7	<3.3
203	<33	160	<40	<28	54

Appendix 1, Table 8 – Organochlorine pesticide and PBDE concentrations in blood samples

Sample	EU2	EU3	EU4	EU5	EU6	EU7	EU8
Chemical	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
a-chlordane	<5.0	<5.3	<5.4	<5.2	<5.1	<5.8	<6.4
g-chlordane	<5.0	<5.3	<5.4	<5.2	<5.1	<5.8	<6.4
HCB	370	460	350	310	160	210	120
o,p'-DDD	<5.0	<5.3	<5.4	<5.2	<5.1	<5.8	<6.4
o,p'-DDE	<5.0	<5.3	<5.4	<5.2	<5.1	<5.8	<6.4
o,p'-DDT	<5.0	<5.3	<5.4	<5.2	<5.1	5.9	<6.4
p,p'-DDD	<5.0	<5.3	<5.4	<5.2	<5.1	19	<6.4
p,p'-DDE	890	1300	2800	330	390	2100	670
p,p'-DDT	28	60	69	33	13	110	<6.4
a-HCH	<5.0	<5.3	<5.4	<5.2	8.1	<5.8	<6.4
b-HCH	200	270	150	67	20	270	15
g-HCH	<54	<58	<58	<57	<55	<63	<70
PBDE							
17	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
28	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
32	<1.7	<1.8	<1.8	<1.8	<1.7	<2	<2.2
35	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
37	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
47	<2.6	<2.8	9	<2.7	<2.7	<3.1	3.7
49	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
66	1.3	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
71	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
75	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
77	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
85	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
99	<3.1	<3.3	<3.3	<3.2	3.9	<3.6	<3.9
100	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
119	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
138	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
153	8.1	3.0	13	11	9.2	8.3	9.7
154	3.2	<1.3	4.2	6.9	2	2.4	3.4
166	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
181	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
183	2.8	4.0	17	3.4	2.7	2.9	4.4
190	<1.2	<1.3	<1.3	<1.3	<1.3	<1.5	<1.6
209	300	<220	<220	<220	230	<240	<270

Appendix 1, Table 9 – Organochlorine pesticide and PBDE concentrations in blood samples

Sample	EU10	EU11	EU12	EU13	EU15	EU16	EU17
Chemical	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
a-chlordane	<5.4	<5.0	<5.7	<4.9	<7.3	<4.9	<5.3
g-chlordane	<5.4	<5.0	<5.7	<4.9	<7.3	<4.9	<5.3
HCB	260	230	210	220	250	80	280
o,p'-DDD	<5.4	<5.0	<5.7	<4.9	<7.3	<4.9	<5.3
o,p'-DDE	<5.4	<5.0	<5.7	5.8	<7.3	<4.9	<5.3
o,p'-DDT	6.7	<5.0	<5.7	<4.9	<7.3	<4.9	<5.3
p,p'-DDD	34	6.7	<5.7	5.5	8.1	4.9	9.6
p,p'-DDE	6100	1800	1200	1300	2400	360	880
p,p'-DDT	300	28	7.1	45	35	7.8	26
a-HCH	<5.4	<5.0	<5.7	<4.9	<7.3	<4.9	<5.3
b-HCH	87	81	100	71	140	<5	390
g-HCH	<59	<54	<62	<53	<80	<53	<57
PBDE							
17	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
28	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
32	<1.9	<1.7	<2.0	<1.7	<2.5	<1.7	<1.8
35	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
37	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
47	<2.9	13	<3.0	12	<3.9	<2.6	<2.8
49	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
66	<1.4	<1.3	<1.4	3.3	<1.8	<1.2	1.5
71	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
75	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
77	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
85	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
99	<3.3	7.7	<3.5	<3	6.7	<3	<3.2
100	<1.4	6.6	<1.4	2	<1.8	<1.2	<1.3
119	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
138	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
153	18	13	5.8	34	11	6.9	8.7
154	6.9	4.7	2.9	9.1	6.4	3.4	2.7
166	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
181	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
183	5.4	3.5	2.3	3.3	5	<1.2	2.8
190	<1.4	<1.3	<1.4	<1.2	<1.8	<1.2	<1.3
209	<230	280	420	380	860	400	560

Appendix 1, Table 10 – Organochlorine pesticide and PBDE concentrations in blood samples

Sample	EU18	EU19	EU20	EU21	EU22	EU23	EU24
Chemical	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
a-chlordane	<5.0	<5.0	<5.0	<5.6	<4.8	<6.4	<4.9
g-chlordane	<5.0	<5.0	<5.0	<5.6	<4.8	<6.4	<4.9
HCB	170	170	300	200	130	660	420
o,p'-DDD	<5.0	<5.0	<5.0	<5.6	<4.8	<6.4	<4.9
o,p'-DDE	<5.0	<5.0	<5.0	<5.6	<4.8	<6.4	<4.9
o,p'-DDT	5.8	<5.0	<5.0	<5.6	<4.8	<6.4	<4.9
p,p'-DDD	<5.0	<5.0	5.7	<5.6	<4.8	<6.4	<4.9
p,p'-DDE	2400	750	1800	4700	330	1400	1800
p,p'-DDT	24	18	33	<5.6	<4.8	27	14
a-HCH	<5.0	<5.0	<5.0	<5.6	<4.8	<6.4	<4.9
b-HCH	49	47	150	44	87	550	150
g-HCH	<54	<55	<54	<61	<52	<70	<53
PBDE							
17	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
28	<1.2	<1.3	4.5	<1.4	<1.2	<1.6	<1.2
32	<1.7	<1.7	<1.7	20	<1.6	<2.2	<1.7
35	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
37	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
47	11	<2.7	40	4.1	7.1	4.3	<2.6
49	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
66	<1.2	<1.3	2.1	<1.4	<1.2	<1.6	<1.2
71	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
75	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
77	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
85	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
99	4.2	<3.1	15	<3.5	3.8	<4	<3
100	7.8	<1.3	5	1.6	<1.2	5.4	<1.2
119	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
138	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
153	23	8.6	20	7.1	11	10	9.8
154	5.5	6	6.5	3.5	6	3.9	4.2
166	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
181	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
183	3.3	1.9	5.4	<1.4	<1.2	2.2	2.5
190	<1.2	<1.3	<1.3	<1.4	<1.2	<1.6	<1.2
209	260	230	410	750	<200	8700	230

Appendix 1, Table 11 – Organochlorine pesticide and PBDE concentrations in blood samples

Sample	EU25	EU26	EU27	EU28	EU29	EU31	EU32
Chemical	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
a-chlordane	<5.8	<6.6	<5.4	<6.4	<4.9	<6.5	<5.2
g-chlordane	<5.8	<6.6	<5.4	<6.4	<4.9	<6.5	<5.2
HCB	160	800	960	150	210	180	500
o,p'-DDD	<5.8	<6.6	<5.4	<6.4	<4.9	<6.5	<5.2
o,p'-DDE	<5.8	<6.6	<5.4	<6.4	<4.9	<6.5	<5.2
o,p'-DDT	<5.8	<6.6	<5.4	<6.4	<4.9	<6.5	<5.2
p,p'-DDD	6.2	<6.6	<5.4	<6.4	<4.9	<6.5	<5.2
p,p'-DDE	1900	3100	3000	2300	980	620	1000
p,p'-DDT	25	650	29	7.9	18	8.6	21
a-HCH	<5.8	<6.6	<5.4	<6.4	<4.9	<6.5	<5.2
b-HCH	82	510	330	47	140	66	300
g-HCH	<63	<72	<59	<70	<53	<70	<57
PBDE							
17	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
28	<1.4	<1.7	<1.4	3.4	<1.2	<1.6	<1.3
32	2.5	<2.3	<1.9	<2.2	<1.7	32	3.2
35	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
37	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
47	<3	<3.5	<2.8	36	7.8	<3.4	3.4
49	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
66	<1.4	<1.7	<1.4	<1.6	4.3	<1.6	<1.3
71	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
75	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
77	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
85	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
99	<3.6	<4.1	<3.3	19	3.1	<4	<3.2
100	<1.4	<1.7	<1.4	12	1.7	<1.6	<1.3
119	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
138	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
153	5.6	4.6	8.5	21	9.1	15	3.9
154	2.9	<1.7	2.7	6.6	4.2	9.1	6.3
166	<1.4	<1.7	<1.4	3.2	<1.2	<1.6	<1.3
181	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
183	<1.4	1.9	<1.4	5.1	<1.2	<1.6	<1.3
190	<1.4	<1.7	<1.4	<1.6	<1.2	<1.6	<1.3
209	<240	<270	<220	<270	<200	2100	<220

Appendix 1, Table 12 – Organochlorine pesticide and PBDE concentrations in blood samples

Sample	EU33	EU34	EU35	EU36	EU37	EU38	EU39
Chemical	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
a-chlordane	<5.7	<6.8	<6.3	<7.7	<7	<6.9	<5.0
g-chlordane	<5.7	<6.8	<6.3	<7.7	<7	<6.9	<5.0
HCB	140	460	200	100	140	300	180
o,p'-DDD	<5.7	<6.8	<6.3	<7.7	<7	<6.9	<5.0
o,p'-DDE	<5.7	<6.8	<6.3	<7.7	<7	<6.9	<5.0
o,p'-DDT	<5.7	<6.8	<6.3	<7.7	<7	<6.9	7.5
p,p'-DDD	<5.7	<6.8	6.6	<7.7	<7	<6.9	7.3
p,p'-DDE	640	1800	3500	520	1900	2900	1400
p,p'-DDT	16	17	54	7.8	19	20	29
a-HCH	<5.7	<6.8	<6.3	<7.7	<7	<6.9	<5.0
b-HCH	32	130	210	<8	110	480	41
g-HCH	<62	<74	<69	<84	<77	<75	<54
PBDE							
17	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
28	<1.4	<1.7	4.6	<1.9	<1.8	<1.7	<1.3
32	<2	8	<2.2	<2.7	<2.4	<2.4	<1.7
35	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
37	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
47	3.7	<3.6	<3.3	<4.1	6.1	<3.6	16
49	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
66	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
71	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
75	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
77	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
85	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
99	<3.5	<4.2	<3.9	<4.7	5.2	<4.2	8.4
100	<1.4	<1.7	34	<1.9	<1.8	<1.7	5.9
119	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
138	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
153	13	6.4	17	6.9	12	8	30
154	3.4	2.8	3.9	2	4	6.2	9.3
166	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
181	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
183	<1.4	<1.7	1.8	<1.9	3.9	<1.7	2.5
190	<1.4	<1.7	<1.6	<1.9	<1.8	<1.7	<1.3
209	<240	<280	<260	<320	<290	<290	<210

Appendix 1, Table 13 – Organochlorine pesticide and PBDE concentrations in blood samples

Sample	EU40	EU41	EU42	EU43	EU44	EU45	EU46
Chemical	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
a-chlordane	<6.6	<5.0	<5.6	<6.9	<6.1	<5.2	<6.8
g-chlordane	<6.6	<5.0	<5.6	<6.9	<6.1	<5.2	<6.8
HCB	92	140	1060	160	180	100	98
o,p'-DDD	<6.6	<5.0	<5.6	<6.9	<6.1	<5.2	<6.8
o,p'-DDE	<6.6	<5.0	<5.6	<6.9	<6.1	<5.2	<6.8
o,p'-DDT	<6.6	<5.0	<5.6	<6.9	<6.1	<5.2	<6.8
p,p'-DDD	<6.6	<5.0	<5.6	<6.9	<6.1	8.2	<6.8
p,p'-DDE	370	1100	8000	880	810	3400	600
p,p'-DDT	<6.6	14	86	30	16	72	52
a-HCH	<6.6	<5.0	<5.6	<6.9	<6.1	<5.2	<6.8
b-HCH	<7	150	570	7.2	65	28	35
g-HCH	<72	<54	<61	<75	<67	<57	<74
PBDE							
17	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
28	<1.7	2.2	<1.4	<1.7	<1.5	<1.3	<1.7
32	<2.3	<1.7	<1.9	<2.4	<2.1	<1.8	45
35	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
37	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
47	<3.5	12	6.9	<3.6	8.1	40	34
49	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
66	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
71	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
75	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
77	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
85	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
99	<4.1	8.2	15	<4.2	<3.8	5.4	<4.2
100	<1.7	6.5	260	<1.7	<1.5	3	<1.7
119	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
138	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
153	9.4	17	5.8	18	17	14	29
154	3.0	8.8	3.2	5.1	5.3	<1.3	<1.7
166	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
181	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
183	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
190	<1.7	<1.3	<1.4	<1.7	<1.5	<1.3	<1.7
209	<280	<210	<230	<290	<260	<220	<280

Appendix 1, Table 14 – Organochlorine pesticide and PBDE concentrations in blood samples

Sample	EU47	EU49	EU52	EU53	EU54
Chemical	pg/g serum	pg/g serum	pg/g serum	pg/g serum	pg/g serum
a-chlordane	<6.4	<6.6	<7.6	<5.4	<6.6
g-chlordane	<6.4	<6.6	<7.6	<5.4	<6.6
HCB	79	740	400	88	180
o,p'-DDD	<6.4	<6.6	<7.6	<5.4	<6.6
o,p'-DDE	<6.4	<6.6	<7.6	<5.4	<6.6
o,p'-DDT	<6.4	<6.6	<7.6	<5.4	<6.6
p,p'-DDD	<6.4	<6.6	<7.6	<5.4	10
p,p'-DDE	800	2170	250	920	2250
p,p'-DDT	15	<6.6	<7.6	<5.4	<6.6
a-HCH	<6.4	<6.6	<7.6	<5.4	<6.6
b-HCH	8.1	94	110	26	120
g-HCH	<69	<72	<83	<58	<72
PBDE					
17	<1.6	<1.6	<1.9	<1.3	<1.7
28	<1.6	<1.6	<1.9	<1.3	<1.7
32	<2.2	<2.3	<2.6	<1.9	<2.3
35	<1.6	<1.6	<1.9	<1.3	<1.7
37	<1.6	<1.6	<1.9	<1.3	<1.7
47	4.1	<3.5	8.4	9.7	51
49	<1.6	<1.6	<1.9	<1.3	<1.7
66	<1.6	<1.6	<1.9	<1.3	<1.7
71	<1.6	<1.6	<1.9	<1.3	<1.7
75	<1.6	<1.6	<1.9	<1.3	<1.7
77	<1.6	<1.6	<1.9	<1.3	<1.7
85	<1.6	<1.6	<1.9	<1.3	<1.7
99	<3.9	<4.1	4.8	6.8	32
100	<1.6	<1.6	2.0	3.5	22
119	<1.6	<1.6	<1.9	<1.3	<1.7
138	<1.6	<1.6	<1.9	<1.3	<1.7
153	6.9	8.0	11	30	24
154	6.9	<1.6	6.2	7	8.3
166	<1.6	<1.6	<1.9	<1.3	<1.7
181	<1.6	<1.6	<1.9	<1.3	<1.7
183	4.9	<1.6	2.2	4.4	3
190	<1.6	<1.6	<1.9	<1.3	<1.7
209	<260	<270	18000	<220	<280

Appendix 1, Table 15 – HBCD, TBBP-A, Phthalate and PFOS/PFOA concentrations in blood samples

Sample	EU2	EU3	EU4	EU5	EU6	EU7	EU8
Chemical	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood
TBBP-A	0.100	<0.060	<0.060		<0.060	<0.050	<0.050
HBCD	<0.050	<0.070	<0.060		<0.070	<0.060	<0.060
DMP	<2	<2	<2	<2	<2	<2	<2
DEP	5.0	<2	<2	<2	<2	<2	<2
DiBP	21	20	9.0	65	<2	<2	2.0
DBP	<2	<2	<2	27	<2	<2	<2
BzBP	29	<2	<2	<2	<2	<2	<2
DEHP	330	620	160	37	89	61	89
DiNP	92	39	<20	<20	<20	70	28
DiDP	<20	<20	<20	<20	<20	140	<20
PFHxA (1)	<0.10	<0.10	<0.10	0.10	0.10	<0.10	<0.10
PFHpA (2)	0.10	0.10	0.10	<0.10	0.10	<0.10	0.30
PFHxS (3)	1.1	0.90	4.3	1.6	0.60	1.4	2.3
PFOA (4)	3.2	1.8	4.2	3.4	3.2	1.9	5.5
PFNA (5)	1.1	1.4	0.50	0.50	0.80	0.80	0.80
PFOS (6)	14	15	20	16	5.0	13	28
PFOSA (7)	1.3	0.6	1.2	0.7	1.0	0.5	0.5
PFDA (8)	0.70	0.70	0.20	0.20	0.80	0.30	0.50
PFUnA (9)	0.20	0.50	0.20	0.30	0.30	0.20	0.40
Sum1-9	22	21	31	23	12	18	38
PFDoA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFTrDA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFDS	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
THPFOS	<10	<10	<10	<10	<10	<10	<10
Sum PFOS/PFOA	22	21	31	23	12	18	38

Appendix 1, Table 16 – HBCD, TBBP-A, Phthalate and PFOS/PFOA concentrations in blood samples

Sample	EU10	EU11	EU12	EU13	EU15	EU16	EU17
Chemical	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood
TBBP-A	0.21	<0.060	0.029	0.25	0.0048	0.0027	0.0019
HBCD	<0.050	<0.070	<0.070	<0.030	<0.070	<0.050	<0.040
DMP	<2	<2		<2	<2	<2	<2
DEP	<2	<2		<2	<2	<2	<2
DiBP	1.0	3.0		4.0	2.0	<2	<2
DBP	<2	<2		<2	<2	<2	<2
BzBP	<2	<2		<2	<2	<2	<2
DEHP	61	290		63	91	44	200
DiNP	<20	28		<20	34	<20	24
DiDP	<20	<20		<20	<20	<20	47
PFHxA (1)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
PFHpA (2)	0.20	0.10	0.10	0.30	0.40	<0.10	
PFHxS (3)	0.70	2.20	3.10	1.60	3.50	1.20	
PFOA (4)	1.6	2.2	4.8	2.8	6.1	1.5	
PFNA (5)	0.80	0.60	1.5	0.60	1.7	0.60	
PFOS (6)	8	15	26	16	50	17	
PFOSA (7)	0.5	0.5	1.8	0.9	0.9	1.0	
PFDA (8)	0.60	0.70	0.90	0.20	1.4	0.40	
PFUnA (9)	0.40	0.60	0.50	0.20	1.2	0.20	
Sum1-9	13	22	39	22	65	22	
PFDoA	<0.10	<0.10	<0.10	<0.10	0.17	<0.10	
PFTrDA	<0.10	0.15	<0.10	<0.10	0.27	<0.10	
PFDS	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	
THPFOS	<10	<10	<10	<10	<10	<10	
Sum PFOS/PFOA	13	22	39	22	65	22	

Appendix 1, Table 17 – HBCD, TBBP-A, Phthalate and PFOS/PFOA concentrations in blood samples

Sample	EU18	EU19	EU20	EU21	EU22	EU23	EU24
Chemical	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood
TBBP-A	0.0029	0.0035	0.0032	0.0046	0.11		0.0032
HBCD	<0.060	<0.070	<0.080	<0.110	<0.060		<0.080
DMP	<2	<2	<2	<2	<2	<2	<2
DEP	<2	<2	<2	<2	<2	<2	<2
DiBP	2.0	<2	1.0	5.0	6.0	12	8.0
DBP	<2	<2	<2	<2	<2	<2	<2
BzBP	<2	<2	<2	<2	<2	<2	<2
DEHP	52	200	1090	230	210	38	430
DiNP	<20	140	23	21	<20	16	<20
DiDP	<20	550	<20	<20	<20	<20	<20
PFHxA (1)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFHpA (2)	0.30	0.10	0.10	<0.10	0.10	<0.10	<0.10
PFHxS (3)	3.0	1.8	2.2	1.6	2.8	1.2	1.6
PFOA (4)	4.7	3.3	4.5	3.1	4.9	3.0	4.7
PFNA (5)	0.70	1.1	0.70	1.0	0.80	1.7	0.80
PFOS (6)	19	17	17	24	21	18	16
PFOSA (7)	0.6	0.4	1.0	1.1	1.8	0.4	1.3
PFDA (8)	0.50	0.70	0.40	0.70	0.50	1.20	0.60
PFUnA (9)	0.40	0.10	0.70	0.60	0.30	1.70	0.30
Sum1-9	29	24	27	32	33	27	25
PFDoA	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	<0.10
PFTrDA	<0.10	<0.10	<0.10	<0.10	0.15	0.23	<0.10
PFDS	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
THPFOS	<10	<10	<10	<10	<10	<10	<10
Sum PFOS/PFOA	29	24	27	32	33	28	25

Appendix 1, Table 18 – HBCD, TBBP-A, Phthalate and PFOS/PFOA concentrations in blood samples

Sample	EU25	EU26	EU27	EU28	EU29	EU31	EU32
Chemical	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood
TBBP-A		0.0042		0.0035	0.29	0.31	0.068
HBCD		0.063		<0.090	<0.050	<0.040	<0.060
DMP	<2	<2	<2	<2	<2	<2	<2
DEP	<2	<2	<2	<2	<2	<2	<2
DiBP	9.0	10	20	5.0	4.0	15	5.0
DBP	<2	<2	<2	<2	<2	<2	<2
BzBP	29	<2	<2	6	<2	<2	<2
DEHP	130	240	140	120	190	230	120
DiNP	<20	<20	<20	24	<20	<20	<20
DiDP	<20	<20	<20	<20	<20	<20	<20
PFHxA (1)	<0.10	0.10	<0.10	<0.10	<0.10	<0.10	0.10
PFHpA (2)	<0.10	0.10	0.10	0.10	0.10	0.40	0.20
PFHxS (3)	1.0	0.80	0.50	1.3	0.80	2.1	1.8
PFOA (4)	2.8	1.8	1.7	3.3	1.7	4.4	5.7
PFNA (5)	0.60	0.80	0.70	0.70	0.40	1.0	1.6
PFOS (6)	13	18	11	11	13	25	33
PFOSA (7)	0.3	0.5	1.2	0.6	0.5	1.0	0.7
PFDA (8)	0.30	0.80	0.50	0.40	0.20	0.80	1.1
PFUnA (9)	0.50	0.90	0.70	0.40	0.10	0.60	0.50
Sum1-9	18	23	16	17	17	35	44
PFDoA	<0.10	0.10	0.10	<0.10	<0.10	<0.10	0.10
PFTrDA	<0.10	<0.10	0.20	<0.10	<0.10	0.15	0.20
PFDS	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
THPFOS	<10	<10	<10	<10	<10	<10	<10
Sum PFOS/PFOA	18	24	16	17	17	35	45

Appendix 1, Table 19 – HBCD, TBBP-A, Phthalate and PFOS/PFOA concentrations in blood samples

Sample	EU33	EU34	EU35	EU36	EU37	EU38	EU39
Chemical	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood
TBBP-A	0.036		0.24	0.033	0.13	0.33	0.23
HBCD	<0.040		<0.030	<0.030	<0.070	<0.040	<0.040
DMP	<2	<2	34	<2	<2	<2	<2
DEP	<2	<2	340	<2	<2	<2	180
DiBP	<2	5.0	58	5.0	19	<2	33.0
DBP	<2	<2	<2	<2	<2	<2	22
BzBP	<2	<2	<2	<2	<2	<2	<2
DEHP	87	260	580	43	380	83	600
DiNP	<20	44	<20	<20	<20	<20	<20
DiDP	<20	<20	<20	<20	32	<20	<20
PFHxA (1)	<0.10	0.10	<0.10	<0.10	0.10	0.10	<0.10
PFHpA (2)	0.20	<0.10	<0.10	<0.10	0.30	<0.10	<0.10
PFHxS (3)	2.9	0.50	2.5	1.5	1.2	1.1	1.7
PFOA (4)	5.6	3.0	3.3	2.0	3.3	2.2	2.4
PFNA (5)	1.0	1.0	0.60	0.50	0.40	0.70	0.40
PFOS (6)	25	28	17	12	13	15	15
PFOSA (7)	0.5	0.6	0.5	0.3	0.4	0.3	1.3
PFDA (8)	0.50	0.70	0.40	0.30	0.20	0.40	0.20
PFUnA (9)	0.30	0.80	0.40	0.10	0.30	0.40	0.30
Sum1-9	36	35	24	17	19	20	22
PFDoA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFTrDA	<0.10	0.20	<0.10	<0.10	<0.10	<0.10	<0.10
PFDS	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
THPFOS	<10	<10	<10	<10	<10	<10	<10
Sum PFOS/PFOA	36	35	24	17	19	20	22

Appendix 1, Table 20 – HBCD, TBBP-A, Phthalate and PFOS/PFOA concentrations in blood samples

Sample	EU40	EU41	EU42	EU43	EU44	EU45	EU46
Chemical	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood
TBBP-A	<0.020		0.047	<0.060		<0.060	0.050
HBCD	<0.030		<0.030	<0.070		<0.070	<0.050
DMP	<2	<2	<2	<2	<2	<2	<2
DEP	3.0	<2	<2	5.0	<2	<2	<2
DiBP	6.0	16	2.0	9.0	2.0	2.0	8.0
DBP	<2	<2	<2	<2	<2	<2	<2
BzBP	<2	<2	<2	<2	<2	<2	<2
DEHP	380	180	120	150	230	90	74
DiNP	<20	<20	49	<20	<20	68	<20
DiDP	<20	<20	<20	<20	<20	<20	<20
PFHxA (1)	<0.10	0.10	<0.10	0.10	0.10	0.20	0.10
PFHpA (2)	<0.10	<0.10	0.10	0.20	0.30	0.20	0.10
PFHxS (3)	1.6	2.9	0.70	1.8	0.70	0.80	2.6
PFOA (4)	3.6	4.9	2.7	9.9	2.5	9.8	4.5
PFNA (5)	0.70	0.90	0.80	1.0	0.70	0.90	1.1
PFOS (6)	25	27	24	55	11	12	33
PFOSA (7)	0.6	0.9	0.4	2.0	0.4	0.2	0.5
PFDA (8)	0.40	0.30	0.50	0.40	0.40	0.30	0.60
PFUnA (9)	0.50	0.30	0.40	0.60	0.20	0.00	0.40
Sum1-9	33	38	29	71	16	24	43
PFDoA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PFTrDA	0.20	<0.10	0.20	<0.10	<0.10	<0.10	0.20
PFDS	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
THPFOS	<10	<10	<10	<10	<10	<10	<10
Sum PFOS/PFOA	33	38	29	71	16	24	44

Appendix 1, Table 21 – HBCD, TBBP-A, Phthalate and PFOS/PFOA concentrations in blood samples

Sample	EU47	EU49	EU52	EU53	EU54
Chemical	ng/g blood	ng/g blood	ng/g blood	ng/g blood	ng/g blood
TBBP-A	<0.070	<0.020	<0.020	0.036	<0.020
HBCD	<0.060	<0.050	<0.030	<0.040	<0.030
DMP	<2		<2	<2	<2
DEP	<2		<2	<2	<2
DiBP	9.0		9.0	4.0	18
DBP	<2		<2	<2	<2
BzBP	<2		7	<2	<2
DEHP	120		270	210	1200
DiNP	31		24	<20	<20
DiDP	<20		<20	<20	<20
PFHxA (1)	<0.10		<0.10	<0.10	<0.10
PFHpA (2)	0.20		<0.10	<0.10	0.30
PFHxS (3)	1.2		2.0	8.4	3.9
PFOA (4)	2.4		3.0	8.0	9.0
PFNA (5)	0.90		0.30	0.70	1.3
PFOS (6)	16		13	20	29
PFOSA (7)	0.5		0.6	0.6	0.7
PFDA (8)	0.60		0.10	0.30	1.00
PFUnA (9)	0.60		0.10	0.10	0.40
Sum1-9	23		19	39	45
PFDoA	<0.10		<0.10	<0.10	<0.10
PFTrDA	<0.10		<0.10	<0.10	<0.10
PFDS	<0.40		<0.40	<0.40	<0.40
THPFOS	<10		<10	<10	<10
Sum PFOS/PFOA	23		19	39	45

APPENDIX 2 – PCB, PBDE AND ORGANOCHLORINE PESTICIDE DATA EXPRESSED AS NG/G LIPID

Appendix 2, Table 1 – PCB data expressed as ng/g lipid

	Minimum	Maximum	Median	25th percentile	75th percentile	N
PCB	ng/g lipid	ng/g lipid	ng/g lipid	ng/g lipid	ng/g lipid	(out of 47)
18	0.7	3.6	1.3	1.2	1.6	25
22	0.8	9.6	1.4	1.1	2.2	19
28	2.0	10	4.2	3.2	5.8	37
31	1.6	6.6	3.7	2.3	4.5	15
41 + 64						0
44	0.3	2.7	0.5	0.4	0.7	23
49	0.9	2.6	1.5	1.3	1.9	20
52	0.5	3.0	0.9	0.7	1.1	47
54						0
70	0.5	4.0	0.7			5
74	1.4	23	8.4	5.0	9.7	47
87	0.5	1.6	0.6			5
90 + 101	1.3	8.0	2.7	2.1	3.0	13
95	1.0	6.3	2.1	1.8	2.5	15
99	1.3	16	6.2	4.2	7.4	44
105	0.6	9.5	2.5	1.6	3.7	32
110	0.6	2.9	0.8			8
114	0.4	2.8	1.0	0.7	1.2	36
118	2.6	44	14	10	20	45
123			0.4			1
138	12	170	67	49	96	42
141	2.0	3.0	2.5			2
149	5.3	16	7.6			4
151	2.1	7.5	3.2			6
153	15	230	98	77	130	41
156	1.0	32	11	8.0	18	46
157	0.5	5.0	1.9	1.3	2.8	35
158	0.5	2.5	1.2	0.8	1.4	43
167	0.7	14	4.6	3.2	7.4	41
170	3.2	110	40	26	65	40
174	3.5	4.4	3.9			2
180	8.2	230	85	56	130	43
183	2.5	18	6.6	4.8	10	41
187	7.4	69	21	15	28	41
189	0.5	1.6	1.0			5
194	5.1	38	15	8.0	19	40
203	4.3	24	9.7	7.1	13	34

Appendix 2, Table 2 – PBDE and organochlorine pesticide data expressed as ng/g lipid

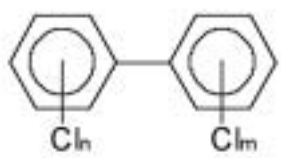
	Minimum	Maximum	Median	25th percentile	75th percentile	N
Chemical	ng/g lipid	ng/g lipid	ng/g lipid	ng/g lipid	ng/g lipid	(out of 47)
HCB	11	150	27	21	42	47
o,p'-DDD						0
o,p'-DDT	0.7	0.9	0.8			4
o,p'-DDE	0.6	0.6	0.6			1
p,p'-DDD	0.6	3.6	0.9	0.8	1.2	13
p,p'-DDE	32	1200	200	110	270	47
p,p'-DDT	1.0	110	3.4	2.1	4.8	39
a-HCH	1.2	1.2	1.2			1
b-HCH	1.1	86	13	7.2	20	44
g-HCH						0
PBDE						0
17						0
28	0.3	0.5	0.5			4
32	0.3	8.4	2.1			6
35						0
37						0
47	0.4	7.4	1.2	0.8	1.8	24
49						0
66	0.2	0.5	0.2			5
71						0
75						0
77						0
85						0
99	0.4	3.8	1.0	0.6	1.2	16
100	0.2	39	0.7	0.5	1.3	16
119						0
138						0
153	0.5	5.4	1.4	1.1	2.2	47
154	0.3	1.2	0.7	0.5	0.8	42
166	0.5	0.5	0.5	0.5	0.5	1
181						0
183	0.2	2.2	0.4	0.3	0.6	27
209	28	2400	57	38	100	16
Total PBDE	0.9	2400	7.3	2.7	44	47
Total PCB	23	930	390	250	550	47
All OC pesticides analysed	73	1400	230	150	360	47
Total HCH	nd	86	12	6.6	20	47
Total DDT & metabolites	32	1200	200	120	280	47

APPENDIX 3 – PCB NUMBERING USED

PCB Number	PCB Name
18	2,2’,5-Trichlorobiphenyl
22	2,3,4’-Trichlorobiphenyl
28	2,4,4’-Trichlorobiphenyl
31	2,4’,5-Trichlorobiphenyl
41/64	2,2’,3,4-Tetrachlorobiphenyl / 2,3,4’,6-Tetrachlorobiphenyl
44	2,2’,3,5’-Tetrachlorobiphenyl
49	2,2’,4,5’-Tetrachlorobiphenyl
52	2,2’,5,5’-Tetrachlorobiphenyl
54	2,2’,6,6’-Tetrachlorobiphenyl
60/56	2,3,4,4’-Tetrachlorobiphenyl / 2,3,3’,4’-Tetrachlorobiphenyl
70	2,3’,4’,5-Tetrachlorobiphenyl
74	2,4,4’,5-Tetrachlorobiphenyl
87	2,2’,3,4,5’-Pentachlorobiphenyl
90/101	2,2’,3,4’,5-Pentachlorobiphenyl / 2,2’,4,5,5’-Pentachlorobiphenyl
95	2,2’,3,5’,6-Pentachlorobiphenyl
99	2,2’,4,4’,5-Pentachlorobiphenyl
104	2,2’,4,6,6’-Pentachlorobiphenyl
105	2,3,3’,4,4’-Pentachlorobiphenyl
110	2,3,3’,4’,6-Pentachlorobiphenyl
114	2,3,4,4’,5-Pentachlorobiphenyl
118	2,3’,4,4’,5-Pentachlorobiphenyl
123	2’,3,4,4’,5-Pentachlorobiphenyl
138	2,2’,3,4,4’,5’-Hexachlorobiphenyl
141	2,2’,3,4,5,5’-Hexachlorobiphenyl
149	2,2’,3,4’,5’,6-Hexachlorobiphenyl
151	2,2’,3,5,5’,6-Hexachlorobiphenyl
153	2,2’,4,4’,5,5’-Hexachlorobiphenyl
155	2,2’,4,4’,6,6’-Hexachlorobiphenyl
156	2,3,3’,4,4’,5-Hexachlorobiphenyl
157	2,3,3’,4,4’,5’-Hexachlorobiphenyl
158	2,3,3’,4,4’,6-Hexachlorobiphenyl
167	2,3’,4,4’,5,5’-Hexachlorobiphenyl
170	2,2’,3,3’,4,4’,5-Heptachlorobiphenyl
174	2,2’,3,3’,4,5,6’-Heptachlorobiphenyl
180	2,2’,3,4,4’,5,5’-Heptachlorobiphenyl
183	2,2’,3,4,4’,5’,6-Heptachlorobiphenyl
187	2,2’,3,4’,5,5’,6-Heptachlorobiphenyl
188	2,2’,3,4’,5,6,6’-Heptachlorobiphenyl
189	2,3,3’,4,4’,5,5’-Heptachlorobiphenyl
194	2,2’,3,3’,4,4’,5,5’-Octachlorobiphenyl
199*	2,2’,3,3’,4,5,6,6’-Octachlorobiphenyl
203	2,2’,3,4,4’,5,5’,6-Octachlorobiphenyl

* = sometimes numbered 200

The PCB structure is $C_{12}H_{10-(n+m)}Cl_{(n+m)}$, where (n + m) = 1-10

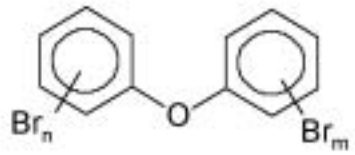


On each ring the position number starts at the carbon where the rings are attached.

APPENDIX 4 – PBDE NUMBERS USED

PBDE Number	PBDE Name
17	2,2',4-Tribromodiphenyl ether
28	2,3',5'-Tribromodiphenyl ether
32	2,4,6-Tribromodiphenyl ether
35	3,3',4-Tribromodiphenyl ether
37	3,4,4'-Tribromodiphenyl ether
47	2,2',4,4'-Tetrabromodiphenyl ether
49	2,2',4,5'-Tetrabromodiphenyl ether
66	2,3',4,4'-Tetrabromodiphenyl ether
71	2,3',4',5'-Tetrabromodiphenyl ether
75	2,4,4',5-Tetrabromodiphenyl ether
77	3,3',4,4'-Tetrabromodiphenyl ether
85	2,2',3,4,4'-Pentabromodiphenyl ether
99	2,2',4,4',5-Pentabromodiphenyl ether
100	2,2',4,4',6-Pentabromodiphenyl ether
119	2,3',4,4',5-Pentabromodiphenyl ether
138	2,2',3,4,4',5'-Hexabromodiphenyl ether
153	2,2',4,4',5,5'-Hexabromodiphenyl ether
154	2,2',4,4',5,6'-Hexabromodiphenyl ether
166	2,3,4,4',5,6-Hexabromodiphenyl ether
181	2,2',3,4,4',5,6-Heptabromodiphenyl ether
183	2,2',3,4,4',5',6-Heptabromodiphenyl ether
190	2,3,3',4,4',5,6-Heptabromodiphenyl ether
209	2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether

The PBDE structure is $C_{12}H_{10-(n+m)}OBr_{(n+m)}$, where (n + m) = 1-10



On each ring the position number starts at the carbon attached to the bridging oxygen atom.

APPENDIX 5 – GLOSSARY

Adipose	Body fat tissue
Body mass Index	Body weight (kg) divided by height (m) squared: a general measure of one's 'fatness'
Chlorination / Bromination level	The number of chlorine/bromine atoms in a single molecule of a particular chemical (e.g. PCB153 has a chlorination level of 6 – it has 6 chlorine atoms per molecule)
Congener	An individual chemical out of a group of closely related chemicals (e.g. PCB153 is a congener in the PCB chemical 'family')
Correlate / correlation	A connection between two or more things, often one in which one of them causes or influences the other
Geometric mean	The mean (average) of log-transformed data
Limit of detection	The lowest quantity reliably detected in a sample
Median	The middle value in a set of values arranged in order of size
Normal distribution	A distribution following a symmetrical, bell-shaped frequency curve
Not detected	Below the limit of detection
Octanol-water partition coefficient	The ratio of the equilibrium concentrations of a chemical in octanol and water
Organohalogen / Organochlorine	Organic chemical whose molecules contain halogen/chlorine atoms
Principal component analysis	A statistical method which attempts to identify underlying variables, or factors, that explain the pattern of correlations within a set of observed variables
Serum	The straw coloured liquid separated from clotted blood after centrifugation