Environ Health Perspect

DOI: 10.1289/EHP1079

Supplemental Material

Prenatal serum concentrations of brominated flame retardants and autism spectrum disorder and intellectual disability in the Early Markers of Autism study: A population-based case-control study in California.

Kristen Lyall, Lisa A. Croen, Lauren A. Weiss, Martin Kharrazi, Michela Traglia, Gerald N. Delorenze, Gayle C. Windham

Table of Contents

Supplemental Material

Table S1: Descriptive statistics[a] of serum brominated flame retardants (ng/g lipid weight) in general population controls (n=418) from the EMA study, compared to a national sample

Compound	Geometric Mean (95% CI)	Median	NHANES Female Geometric Mean (95% CI)[b]	NHANES Pregnant Women Geometric Mean (GSE)[c]
BB153	1.14 (1.04, 1.25)	1.10	1.92 (1.50-2.46)	Not provided
BDE-28	0.94 (0.88, 1.02)	0.84	1.17 (0.99-1.38)	Not provided
BDE-47	17.9 (16.2, 19.7)	16.9	19.6 (16.4-23.5)	23.9 (2.21)
BDE-99	5.52 (4.98, 6.11)	4.90	Not calculated[d]	5.51 (0.81)
BDE-100	4.48 (4.05, 4.95)	3.90	3.72 (3.15-4.40)	6.06 (0.91)
BDE-153	5.02 (4.51, 5.58)	4.2	4.78 (4.20-5.43)	9.90 (3.04)
Sum[e]	38.8 (35.3, 42.7)	35.1	-	-

Table shows only those congeners meeting our inclusion cut-off of for further analyses of at least 55% of the study population with concentrations above the limit of detection (LOD).
[a]Means and median calculated after replacing values <LOD with the LOD/√2.[b]Estimates for all females from the *Fourth National Report on Human Exposure to Environmental Chemicals (2009) and the Fourth National Report on Human Exposure to Environmental Chemicals: Updated Tables, August 2014,* years of sampling 2003-2004. [c] GSE=Geometric standard error. Values from Woodruff et al., 2011. [d]BDE-99 was not provided in the *Report* for females, as the proportion of results below the LOD was too high to provide a valid result, but the male geometric mean provided was= 5.28 (CI <LOD-6.14) [e]Sum of congeners listed (those detected in at least 55% of the study population).

Table S2: Pearson correlation coefficients of BFR congeners in the EMA study population

PBDE congener	BB153	PBDE28	PBDE47	PBDE99	PBDE100	PBDE153	SUM
BB153	1	0.02 0.46	.02 0.43	0.02 0.51	0.05 0.13	0.07 0.02	0.07 0.02
BDE-28		1	0.91 <.0001	0.79 <.0001	0.82 <.0001	0.55 <.0001	0.88 <.0001
BDE-47			1	0.93 <.0001	0.94 <.0001	0.63 <.0001	0.99 <.0001
BDE-99				1	0.85 <.0001	0.54 <.0001	0.94 <.0001
BDE-100					1	0.80 <.0001	0.97 <.0001
BDE-153						1	0.73 <.0001

Table shows Pearson correlation coefficients (r; first number in cell) and p-values (2nd number in cells).

Table S3: Adjusted odds ratios and 95% confidence intervals for alternate sums of BFRs in association with ASD (vs. GP controls)

	Included congeners		BFR concentration[a]	AOR (95% CI)[b]
Primary sum	BB153, BDEs 28, 47, 99, 100, 153	Q1	≤ 20.2	1.0
		Q2	>20.2-35.1	0.83 (0.58, 1.18)
		Q3	>35.1-<70.5	1.01 (0.71, 1.44)
		Q4	≥70.5	0.64 (0.44, 0.93)
Sum of congeners with ≥60% >LOD	BB153, BDEs 47, 99, 100, 153	Q1	≤ 19.7	1.0
		Q2	>19.7-33.5	0.66 (0.45, 0.96)
		Q3	>33.5- 68.0	0.88 (0.60, 1.28)
		Q4	>68.0	0.54 (0.36, 0.80)
Sum of congeners with ≥90% >LOD	BDEs 47, 99, 100, 153	Q1	≤ 18	1.0
		Q2	18-<31.2	0.69 (0.48, 1.00)
		Q3	>31.2-<63.7	0.74 (0.52, 1.07)
		Q4	≥63.7	0.61 (0.42, 0.90)
Sum of high brominated congeners	BDE 100, 153	Q1	≤ 4.8	1.0
		Q2	>4.8-8.6	0.74 (0.52, 1.06)
		Q3	>8.6-<16.6	0.71 (0.49, 1.02)
		Q4	≥16.6	0.66 (0.45, 0.96)
Sum of low brominated congeners	BDEs -28, 47	Q1	≤ 8.9	1.0
		Q2	>8.9-16.2	0.79 (0.53, 1.17)
		Q3	>16.2-<31.1	0.75 (0.51, 1.11)
		Q4	≥31.1	0.68 (0.46, 1.01)

Q= quartile.
[a]Lipid-adjusted concentration in ng/g lipid, categorized into quartiles based on control distribution.
[b]Adjusted for child sex, month and year of birth, maternal age, maternal race/ethnicity, maternal weight at time of sample collection, parity, and maternal education, as in Model 2 of primary tables 3 and 4.

Table S4: Adjusted odds ratios and 95% confidence intervals of the association between prenatal BFRs and ASD (relative to GP controls), stratified by comorbid intellectual disability[a]

	ASD with ID (ASD n=287)			ASD without ID (ASD n=221)		
	Case n	**AOR (95%CI)[b]**	**P for trend[c]**	**Case n**	**AOR (95%CI)**	**P for trend**
BB153			0.75			0.78
Q1	66	1.0		39	1.0	
Q2	72	1.13 (0.72, 1.79)		43	1.10 (0.66, 1.84)	
Q3	50	0.73 (0.44, 1.22)		63	0.98 (0.57, 1.67)	
Q4	78	1.09 (0.67, 1.78)		65	1.10 (0.64, 1.87)	
BDE-28			0.30			0.72
Q1	73	1.0		57	1.0	
Q2	70	1.00 (0.64, 1.56)		50	0.93 (0.58, 1.49)	
Q3	62	0.91 (0.58, 1.45)		47	0.91 (0.56, 1.48)	
Q4	57	0.80 (0.50, 1.28)		54	0.84 (0.52, 1.35)	
BDE-47			0.20			0.58
Q1	94	1.0		66	1.0	
Q2	70	0.73 (0.48, 1.12)		56	0.87 (0.55, 1.35)	
Q3	64	0.71 (0.46, 1.09)		46	0.71 (0.45, 1.13)	
Q4	59	0.69 (0.45, 1.08)		53	0.76 (0.48, 1.19)	
BDE-99			0.44			0.16
Q1	91	1.0		69	1.0	
Q2	65	0.68 (0.44, 1.05)		58	0.84 (0.54, 1.32)	
Q3	61	0.67 (0.43, 1.04)		48	0.75 (0.47, 1.20)	
Q4	64	0.74 (0.48, 1.15)		42	0.62 (0.38, 1.00)	
BDE-100			0.21			0.75
Q1	98	1.0		66	1.0	
Q2	57	0.55 (0.36, 0.85)		53	0.79 (0.51, 1.25)	
Q3	68	0.68 (0.45, 1.05)		44	0.63 (0.39, 0.99)	
Q4	58	0.63 (0.41, 0.98)		54	0.75 (0.48, 1.19)	
BDE-153			0.08			
Q1	93	1.0		70	1.0	0.06
Q2	70	0.72 (0.47, 1.10)		42	0.47 (0.29, 0.76)	
Q3	67	0.68 (0.44, 1.04)		61	0.70 (0.44, 1.10)	
Q4	51	0.59 (0.37, 0.95)		44	0.50 (0.30, 0.81)	
Sum[d]			0.01			0.16
Q1	95	1.0		57	1.0	
Q2	56	0.66 (0.43, 1.01)		54	1.19 (0.75, 1.90)	
Q3	70	0.92 (0.62, 1.38)		59	1.32 (0.83, 2.09)	
Q4	41	0.55 (0.35, 0.86)		38	0.82 (0.50, 1.36)	

GP= General population. GP control n's same as for Table 4 and 5. [a]37 ASD cases were missing information on ID status and were not included in these analyses. [b]Adjusted for child sex, month and year of birth, maternal age, maternal race/ethnicity, maternal weight at time of sample collection, parity, and maternal education. [c]P for trend from model with quartile median-value variable, adjusted as Model 2/ adjusted model shown in this table. [d]Sum indicates the sum of congeners listed (those with at least 55% of study population with values >LOD).

Table S5: Adjusted[a] odds ratios and 95% confidence intervals for sensitivity analyses of the association between prenatal BFRs and risk of ASD (relative to GP controls)

Congener	Removal of individuals with values <LOD		Using Uncensored laboratory data[b]		Using multiple imputation of values <LOD[c]		Removal of ID to ASD group[d]		Additional Adjustment for Genetic PCs[e]		Matched case-control analysis[f]	
	Case n[g]	AOR (95%CI)	Case n	AOR (95%CI)	Case n	AOR (95%CI)	Case n	AOR (95%CI)	Case n	AOR (95%CI)	Case n	AOR (95%CI)
BB153												
Q1	3	1.0	150	1.0	114	1.0	90	1.0	87	1.0	90	1.0
Q2	55	1.08 (0.16, 7.44)	123	1.15 (0.77, 1.72)	124	0.84 (0.52, 1.35)	90	0.99 (0.65, 1.53)	83	0.92 (0.59, 1.45)	90	0.90 (0.55, 1.46)
Q3	117	0.78 (0.11, 5.29)	118	0.85 (0.55, 1.30)	117	1.08 (0.66, 1.74)	94	0.80 (0.51, 1.27)	89	0.74 (0.45, 1.21)	94	0.69 (0.40, 1.16)
Q4	154	0.97 (0.14, 6.59)	154	1.11 (0.73, 1.70)	154	0.89 (0.41, 1.91)	118	1.00 (0.63, 1.58)	106	0.86 (0.53, 1.40)	118	0.90 (0.53, 1.51)
BDE-28												
Q1	3	1.0	178	1.0	142	1.0	111	1.0	102	1.0	111	1.0
Q2	57	0.35 (0.03, 3.68)	111	0.95 (0.64, 1.42)	130	0.86 (0.39, 1.87)	102	0.96 (0.64, 1.45)	96	0.99 (0.65, 1.52)	102	0.87 (0.56, 1.35)
Q3	104	0.37 (0.04, 3.73)	140	0.94 (0.64, 1.37)	114	0.69 (0.34, 1.40)	85	0.86 (0.57, 1.32)	76	0.84 (0.54, 1.31)	85	0.85 (0.53, 1.37)
Q4	116	0.34 (0.03, 3.41)	116	0.84 (0.56, 1.25)	116	0.69 (0.35, 1.34)	90	0.80 (0.53, 1.21)	89	0.87 (0.56, 1.34)	90	0.79 (0.50, 1.26)
BDE-47												
Q1	168	1.0	178	1.0	178	1.0	135	1.0	124	1.0	135	1.0
Q2	133	0.77 (0.53, 1.11)	134	0.77 (0.53, 1.10)	134	0.77 (0.52,1.13)	101	0.76 (0.51, 1.11)	90	0.67 (0.44, 1.01)	101	0.87 (0.58, 1.30)
Q3	116	0.71 (0.48, 1.03)	116	0.71 (0.49, 1.02)	116	0.72 (0.49, 1.07)	85	0.69 (0.46, 1.02)	78	0.64 (0.42, 0.97)	85	0.71 (0.46, 1.10)
Q4	117	0.73 (0.50, 1.06)	117	0.73 (0.50, 1.06)	117	0.70 (0.47, 1.03)	92	0.75 (0.50, 1.11)	91	0.75 (0.49, 1.14)	90	0.82 (0.54, 1.24)
BDE-99												
Q1	133	1.0	189	1.0	183	1.0	138	1.0	126	1.0	138	1.0
Q2	130	0.84 (0.57, 1.24)	130	0.74 (0.51, 1.06)	117	0.79 (0.53, 1.18)	99	0.76 (0.51, 1.12)	91	0.65 (0.43, 0.97)	99	0.82 (0.54, 1.26)
Q3	116	0.80 (0.54, 1.18)	116	0.71 (0.49, 1.03)	145	0.71 (0.47, 1.06)	90	0.69 (0.46, 1.02)	84	0.69 (0.46, 1.06)	90	0.67 (0.44, 1.02)
Q4	110	0.77 (0.52, 1.15)	110	0.69 (0.47, 1.00)	88	0.73 (0.49, 1.10)	80	0.75 (0.50, 1.11)	78	0.67 (0.43, 1.03)	80	0.71 (0.45, 1.13)
BDE-100												
Q1	146	1.0	193	1.0	181	1.0	140	1.0	130	1.0	140	1.0
Q2	116	0.71 (0.49, 1.05)	116	0.66 (0.45, 0.95)	116	0.66 (0.45, 0.97)	88	0.66 (0.44, 0.97)	80	0.58 (0.38, 0.88)	88	0.63 (0.42, 0.96)
Q3	120	0.73 (0.50, 1.07)	120	0.68 (0.47, 0.98)	120	0.69 (0.47, 1.03)	88	0.63 (0.43, 0.94)	80	0.58 (0.38, 0.89)	88	0.67 (0.43, 1.03)
Q4	116	0.74 (0.50, 1.08)	116	0.69 (0.47, 1.00)	116	0.66 (0.44, 0.99)	91	0.71 (0.48, 1.05)	89	0.72 (0.47, 1.09)	91	0.76 (0.50, 1.17)
BDE-153												
Q1	152	1.0	191	1.0	179	1.0	141	1.0	132	1.0	141	1.0
Q2	116	0.60 (0.41, 0.89)	116	0.62 (0.43, 0.90)	116	0.59 (0.40, 0.86)	82	0.56 (0.37, 0.83)	77	0.55 (0.36, 0.84)	82	0.60 (0.39, 0.94)
Q3	134	0.68 (0.46, 1.01)	134	0.71 (0.49, 1.03)	134	0.73 (0.49, 1.08)	105	0.71 (0.48, 1.05)	93	0.65 (0.42, 0.98)	105	0.77 (0.50, 1.17)
Q4	104	0.55 (0.36, 0.82)	104	0.56 (0.38, 0.84)	104	0.53 (0.35, 0.81)	79	0.52 (0.34, 0.80)	77	0.51 (0.33, 0.80)	79	0.60 (0.38, 0.94)

Sum[h]												
Q1	73	1.0	213	1.0	116	1.0	126	1.0	118	1.0	126	1.0
Q2	71	0.81 (0.46, 1.44)	115	0.80 (0.56, 1.14)	118	0.73 (0.47, 1.15)	98	0.87 (0.52, 1.43)	87	0.84 (0.57, 1.26)	98	0.94 (0.63, 1.43)
Q3	93	0.79 (0.45, 1.39)	133	0.99 (0.69, 1.40)	134	0.83 (0.54, 1.27)	99	0.87 (0.53, 1.43)	93	0.98 (0.66, 1.45)	99	1.04 (0.69, 1.58)
Q4	70	0.77 (0.44, 1.35)	84	0.64 (0.44, 0.93)	84	0.57 (0.38, 0.86)	65	0.58 (0.33, 1.03)	65	0.72 (0.47, 1.10)	65	0.70 (0.45, 1.08)

GP= General population. Quartile cut-points are the same for these analyses as those used in primary analyses (based on the control distribution) and shown in Table 4.

[a]Adjusted for child sex, month and year of birth, maternal age, maternal race/ethnicity, maternal weight at time of sample collection, parity, and maternal education, as in Model 2 of primary tables 3 and 4.

[b]Original concentrations received from laboratory analysis of these chemicals included censoring of values with small volumes, due to potential bias. These analyses include all concentration data, even those with small sample volumes, and not imputing <LOD values, in order to examine potential differences in censored vs uncensored data (and as a comparison to the primary method of replacing values <LOD with LOD/$\sqrt{2}$).

[c]Results using SAS Proc MI for those individuals with values <LOD (as a comparison to the primary method of replacing values <LOD with LOD/$\sqrt{2}$).

[d]These results exclude the n=132 cases who were originally identified as having ID/developmental delay through the California DDS system, but were classified as ASD in our study following expert review of DDS records.

[e]As described in text (sensitivity analyses), adjusted for top 2 principal components (PCs) from principal components analysis of GWAS data.

[f]Analysis of individuals originally identified from DDS as ASD cases and matched to GP controls, using conditional logistic regression. Adjusted as in other models here, with the exception of no additional adjustment for matching factors.

[g]N shown for all columns is number of cases per quartile. Numbers for controls per quartile are identical to primary analysis n (Table 4) for multiple imputation and removal of ID to ASD group analyses. Control n's relevant to other analyses are provided in the text (matched n) and/or supplementary tables (censored in Table S6; number <LOD in Table 2).

[h]Sum of congeners listed (those with 55% of study population with values >LOD) for all analyses but removal of those <LOD (this sum excluded PBDE28, which was detected at a lower rate than other congeners and yielded estimates with wide confidence intervals when included in sum for this analysis).

Table S6: Numbers censored by diagnostic group and sex

	ASD	ID	GP	Males			Females		
				ASD	ID	GP	ASD	ID	GP
BB153	36	21	35	28	16	29	8	5	6
BDE-28	36	21	35	29	16	29	8	5	6
BDE-47	0	0	2	0	0	2	0	0	0
BDE-99	12	5	11	10	4	9	2	1	2
BDE-100	12	5	11	10	4	9	2	1	2
BDE-153	12	5	11	10	4	9	2	1	2

Numbers indicate individuals censored/excluded from primary data analyses due to low sample volume. In sensitivity analyses including machine-read values (despite low volume; results for ASD vs GP analyses shown in Table S5) for these censored individuals, the majority had values falling in the first quartile.

Table S7: Results of analyses examining extremes of the distribution of BFR concentration in association with ASD (vs. GP controls)

	Case n	Control n	BFR concentration	Adjusted OR (95% CI) (Referent= mid 11-89th percentile)[a]
BB153				
≤5th percentile	34	26	≤0.35	0.98 (0.57, 1.70)
6th-10th percentile	38	45	>0.35-≤0.42	0.65 (0.40, 1.06)
11th-89th	367	272	>0.42-<3.2	1.0
90-94th	40	20	3.2-<5.3	1.50 (0.84, 2.67)
≥95th percentile	30	20	≥5.3	1.05 (0.57, 1.91)
PBDE28				
≤5th percentile	36	23	≤0.35	1.11 (0.63, 1.94)
6th-10th percentile	57	37	>0.35-≤0.42	1.15 (0.73, 1.83)
11th-89th	369	274	>0.42-<2.5	1.0
90-94th	26	23	2.5-<3.9	0.84 (0.46, 1.53)
≥95th percentile	14	19	≥3.9	0.58 (0.28, 1.19)
PBDE47				
≤5th percentile	53	21	≤4.1	1.92 (1.12, 3.29)
6th-10th percentile	37	21	>4.1-≤5.7	1.37 (0.78, 2.41)
11th-89th	416	332	>5.7-<63.2	1.0
90-94th	17	21	63.2-<104.6	0.76 (0.39, 1.50)
≥95th percentile	22	21	≥104.6	0.87 (0.46, 1.63)
PBDE99				
≤5th percentile	55	20	≤1.27	1.98 (1.15, 3.41)
6th-10th percentile	35	22	>1.27-≤1.6	1.17 (0.67, 2.07)
11th-89th	406	323	>1.6-<20.1	1.0
90-94th	15	21	20.1-<32.7	0.64 (0.32, 1.27)
≥95th percentile	22	21	≥34.4	0.87 (0.46, 1.64)
PBDE100				
≤5th percentile	59	23	≤1.1	1.94 (1.16, 3.25)
6th-10th percentile	48	26	>1.1-≤1.5	1.38 (0.82, 2.31)
11th-89th	385	317	>1.5-<16.7	1.0
90-94th	19	20	16.7-<32.7	0.83 (0.43, 1.60)
≥95th percentile	22	21	≥32.7	0.88 (0.47, 1.65)
PBDE153				
≤5th percentile	64	26	≤1.2	1.96 (1.19, 3.23)
6th-10th percentile	36	18	>1.2-≤1.5	1.54 (0.84, 2.81)
11th-89th	397	322	>1.5-<26.1	1.0
90-94th	16	20	26.1-<38.0	0.62 (0.31, 1.24)
≥95th percentile	20	21	≥38.0	0.71 (0.37, 1.37)
SUM				
≤5th percentile	55	19	≤11.09	2.27 (1.29, 3.97)
6th-10th percentile	34	18	>11.09-≤13.9	1.34 (0.73, 2.46)
11th-89th	379	301	>13.9-<138.4	1.0
90-94th	12	19	138.4-<204.2	0.56 (0.26, 1.19)
≥95th percentile	22	19	≥204.2	0.95 (0.50, 1.81)

[a]Adjusted for child sex, month and year of birth, maternal age, maternal race/ethnicity, maternal weight at time of sample collection, parity, and maternal education.

Table S8: Geometric mean brominated flame retardant congener serum levels (in ng/g lipid) and 95% confidence intervals by sex and diagnostic group

Compound	ASD		ID		GP	
	Males (n=446)	Females (n=99)	Males (n=104)	Females (n=77)	Males (n=345)	Females (n=73)
BB153	1.24 (1.14, 1.36)	1.06 (0.89, 1.25)	1.08 (0.89, 1.31)	0.96 (0.79, 1.15)	1.16 (1.05, 1.29)	1.03 (0.84, 1.27)
BDE-28	0.86 (0.80, 0.92)	0.92 (0.80, 1.07)	0.83 (0.73, 0.95)	0.86 (0.74, 0.99)	0.96 (0.88, 1.04)	0.88 (0.72, 1.06)
BDE-47	14.1 (12.8, 15.5)	17.6 (14.3, 21.8)	15.5 (12.8, 18.8)	17.5 (14.3, 21.4)	18.4 (16.6, 20.4)	15.8 (12.2, 20.6)
BDE-99	4.27 (3.87, 4.71)	5.40 (4.30, 6.78)	4.73 (3.93, 5.69)	5.76 (4.59, 7.22)	5.61 (5.03, 6.26)	5.09 (3.83, 6.75)
BDE-100	3.48 (3.15, 3.84)	4.14 (3.27, 5.22)	3.84 (3.22, 4.57)	4.02 (3.33, 4.84)	4.60 (4.13, 5.13)	3.91 (2.99, 5.11)
BDE-153	3.92 (3.55, 4.35)	4.44 (3.57, 5.52)	4.14 (3.42, 5.01)	3.62 (2.98, 4.41)	5.22 (4.64, 5.88)	4.15 (3.26, 5.29)
Sum[b]	31.4 (28.7, 34.4)	35.4 (28.7, 43.6)	31.4 (26.2, 37.6)	34.1 (28.0, 41.5)	41.4 (37.3, 45.9)	34.5 (26.4, 45.0)

Table S9: Adjusted odds ratios of prenatal brominated flame retardant congener serum concentrations in association with ID (relative to GP controls), stratified by child sex

	Males			Females			P-value for Interaction[a]
	ID n	Model 1[b]	Model 2[c]	ID n	Model 1	Model 2	
BB153							0.97
Q1	23	1.0	1.0	18	1.0	1.0	
Q2	25	1.10 (0.57, 2.11)	1.22 (0.61, 2.46)	27	1.51 (0.61, 3.74)	2.32 (0.81, 6.60)	
Q3	20	0.73 (0.37, 1.44)	1.00 (0.47, 2.11)	10	0.58 (0.20, 1.66)	0.88 (0.26, 2.94)	
Q4	20	0.79 (0.40, 1.56)	1.24 (0.57, 2.69)	17	1.06 (0.40, 2.77)	2.61 (0.79, 8.69)	
BDE-28							0.12
Q1	22	1.0	1.0	16	1.0	1.0	
Q2	26	1.24 (0.64, 2.38)	1.06 (0.52, 2.15)	21	1.28 (0.51, 3.24)	2.01 (0.69, 5.81)	
Q3	19	0.96 (0.48, 1.92)	0.74 (0.35, 1.58)	15	1.03 (0.38, 2.77)	1.28 (0.42, 3.89)	
Q4	19	0.80 (0.40, 1.61)	0.75 (0.36, 1.57)	17	2.23 (0.77, 6.44)	2.67 (0.82, 8.64)	
BDE-47							0.26
Q1	32	1.0	1.0	14	1.0	1.0	
Q2	25	0.72 (0.39, 1.33)	0.65 (0.34, 1.25)	27	2.67 (1.06, 6.72)	2.89 (1.01, 8.31)	
Q3	27	0.92 (0.50, 1.70)	0.76 (0.39, 1.47)	21	1.53 (0.62, 3.78)	1.73 (0.63, 4.78)	
Q4	20	0.58 (0.31, 1.09)	0.54 (0.27, 1.07)	15	1.82 (0.67, 4.99)	1.75 (0.56, 5.48)	
BDE-99			*				0.09
Q1	31	1.0	1.0	15	1.0	1.0	
Q2	23	0.70 (0.38, 1.31)	0.66 (0.34, 1.29)	23	1.72 (0.69, 4.30)	1.92 (0.68, 5.40)	
Q3	29	0.97 (0.53, 1.77)	0.75 (0.39, 1.43)	19	1.31 (0.51, 3.43)	1.39 (0.50, 3.90)	
Q4	17	0.50 (0.26, 0.97)	0.44 (0.22, 0.89)	19	1.79 (0.68, 4.71)	1.77 (0.59, 5.30)	
BDE-100							0.59
Q1	30	1.0	1.0	16	1.0	1.0	
Q2	22	0.75 (0.40, 1.41)	0.68 (0.35, 1.34)	23	1.33 (0.54, 3.27)	1.67 (0.60, 4.64)	
Q3	27	0.88 (0.48, 1.62)	0.81 (0.43, 1.54)	23	1.66 (0.66, 4.21)	1.77 (0.63, 4.98)	
Q4	21	0.64 (0.34, 1.22)	0.63 (0.32, 1.25)	14	1.19 (0.44, 3.23)	1.38 (0.45, 4.24)	
BDE-153							0.91
Q1	30	1.0	1.0	23	1.0	1.0	

Q2	26	0.73 (0.40, 1.35)	0.79 (0.41, 1.52)	22	1.48 (0.61, 3.57)	1.68 (0.65, 4.38)	
Q3	22	0.63 (0.33, 1.19)	0.66 (0.34, 1.30)	19	0.93 (0.61, 3.57)	1.62 (0.60, 4.38)	
Q4	22	0.60 (0.32, 1.13)	0.76 (0.38, 1.55)	12	0.93 (0.39, 2.21)	1.30 (0.43, 3.92)	
Sum[d]							0.22
Q1	26	1.0	1.0	19	1.0	1.0	
Q2	22	0.70 (0.39, 1.27)	0.75 (0.40, 1.41)	20	1.24 (0.53, 2.87)	1.07 (0.42, 2.69)	
Q3	25	0.80 (0.45, 1.41)	0.71 (0.38, 1.31)	19	1.20 (0.51, 2.81)	1.22 (0.47, 3.14)	
Q4	13	0.39 (0.20, 0.78)	0.43 (0.21, 0.89)	11	1.05 (0.39, 2.86)	1.24 (0.40, 3.82)	

GP= general population. GP n's as for ASD sex-stratified analyses (Table 7). *Indicates test for trend across quartiles according to the median value quartile variable was significant ($p<0.05$) in Model 2.

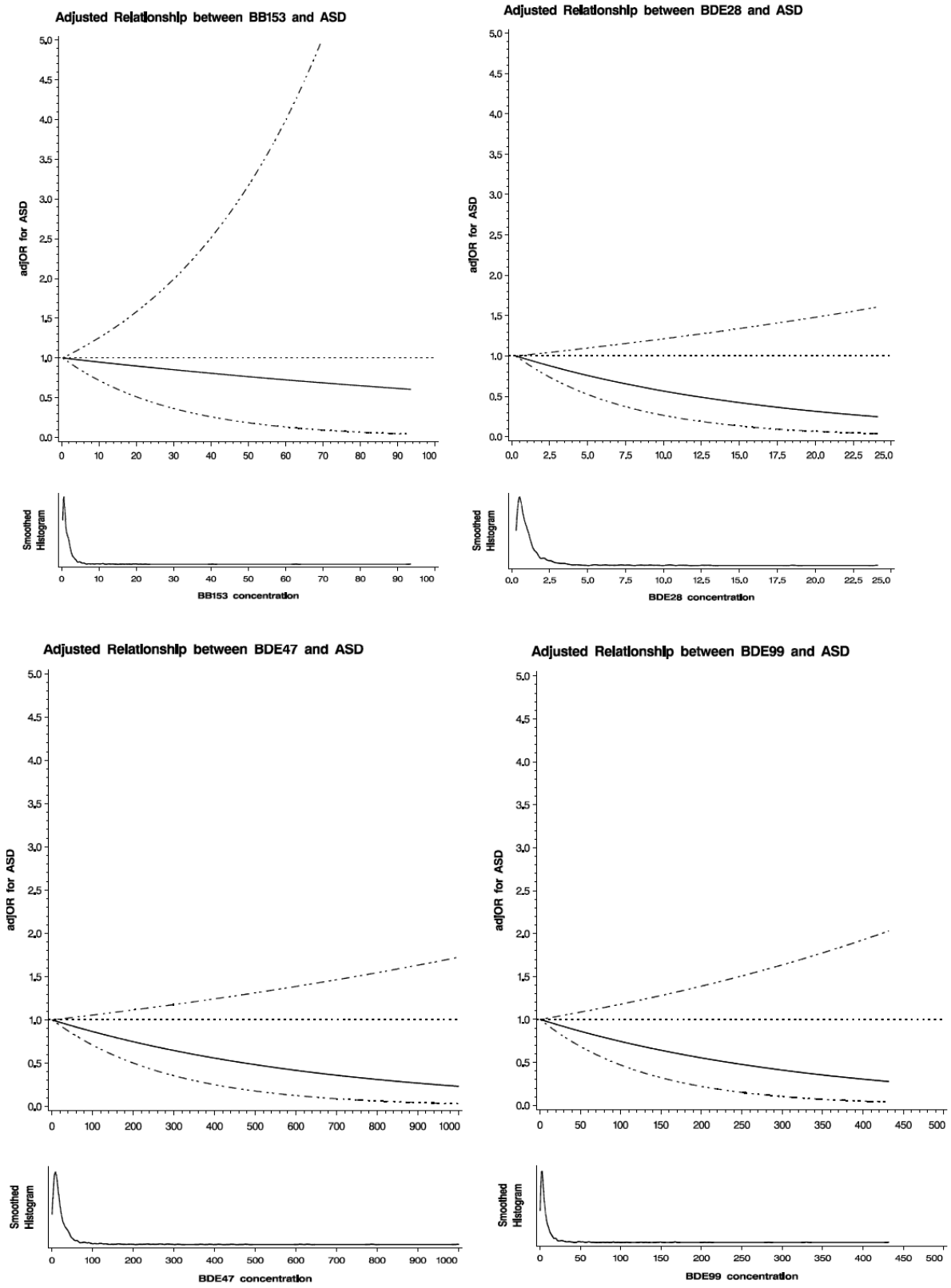
[a]P-value for interaction term for BFR concentration (ordinal median value variable) by sex from model adjusted as in Model 2, including males and females.

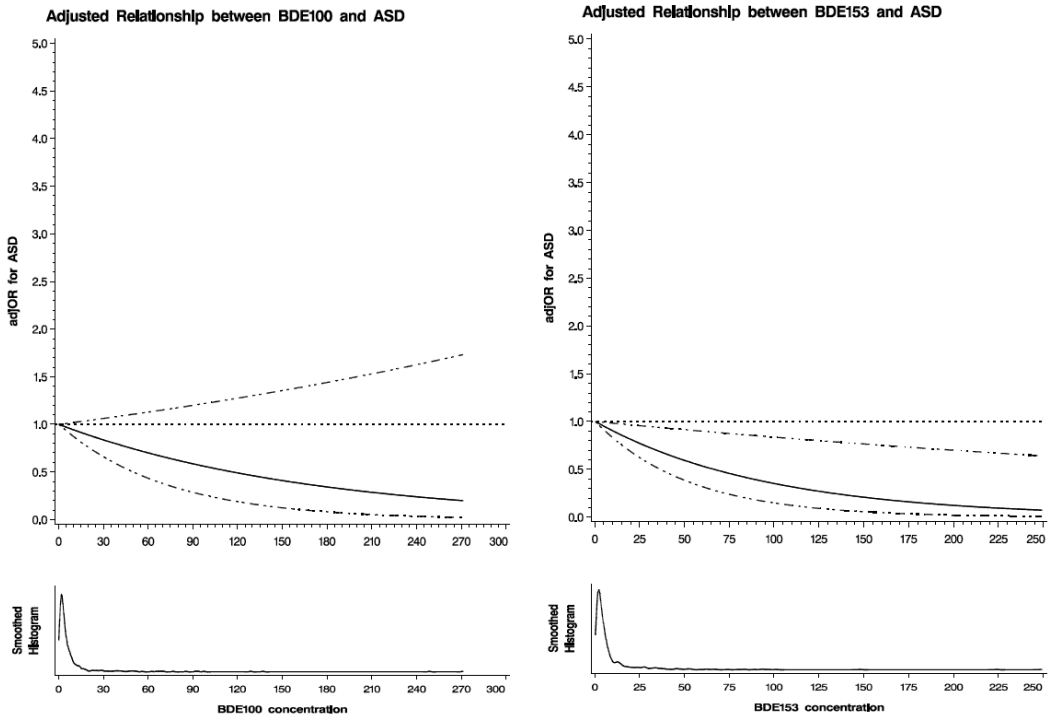
[b]Model 1: Logistic regression adjusted for child month and year of birth.

[c]Model 2 (estimates as shown in Figure 1): Model 1 + maternal age (continuous), maternal race/ethnicity (Non-Hispanic White, Asian, Black/Pacific Islander/or Other, Hispanic, or Missing), maternal weight at time of sample collection (quartiles), parity (multi- vs primiparous), and maternal education (<high school, high school, college, graduate).

[d]Sum of congeners listed in table (detected in >55% of the study population).

Figure S1: Results of cubic spline analyses of the association between serum BFR concentrations (in ng/g lipid) and odds of ASD (vs. GP controls)





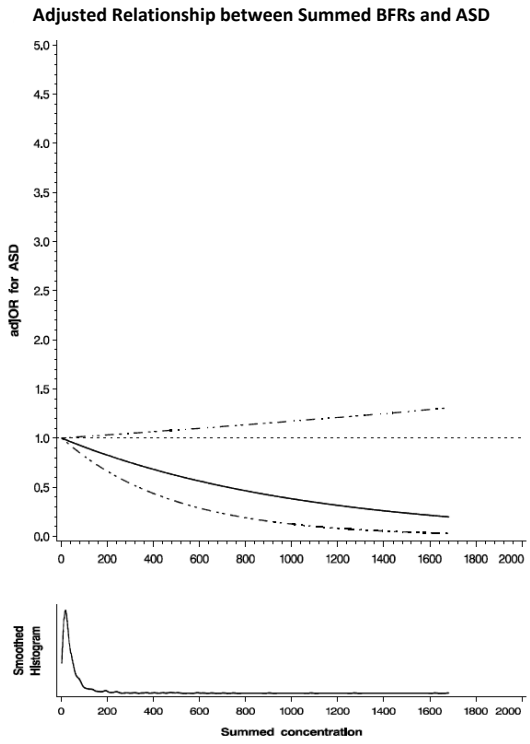


Figure legend: Top panel of each graph depicts the odds of ASD (Y axis) associated with concentration of the BFR (X axis). ORs on the Y axis represent values from adjusted models, as in Tables 3-6. The horizontal dotted line represents the null OR value of no association, while dashed lines flanking the solid line indicated 95% confidence intervals. The solid line represents the adjusted association between the BFR and ASD, allowing for potential non-linearity in the relationship. Bottom panels show histograms below each spline graph, showing the distribution of the given BFR in the study population. Summed BFRs refers to the sum of all congeners shown.