

BPA and its Analogues in Thermal Papers: An Assessment of Presence and Dermal Exposure

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Supporting Information

Table S1. Details of the PCs m/z ratios and retention time

Analyte	Precursor ions	Product ions	Ret. Time (min.)
Bisphenol A	227.0	212.10	1.803
		133.00	
Bisphenol AF	335.05	265.05	1.889
	334.95	68.90	
Bisphenol Z	267.05	173.10	2.091
		145.00	
Bisphenol F	199.00	92.90	1.649
		76.80	
Bisphenol B	241.10	211.00	1.801
		93.00	
Bisphenol P	345.10	133.10	2.485
		315.00	
Bisphenol S	249.00	107.90	1.420
		92.00	
Bisphenol A-d16	241.30	147.00	1.777
		142.10	
Bisphenol A- ¹³ C ₁₂	227.00	113.00	0.942
		180.95	
		85.10	

Table S2. Parameters used in calculation of EDI by means of deterministic and probabilistic approach

Parameter	Unit	Literature Reported Values				Deterministic Calculation	Probabilistic Calculation
						<i>Value Used in Calculation</i>	<i>Range used in Calculation</i>
C	µg/g	- ^a	- ^a	- ^a	- ^a	Min., max., median, mean, 5 th , 25 th , 75 th and 95 th percentile concentrations determined in the current study	Min-Max concentrations determined in the current study
k	ng/sec	1072 ¹	1838 ¹	21522 ²	-	21522	1072-21522
AF	%	2.3 ³	8.6 ³	27 ²	46 ⁴	27	2.3-46
HF	times/day	3 ^{*,5}	96 ^{**6}	150 ^{**5}	-	3 ^{*,150^{**}}	3 [*] ; 96 ^{**} -150 ^{**}
HT	sec	5 ^{7,8}	10 ⁶⁻⁸	-	-	5	5-10
BW	kg	60 ⁹	70 ⁹	-	-	70	60-70

^aThis study; ^{*}for general public exposure; ^{**}for occupational exposure; ¹; ²; ³; ⁴; ⁵; ⁶; ⁷; ⁸; ⁹

Table S3. Parameters used in calculation of RfDdermal, HQ and HI

Parameter	Unit	BP-A	BP-B	BP-S	BP-Z	BP-F	BP-P
RfD _{oral}	µg/kg bw/day	50 ¹⁰	0.0002 ¹¹	0,0002 ¹¹	0.0002 ¹¹	0.0002 ¹¹	0.0002 ¹¹
RfD _{dermal}	µg/kg bw/day	5 ¹²	0.00002 ¹²	0.0001148 ¹²	0.00002 ¹²	0.00002 ¹²	0.00002 ¹²
ABSGI	%	10 ^{13, 14}	10 ^{13, 14}	57.4 ¹⁵	10 ^{13, 14}	10 ^{13, 14}	10 ^{13, 14}

^{10, 11} Calculated using formula given ¹²; ¹³; ¹⁴; ¹⁵

Table S4. Details of thermal paper receipts PCs concentrations levels ($\mu\text{g/g}$) detected in samples collected from Turkish market

Sample Number	BPA	BPB	BPS	BPZ	BPAF	BPF	BPP
1	2.89	nd	114.93	nd	nd	nd	nd
2	514.08	27.52	0.15	0.74	nd	nd	nd
3	382.22	17.68	0.18	nd	nd	nd	nd
4	3.19	nd	172.94	nd	nd	nd	nd
5	3.05	nd	172.80	nd	nd	nd	nd
6	381.74	11.31	0.15	nd	nd	3.53	nd
7	420.07	9.98	0.35	nd	nd	nd	nd
8	434.88	13.33	0.27	nd	nd	nd	nd
9	437.38	28.30	0.10	0.83	nd	nd	nd
10	406.65	15.14	0.42	nd	nd	4.01	nd
11	452.20	9.76	0.43	nd	nd	nd	nd
12	417.32	13.42	0.13	nd	nd	nd	nd
13	479.36	14.03	0.13	nd	nd	nd	nd
14	530.14	20.57	0.13	0.84	nd	4.07	nd
15	509.98	15.50	0.10	0.84	nd	nd	nd
16	372.74	13.58	0.08	nd	nd	3.70	nd
17	418.87	16.20	0.07	nd	nd	nd	nd
18	403.61	17.16	0.09	nd	nd	4.23	nd
19	445.28	13.33	0.22	nd	nd	4.13	nd
20	445.95	17.48	0.12	0.81	nd	4.17	nd
21	400.11	13.47	0.12	0.75	nd	3.66	nd
22	374.48	13.48	0.19	nd	nd	4.18	nd
23	416.55	18.57	0.15	nd	nd	nd	nd
24	4.36	nd	200.43	nd	nd	nd	nd
25	375.92	17.85	0.37	0.86	nd	4.92	nd
26	5.04	nd	210.28	nd	nd	nd	1.41

nd: not detected

Table S4 (cont'd). Details of thermal paper receipts PCs concentrations levels ($\mu\text{g/g}$) detected in samples collected from Turkish market

Sample Number	BPA	BPB	BPS	BPZ	BPAF	BPF	BPP
27	417.14	16.38	0.30	0.83	nd	nd	nd
28	347.22	13.31	0.50	nd	nd	4.02	nd
29	3.34	nd	196.60	nd	nd	nd	nd
30	3.69	nd	191.64	nd	nd	4.31	nd
31	430.44	nd	0.36	0.83	nd	nd	nd
32	3.42	nd	0.37	nd	nd	nd	nd
33	4.27	nd	194.61	nd	nd	4.15	nd
34	5.67	nd	207.59	nd	nd	4.44	nd
35	250.12	16.17	0.19	0.81	nd	4.07	nd
36	311.13	22.20	0.29	0.80	nd	4.10	nd
37	6.90	nd	0.24	nd	nd	nd	1.43
38	414.13	18.48	0.19	nd	nd	nd	nd
39	321.48	11.82	0.21	0.81	nd	4.40	nd
40	350.78	15.17	0.16	0.86	nd	nd	nd
41	3.52	nd	180.35	nd	nd	nd	nd
42	3.95	nd	181.79	nd	nd	4.07	nd
43	24.18	nd	1.28	nd	nd	4.61	nd
44	299.93	17.64	0.32	nd	nd	4.29	nd
45	6.24	nd	0.10	nd	nd	4.31	nd
46	359.69	20.22	0.17	0.84	nd	4.19	nd
47	5.49	nd	184.30	nd	nd	4.06	nd
48	331.52	13.75	0.19	nd	nd	4.71	nd
49	6.57	nd	0.07	nd	nd	nd	nd
50	318.08	12.70	0.47	nd	nd	3.89	nd
51	847.86	15.25	0.24	0.80	nd	4.10	nd
52	607.67	26.25	0.35	0.85	nd	nd	1.34

nd: not detected

Table S4 (cont'd). Details of thermal paper receipts PCs concentrations levels ($\mu\text{g/g}$) detected in samples collected from Turkish market

Sample Number	BPA	BPB	BPS	BPZ	BPAF	BPF	BPP
53	431.45	15.49	0.09	nd	nd	3.79	nd
54	473.14	32.43	0.10	nd	nd	nd	nd
55	829.60	18.99	0.11	0.83	nd	4.01	nd
56	508.13	60.53	0.11	0.84	nd	nd	nd
57	349.89	31.88	0.16	0.76	nd	3.71	nd
58	1.98	43.10	64.26	nd	nd	4.19	nd
59	550.70	29.56	0.19	nd	nd	3.97	nd
60	nd	nd	0.08	0.78	nd	nd	nd
61	4.15	nd	190.56	nd	nd	nd	nd
62	893.84	15.39	0.23	nd	nd	nd	nd
63	669.63	21.10	0.18	0.85	nd	nd	nd
64	692.09	13.19	0.27	0.74	nd	nd	nd
65	3.44	nd	1.23	nd	nd	3.78	nd
66	543.16	22.51	0.14	nd	nd	nd	nd
67	520.34	12.61	0.08	0.80	nd	4.09	nd
68	566.06	20.80	0.15	0.75	nd	nd	nd
69	665.61	23.08	0.13	0.79	nd	3.85	nd
70	4.31	nd	192.01	nd	nd	4.07	nd
71	4.25	nd	171.02	nd	nd	nd	nd
72	616.83	28.73	0.15	0.84	nd	4.09	nd
73	5.16	nd	187.86	nd	nd	nd	nd
74	549.34	13.56	0.16	0.75	nd	4.06	nd
75	711.72	20.79	0.49	0.86	nd	nd	nd
76	522.57	14.85	0.24	0.83	nd	nd	nd
77	663.20	15.38	0.33	nd	nd	nd	1.83

nd: not detected

Table S4 (cont'd). Details of thermal paper receipts PCs concentrations levels ($\mu\text{g/g}$) detected in samples collected from Turkish market

Sample Number	BPA	BPB	BPS	BPZ	BPAF	BPF	BPP
78	539.84	12.02	0.23	0.83	nd	nd	nd
79	498.84	24.76	0.49	nd	nd	3.95	nd
80	5.16	nd	191.39	nd	nd	nd	nd
81	5.57	nd	185.39	nd	nd	nd	nd
82	1061.11	15.52	0.80	nd	nd	nd	nd
83	682.35	17.22	0.22	0.79	nd	3.83	nd
84	461.74	34.17	0.24	0.84	nd	nd	nd
85	728.24	22.71	0.21	0.82	nd	4.00	nd
86	6.28	nd	182.86	nd	nd	nd	nd
87	553.47	26.19	0.23	nd	nd	4.49	nd
88	582.35	20.34	0.21	0.86	nd	4.19	nd
89	490.20	23.37	0.82	nd	nd	nd	nd
90	4.28	nd	188.05	nd	nd	4.16	nd
91	351.78	25.47	0.21	0.83	nd	4.15	nd
92	352.96	39.53	0.09	0.86	nd	4.31	nd
93	391.82	42.43	0.08	0.82	nd	4.22	nd
94	323.31	61.71	0.08	nd	nd	4.40	nd
95	4.08	nd	197.24	nd	nd	nd	nd
96	338.90	12.17	0.21	0.81	nd	4.17	nd
97	401.55	22.39	0.28	0.81	nd	4.04	nd
98	343.05	17.78	0.23	0.80	nd	5.62	nd
99	432.29	19.89	0.15	0.81	nd	4.07	nd
100	318.92	15.71	0.12	nd	nd	4.47	nd
101	389.08	23.48	0.37	0.84	nd	4.31	nd
102	349.98	39.02	0.15	0.79	nd	3.94	nd

nd: not detected

Table S4 (cont'd). Details of thermal paper receipts PCs concentrations levels ($\mu\text{g/g}$) detected in samples collected from Turkish market

Sample Number	BPA	BPB	BPS	BPZ	BPAF	BPF	BPP
103	335.01	21.37	0.12	nd	nd	4.20	nd
104	389.62	33.77	0.10	0.86	nd	4.53	nd
105	494.20	29.88	0.15	0.86	nd	4.20	nd
106	353.91	15.07	0.10	0.84	nd	4.34	nd
107	355.90	18.80	0.14	0.83	nd	4.28	nd
108	437.11	20.89	0.08	nd	nd	4.04	nd
109	359.79	15.09	0.08	0.85	nd	4.63	nd
110	474.63	25.37	0.18	0.84	nd	4.45	nd
111	351.78	13.02	0.11	nd	nd	nd	nd
112	435.25	22.76	0.11	0.85	nd	4.26	nd
113	349.77	16.71	0.13	nd	nd	4.32	nd
114	447.65	21.49	0.13	0.83	nd	4.15	nd
115	429.12	20.11	0.16	nd	nd	nd	nd
116	379.10	16.88	0.08	nd	nd	4.72	nd
117	347.39	17.65	0.11	0.83	nd	4.27	nd
118	439.28	21.86	0.09	0.87	nd	5.75	nd
119	470.01	16.85	0.20	0.79	nd	4.16	nd
120	441.47	19.37	0.10	0.84	nd	4.57	nd
121	400.61	19.18	0.10	0.79	nd	4.17	nd
122	353.84	15.73	0.08	nd	nd	4.49	nd
123	400.99	16.25	0.19	nd	nd	4.59	nd
124	499.88	23.23	0.25	0.87	nd	4.37	nd
125	384.10	17.36	0.09	nd	nd	nd	nd
126	427.74	29.52	0.10	nd	nd	nd	nd
127	345.43	13.76	0.13	0.80	nd	nd	nd

nd: not detected

Table S4 (cont'd). Details of thermal paper receipts PCs concentrations levels ($\mu\text{g/g}$) detected in samples collected from Turkish market

Sample Number	BPA	BPB	BPS	BPZ	BPAF	BPF	BPP
128	394.64	17.58	0.08	nd	nd	4.25	nd
129	401.32	13.42	0.16	0.80	nd	4.77	nd
130	379.36	15.52	0.21	0.85	nd	4.24	nd
131	371.52	27.36	0.22	nd	nd	nd	nd
132	300.44	23.06	0.30	nd	nd	4.44	nd
133	30.77	3.65	167.33	0.77	nd	4.21	nd
134	359.60	26.43	0.39	nd	nd	nd	1.37
135	330.19	15.10	0.64	nd	nd	4.35	nd
136	479.21	36.97	2.08	nd	nd	3.93	nd
137	495.64	34.24	0.31	nd	nd	nd	nd
138	16.56	3.73	172.14	nd	nd	nd	nd
139	360.78	39.11	0.20	nd	nd	nd	nd
140	410.71	29.22	0.26	0.82	nd	3.97	nd
141	292.58	51.56	0.38	nd	nd	nd	nd
142	10.44	nd	189.35	nd	nd	nd	nd
143	8.33	nd	208.72	nd	nd	nd	nd
144	439.30	53.14	0.66	nd	nd	4.08	nd
145	373.48	49.71	0.31	nd	nd	4.13	nd
146	419.40	52.16	0.29	nd	nd	4.10	nd
147	587.91	60.46	0.20	0.87	nd	nd	nd
148	517.60	58.04	0.18	nd	nd	nd	nd
149	376.26	39.27	0.11	nd	nd	nd	nd
150	391.47	29.47	0.22	0.84	nd	4.07	nd
151	549.80	52.04	0.21	nd	nd	nd	nd
152	451.10	46.50	0.40	0.84	nd	3.95	nd

nd: not detected

Table S5. Concentrations of BPs in different thermal paper brands

Thermal Paper Brands	Statistic Parameters	BPA	BPB	BPS	BPAF	BPZ	BPF	BPP
Brand a (n:8)	Min	1.98	9.76	0.10	nc	nc	3.89	nc
	Max	473.14	43.10	184.30			4.71	
	Mean	303.43	22.10	31.25			4.21	
	Median	374.42	13.75	0.31			4.13	
	GeoAvg	120.3	19.15	0.94			4.20	
	SE	68.14	4.54	23.26			0.12	
	25 th Percentile	239.9	13.06	0.12			4.02	
	75 th Percentile	433.8	30.97	16.42			4.32	
Brand b (n:16)	Min	4.25	3.65	0.08	nc	0.74	4.07	nc
	Max	692.09	60.46	171.02		0.87	4.45	
	Avg	426.70	25.75	21.31		0.81	4.22	
	Median	470.01	20.57	0.20		0.82	4.19	
	GeoAvg	292.70	20.71	0.40		0.81	4.22	
	SE	46.65	4.22	14.43		0.01	0.03	
	25 th Percentile	396.21	15.96	0.13		0.78	4.15	
	75 th Percentile	536.65	29.81	0.28		0.84	4.25	
Brand c (n:5)	Min	445.95	14.03	0.10	nc	0.81	nc	nc
	Max	893.84	21.10	0.23		0.85		
	Avg	599.75	16.70	0.15		0.84		
	Median	509.98	15.50	0.13		0.84		
	GeoAvg	579.32	16.53	0.15		0.83		
	SE	82.9	1.23	0.02		0.01		
	25 th Percentile	479.36	15.39	0.12		0.83		
	75 th Percentile	486.78	25.83	0.31		0.84		
Brand d (n:34)	Min	4.31	3.73	0.08	nc	0.75	3.83	1.37
	Max	847.86	58.04	208.72		0.86	4.49	1.83
	Avg	428.13	22.34	33.70		0.82	4.15	1.60
	Median	463.25	20.34	0.23		0.82	4.10	1.60
	GeoAvg	237.66	19.89	0.72		0.82	4.15	1.59
	SE	41.0	1.96	13.61		0.01	0.03	0.06
	25 th Percentile	350.27	15.38	0.17		0.80	4.07	1.49
	75 th Percentile	351.60	15.94	0.18		0.80	4.07	1.50
Brand e (n:23)	Min	4.28	13.33	0.07	nc	0.75	3.66	nc
	Max	439.30	53.14	188.05		0.87	5.75	
	Avg	373.05	20.37	8.36		0.82	4.27	
	Median	394.64	17.61	0.12		0.82	4.23	
	GeoAvg	318.70	19.13	0.20		0.82	4.25	
	SE	18.71	1.83	8.00		0.01	0.10	
	25 th Percentile	350.62	15.25	0.09		0.80	4.07	
	75 th Percentile	423.99	21.74	0.24		0.84	4.29	

nc: not calculated as the compound was not found in any of the samples of the relevant brand

Table S5 (Cont'd). Concentrations of BPs in different thermal paper brands

Thermal Paper Brands	Statistic Parameters	BPA	BPB	BPS	BPAF	BPZ	BPF	BPP
Brand f (n:31)	Min	3.42	9.98	0.07	nc	0.74	3.78	1.34
	Max	692.09	61.71	1.28		0.87	5.62	1.43
	Avg	356.68	25.89	0.27		0.82	4.30	1.39
	Median	375.92	21.84	0.19		0.83	4.18	1.39
	GeoAvg	218.55	23.04	0.20		0.82	4.29	1.39
	SE	31.83	2.50	0.05		0.01	0.07	0.01
	25 th Percentile	338.90	16.70	0.11		0.80	4.05	1.36
	75 th Percentile	420.07	30.61	0.29		0.85	4.50	1.41
Brand g (n:13)	Min	292.58	9.98	0.11	nc	0.76	3.71	nc
	Max	1061.11	51.56	2.08		0.85	4.59	
	Avg	457.41	24.41	0.44		0.82	4.23	
	Median	400.99	16.25	0.24		0.84	4.34	
	GeoAvg	428.54	21.95	0.28		0.82	4.22	
	SE	56.40	3.50	0.16		0.01	0.10	
	25 th Percentile	349.89	15.52	0.19		0.83	4.01	
	75 th Percentile	479.21	31.88	0.35		0.85	4.46	
Brand h (n:5)	Min	4.36	19.37	0.10	nc	nc	3.95	nc
	Max	490.20	46.50	200.43			4.57	
	Avg	278.67	29.75	40.37			4.28	
	Median	441.47	23.37	0.40			4.31	
	GeoAvg	76.71	27.61	0.92			4.27	
	SE	112.0	6.55	40.01			0.14	
	25 th Percentile	6.24	21.37	0.10			4.13	
	75 th Percentile	451.10	34.94	0.82			4.44	
Brand i (n:7)	Min	2.89	nc	0.15	nc	nc	nc	nc
	Max	514.08		210.28				
	Avg	184.60		95.92				
	Median	5.04		114.93				
	GeoAvg	27.06		8.41				
	SE	87.0		35.45				
	25 th Percentile	3.12		0.17				
	75 th Percentile	381.98		172.87				
Brand j (n:10)	Min	3.34	nc	0.09	nc	nc	nc	nc
	Max	431.45		207.59				
	Avg	81.49		154.06				
	Median	192.47		57.56				
	GeoAvg	10.06		44.17				
	SE	52.0		25.77				
	25 th Percentile	3.76		180.71				
	75 th Percentile	5.32		196.10				

nc: not calculated as the compound was not found in any of the samples of the relevant brand

Table S6. Concentrations of the BP-A, BP-B and BP-S ($\mu\text{g/g}$ paper) in thermal paper receipts by service group

Consumption	n	$\mu\text{g/g}$ paper											
		BPA				BPB				BPS			
		Range	Mean \pm SE	Median	% DF	Range	Mean \pm SE	Median	% DF	Range	Mean \pm SE	Median	% DF
Fuel Bill	8	8.33-479.21	305.0 \pm 66.4	374.87	100	21.37-53.14	42.1 \pm 4.3	44.49	75	0.11-208.72	50.2 \pm 32.5	0.48	100
Cafe-Restaurant	3	5.57-318.08	157.5 \pm 101	153.25	100	12.70-17.64	15.1 \pm 2	15.17	50	0.07-185.39	46.5 \pm 53.4	0.39	100
Cinema	3	372.74-418.87	398.4 \pm 13.5	403.61	100	13.58-17.16	15.6 \pm 1	16.20	100	0.07-0.09	0.08 \pm 0.005	0.08	100
Fast food	45	1.98-1061.11	394 \pm 35.8	427.74	100	12.17-60.53	25.08 \pm 2	19,89	82	0.10-207.59	35.3 \pm 11	0.21	100
Gas station	22	6.24-728.24	397.4 \pm 36.6	400.11	95	9.76-51.56	22.05 \pm 2.25	20.69	82	0.08-0.82	0.22 \pm 0.04	0.18	100
Self-pay machine receipt	10	3.42-461.74	259.9 \pm 55.1	340.75	100	3.65-61.71	29.4 \pm 5.8	30.30	80	0.08-182.86	35.38 \pm 23.4	0.22	100
Supermarket	29	2.89-711.72	278.7 \pm 43.1	350.78	100	3.73-39.11	19.4 \pm 1.7	17.36	66	0.08-210.28	62.2 \pm 16.4	0.22	100
Health Center	3	4.36-553.47	342.6 \pm 170.8	470.01	100	16.85-26.19	21.5 \pm 3.9	21.52	95	0.20-200.43	67 \pm 66.74	0.23	100
Apparel	9	3.95-829.60	416.3 \pm 72.6	389.08	100	13,31-23.48	18.7 \pm 1	19.18	95	0,10-181.79	20.4 \pm 20.2	0.30	100
Other*	19	4.36-847.86	430.5 \pm 32.0	418.69	100	15.07-29.88	19.7 \pm 1.6	20.11	95	0.08-0.25	0.25 \pm 0.06	0.15	100

*Copy center, cosmetics, educational charge, hardware store and post-office, DF: Detection Frequency, SE: Standard Error

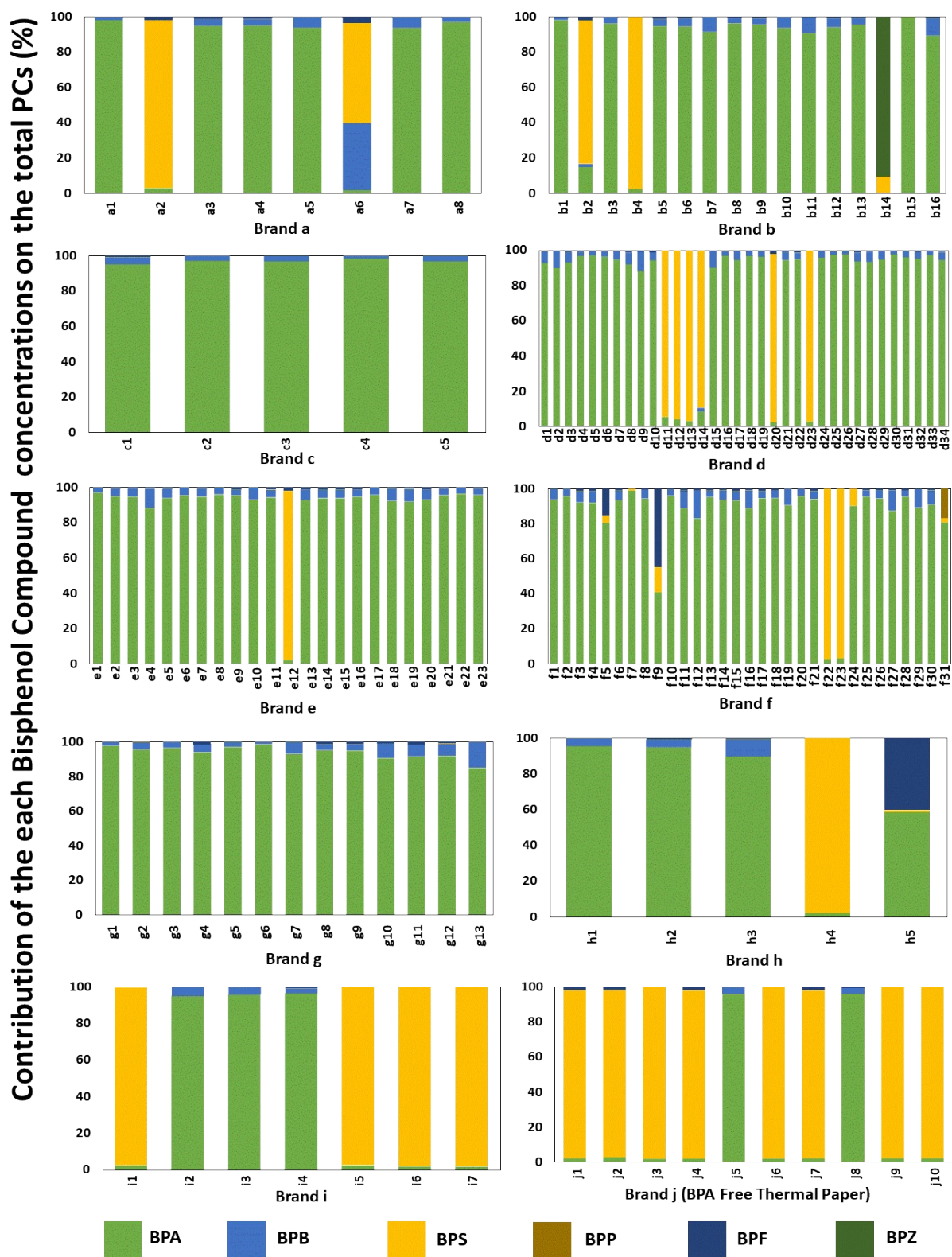


Figure S1. Contribution of each bisphenol compound to total concentration in different brand receipt papers

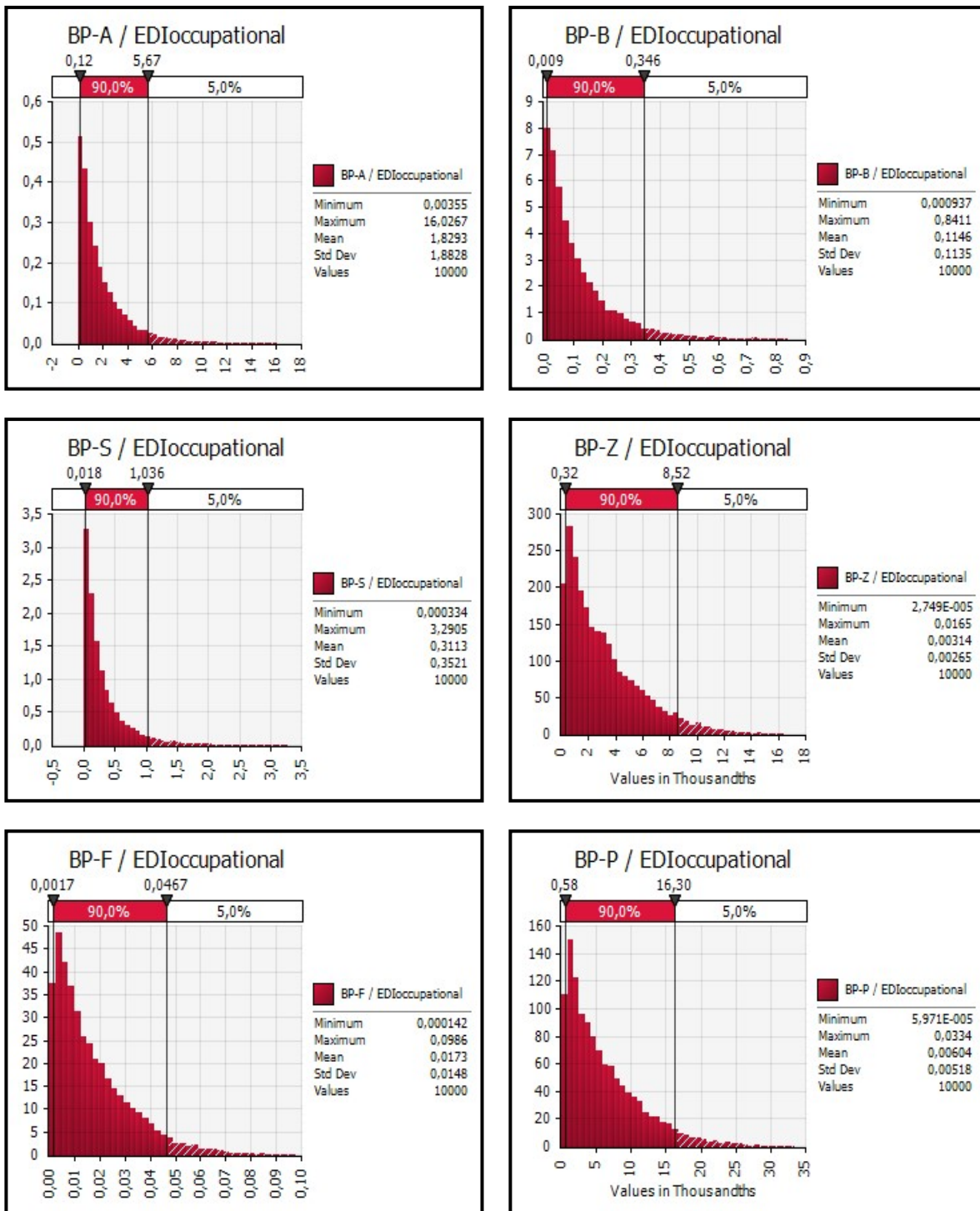


Figure S2. The estimated daily intake (EDI) of BPs for probabilistic calculation in occupational exposure groups

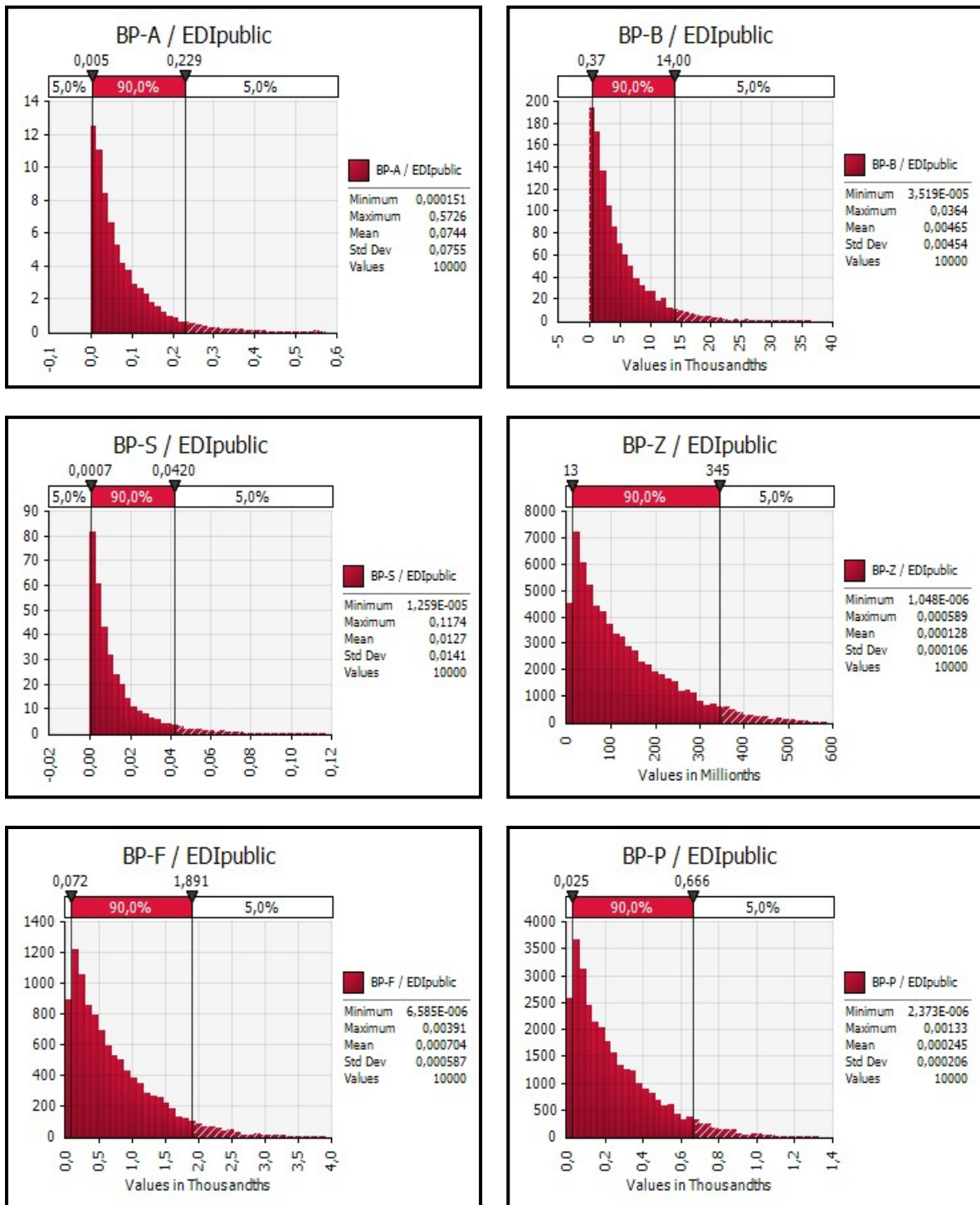


Figure S3. The estimated daily intake (EDI) of BPs for probabilistic calculation in public exposure groups

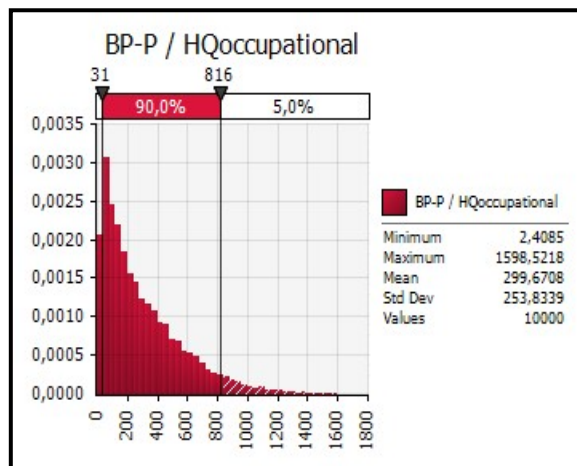
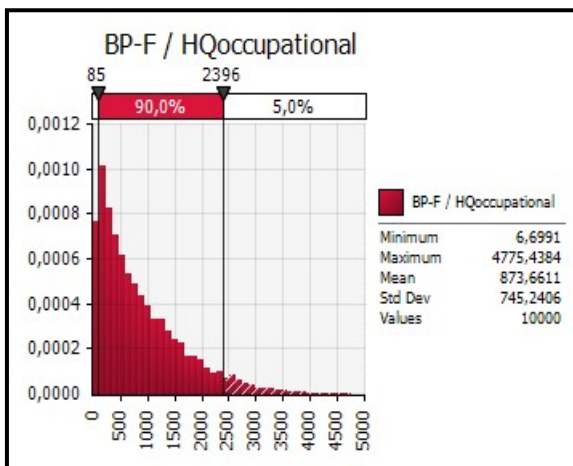
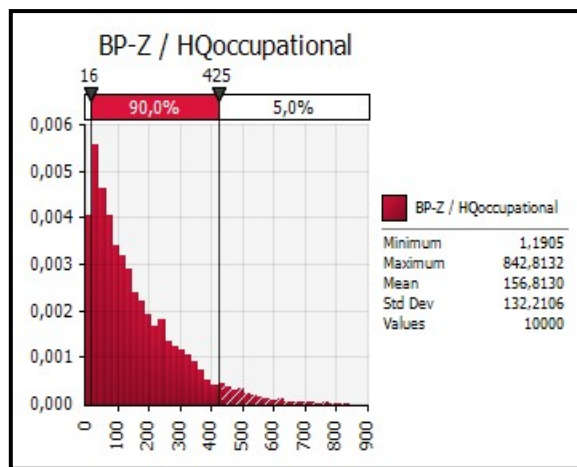
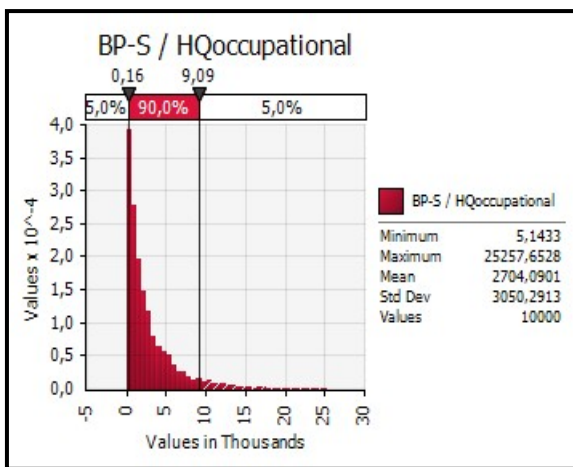
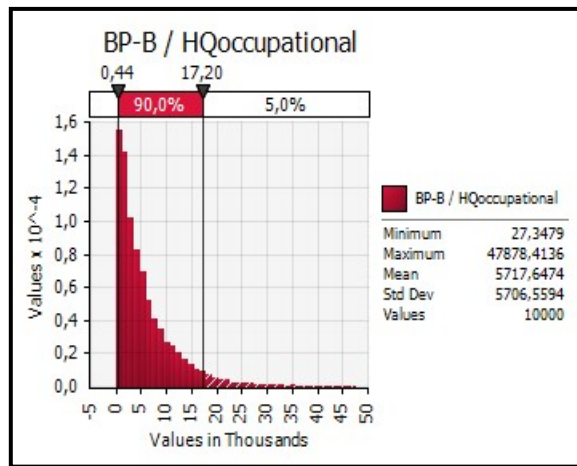
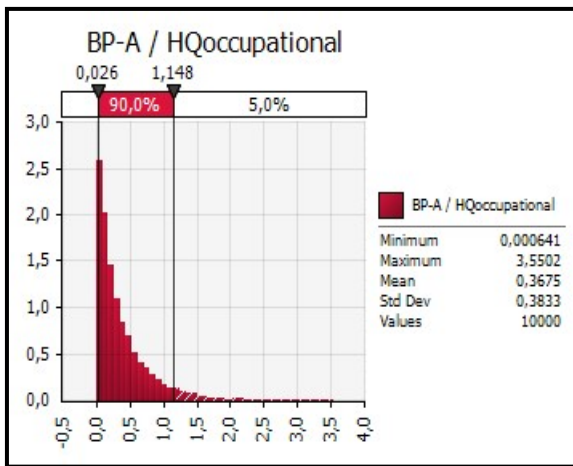


Figure S4. The hazard quotient (HQ) of BPs for probabilistic calculation in occupational exposure groups

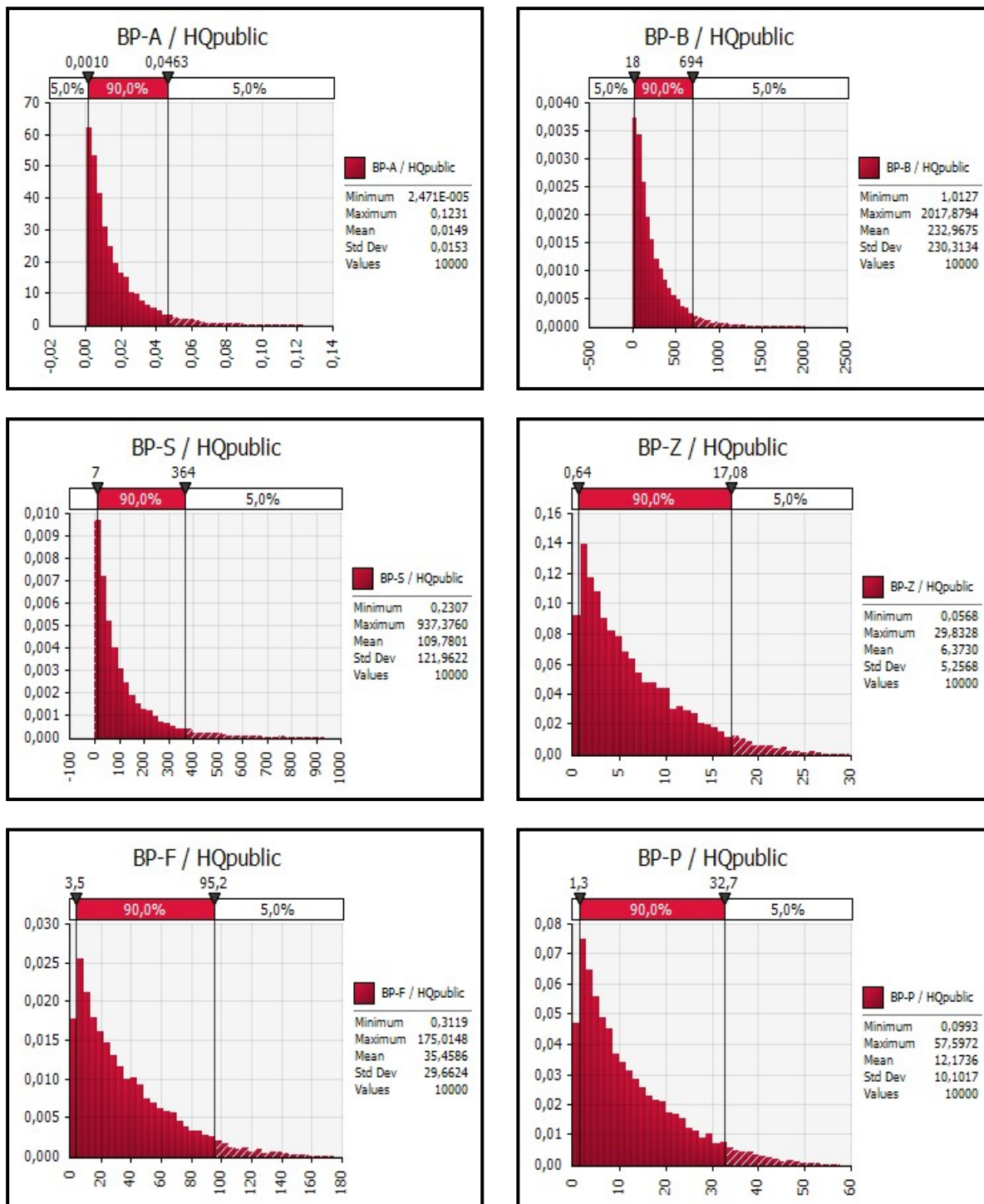


Figure S5. The hazard quotient (HQ) of BPs for probabilistic calculation in public exposure groups

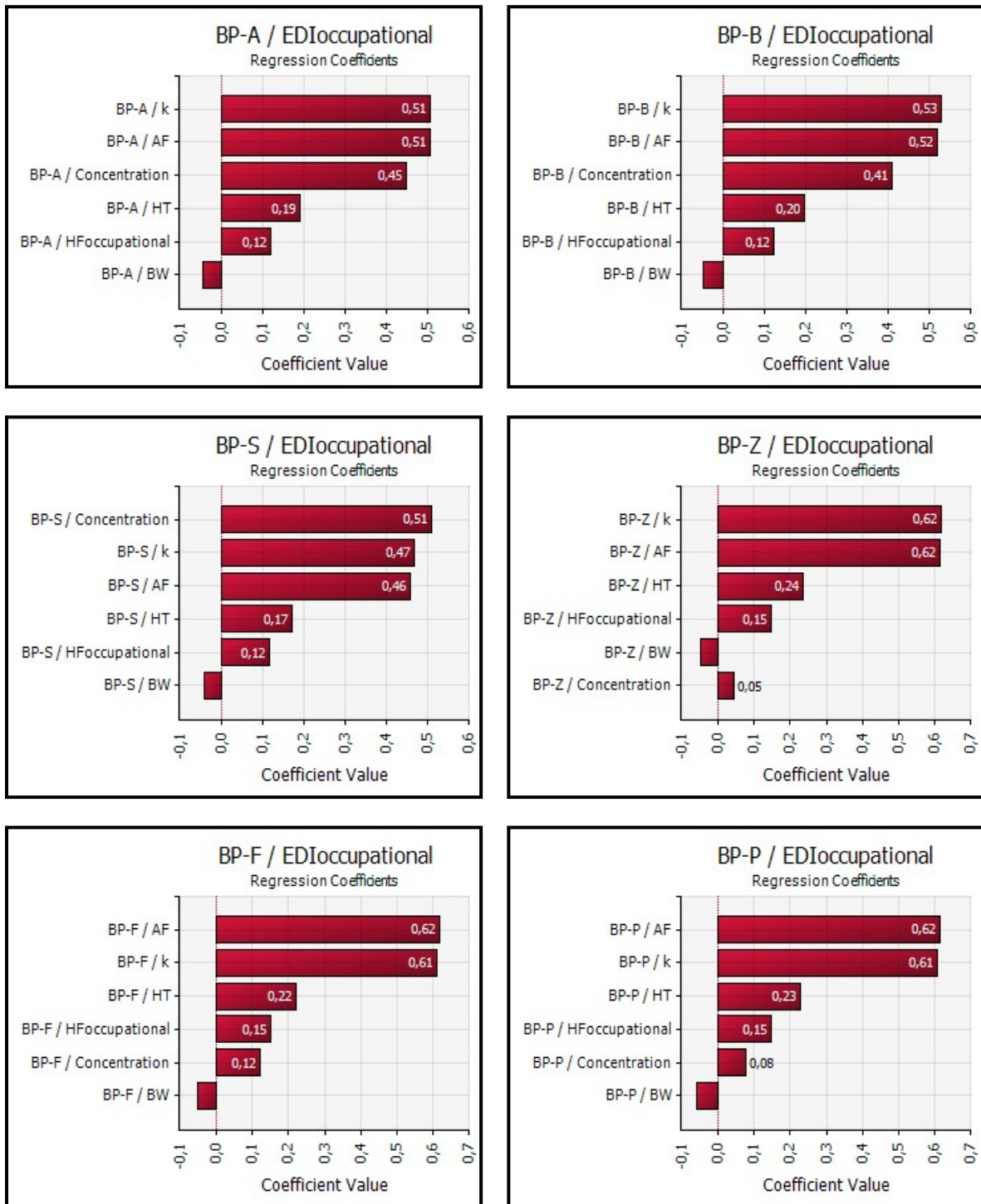


Figure S6. Sensitivity analysis of estimated daily intake (EDI) for BPs in occupational exposure groups

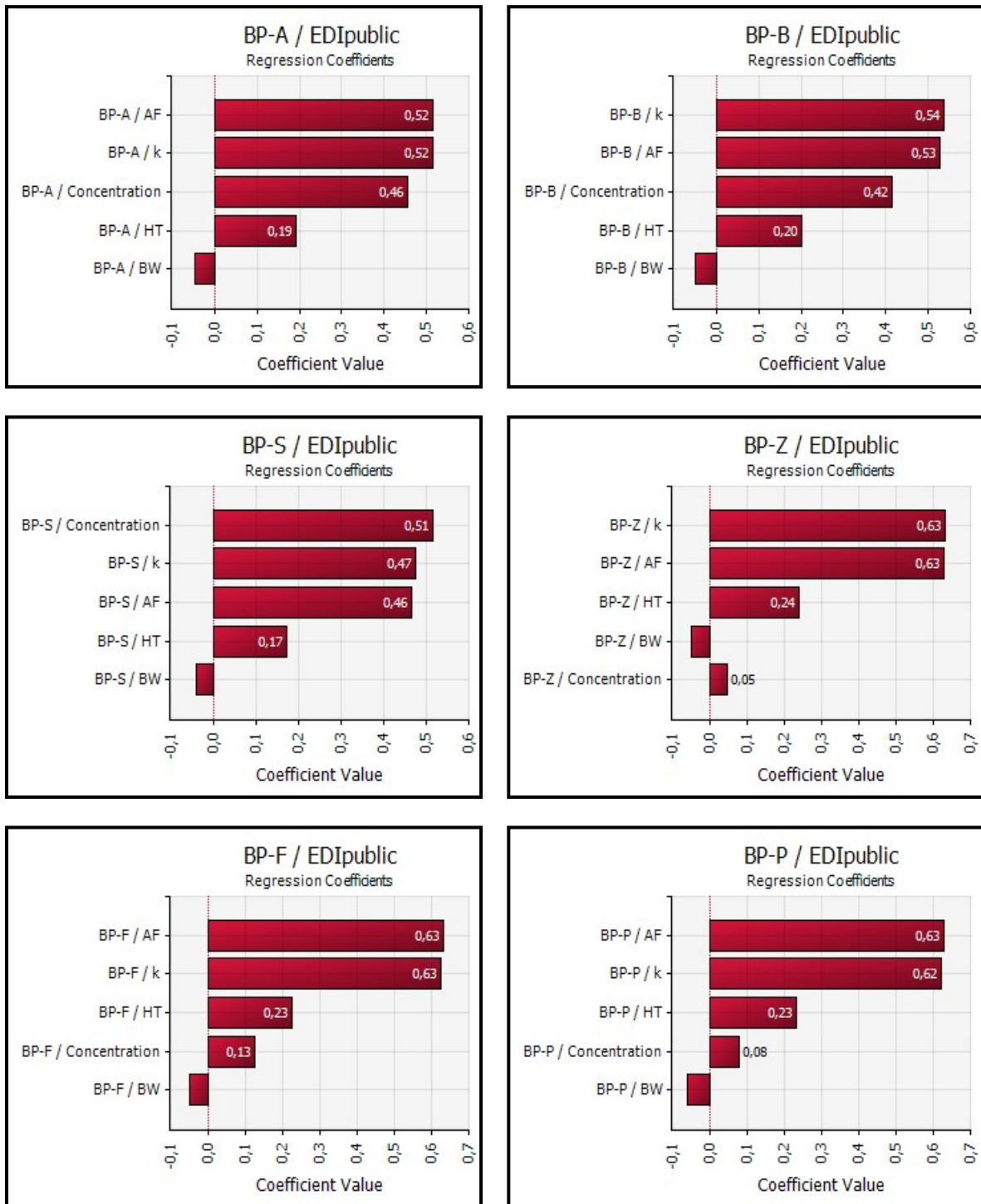


Figure S7. Sensitivity analysis of estimated daily intake (EDI) for BPs in public exposure groups

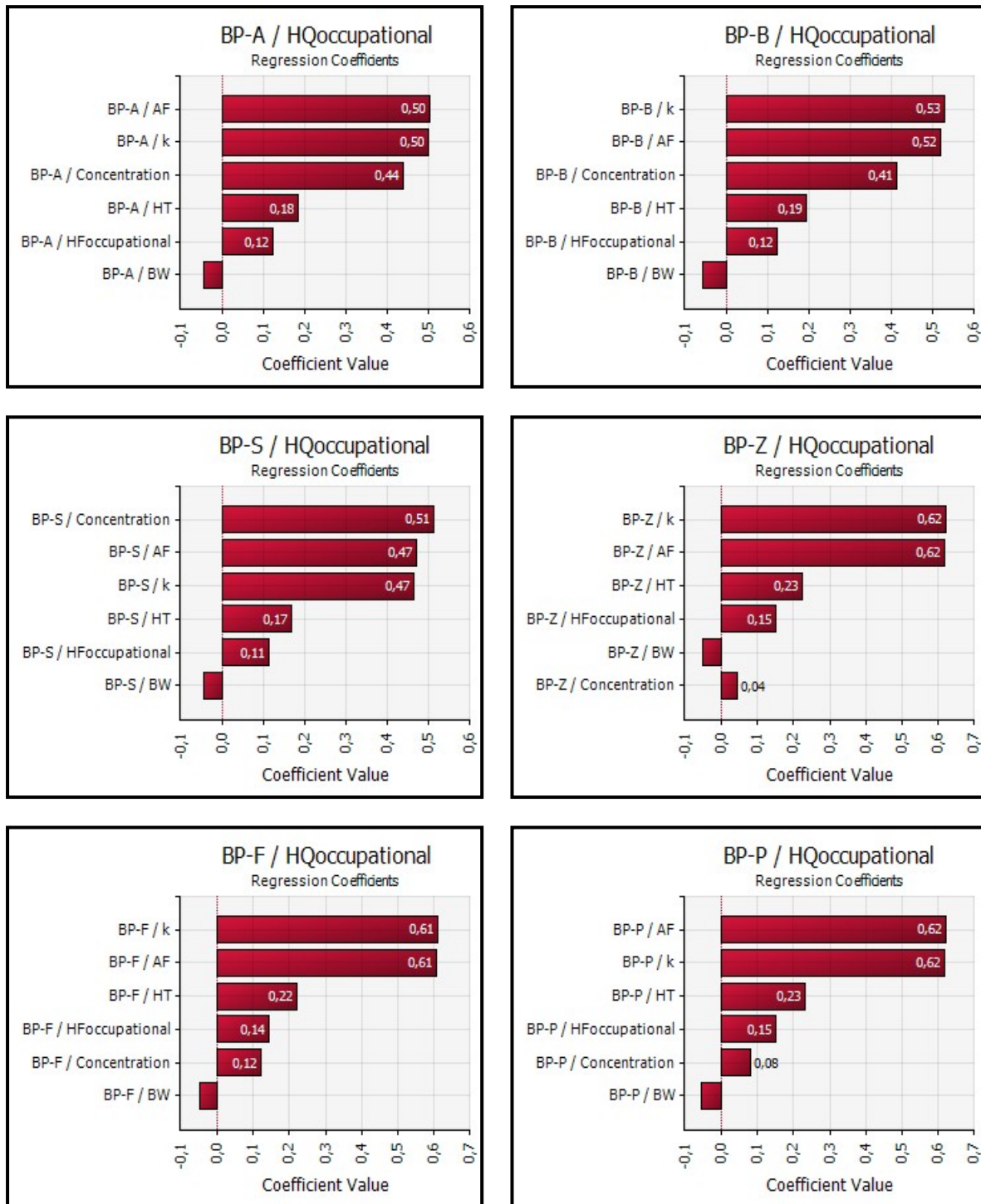


Figure S8. Sensitivity analysis of hazard quotient (HQ) for BPs in occupational exposure groups

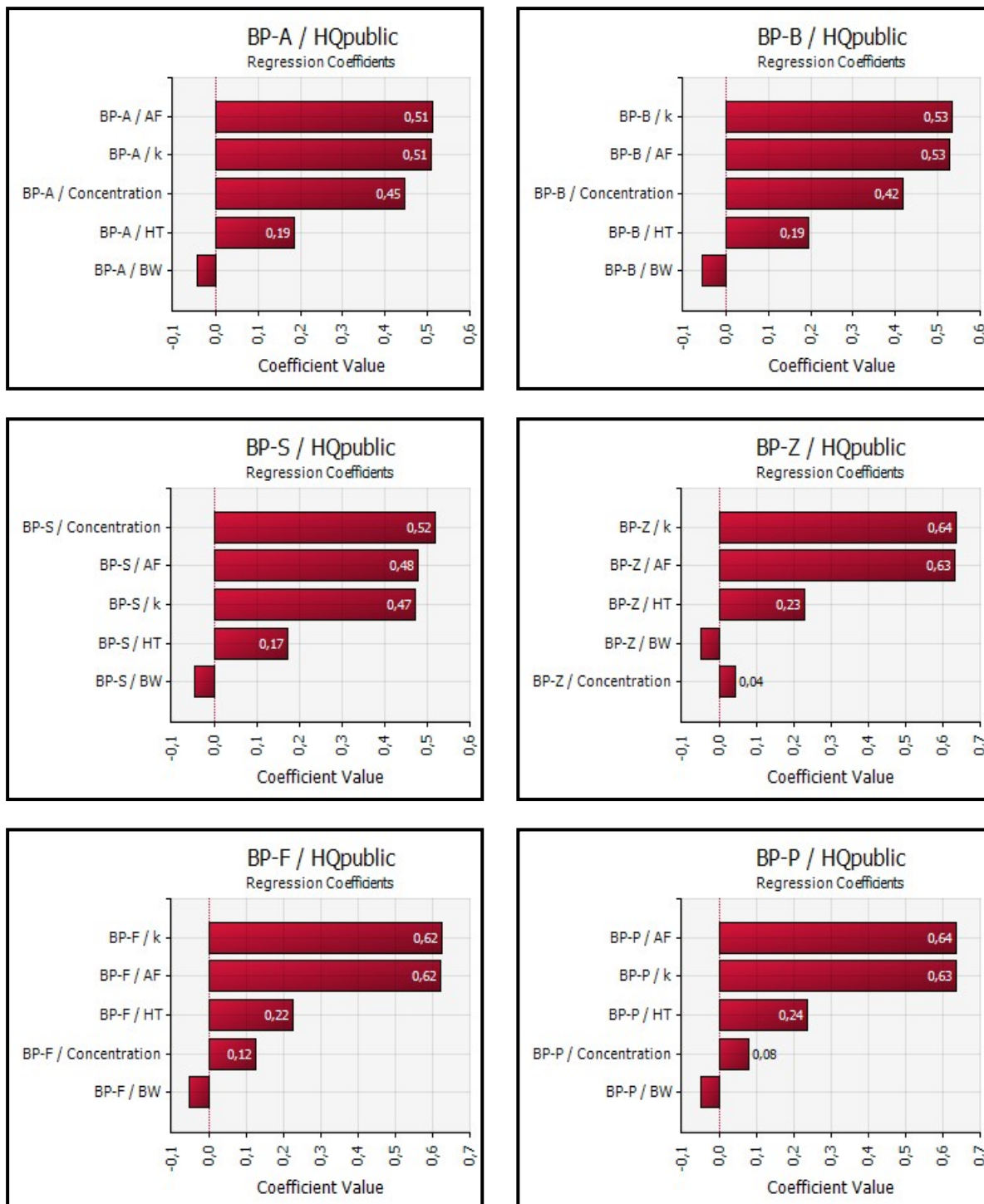


Figure S9. Sensitivity analysis of hazard quotient (HQ) for BPs in public exposure groups

REFERENCES

- 1 A. M. Hormann, F. S. vom Saal, S. C. Nagel, R. W. Stahlhut, C. L. Moyer, M. R. Ellersieck, W. V. Welshons, P. L. Toutain and J. A. Taylor, Holding Thermal Receipt Paper and Eating Food after Using Hand Sanitizer Results in High Serum Bioactive and Urine Total Levels of Bisphenol A (BPA), *Plos One*, 2014, **9**.
- 2 S. Biedermann, P. Tschudin and K. Grob, Transfer of bisphenol A from thermal printer paper to the skin, *Analytical and Bioanalytical Chemistry*, 2010, **398**, 571-576.
- 3 A. L. Demierre, R. Peter, A. Oberli and M. Bourqui-Pittet, Dermal penetration of bisphenol A in human skin contributes marginally to total exposure, *Toxicol Lett*, 2012, **213**, 305-308.
- 4 D. Zalko, C. Jacques, H. Duplan, S. Bruel and E. Perdu, Viable skin efficiently absorbs and metabolizes bisphenol A, *Chemosphere*, 2011, **82**, 424-430.
- 5 B. A. Rocha, L. F. Azevedo, M. Gallimberti, A. D. Campiglia and F. Barbosa, High levels of bisphenol a and bisphenol s in brazilian thermal paper receipts and estimation of daily exposure, *Journal of Toxicology and Environmental Health-Part a-Current Issues*, 2015, **78**, 1181-1188.
- 6 L. Semerjian, N. Alawadhi and K. Nazer, Detection of bisphenol A in thermal paper receipts and assessment of human exposure: A case study from Sharjah, United Arab Emirates, *Plos One*, 2023, **18**.
- 7 S. Y. Lu, W. J. Chang, S. O. Sojinu and H. G. Ni, Bisphenol A in supermarket receipts and its exposure to human in Shenzhen, China, *Chemosphere*, 2013, **92**, 1190-1194.
- 8 R. F. Fan, B. Y. Zeng, X. S. Liu, C. Chen, Q. W. Zhuang, Y. J. Wang, M. L. Hu, Y. S. Lv, J. N. Li, Y. X. Zhou and Z. Y. W. Lin, Levels of bisphenol-A in different paper products in Guangzhou, China, and assessment of human exposure via dermal contact, *Environmental Science-Processes & Impacts*, 2015, **17**, 667-673.
- 9 EC, European Commission, Technical Guidance Document on Risk Assessment Part 1., *Institute for Health and Consumer Protection*, 2003.
- 10 USEPA, *USEPA Integrated Risk Information System (IRIS) database*, 2024.
- 11 EFSA, *EFSA CEF Panel (EFSA Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids). Re-evaluation of the risks to public health related to the presence of bisphenol A (BPA) in foodstuffs.*, Report, EFSA Journal 2023.
- 12 K. Jurowski and M. Krośniak, The Toxicological Risk Assessment of Dermal Exposure of Patients Exposed to Lead and Cadmium Due to Application of Ointments with Marjoram Herb Extract (*Majoranae herbae extractum*), *International journal of environmental research and public health*, 2023, **20**.
- 13 EFSA EFSA Journal, 2579, *Guidance on selected default values to 49 be used by the EFSA Scientific Committee, Scientific Panels and Units in the absence of actual 50 measured data*, 2012.
- 14 EC, *European Comission, OPINION ON the safety of presence of Bisphenol A in clothing articles, SCCS/1620/20*, Scientific Committee on Consumer Safety, 2020.
- 15 V. Gayrard, M. Z. Lacroix, S. H. Collet, C. Viguié, A. Bousquet-Melou, P. L. Toutain and N. Picard-Hagen, High bioavailability of bisphenol A from sublingual exposure, *Environmental health perspectives*, 2013, **121**, 951-956.