Environ Health Perspect

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Supplemental Material

Serum Polybrominated Biphenyls (PBBs) and Polychlorinated Biphenyls (PCBs) and Thyroid Function among Michigan Adults Several Decades after the 1973-1974 PBB Contamination of Livestock Feed

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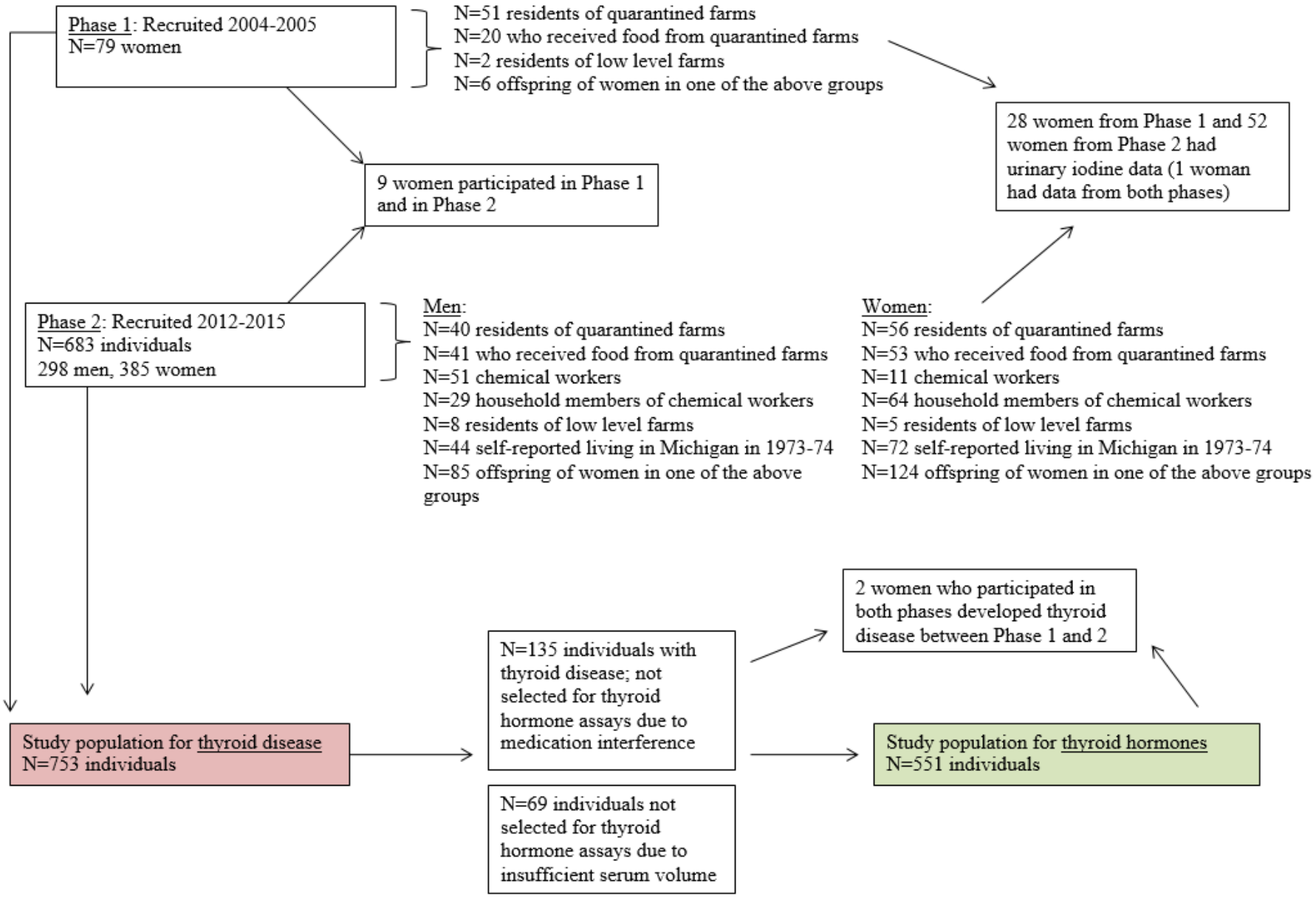
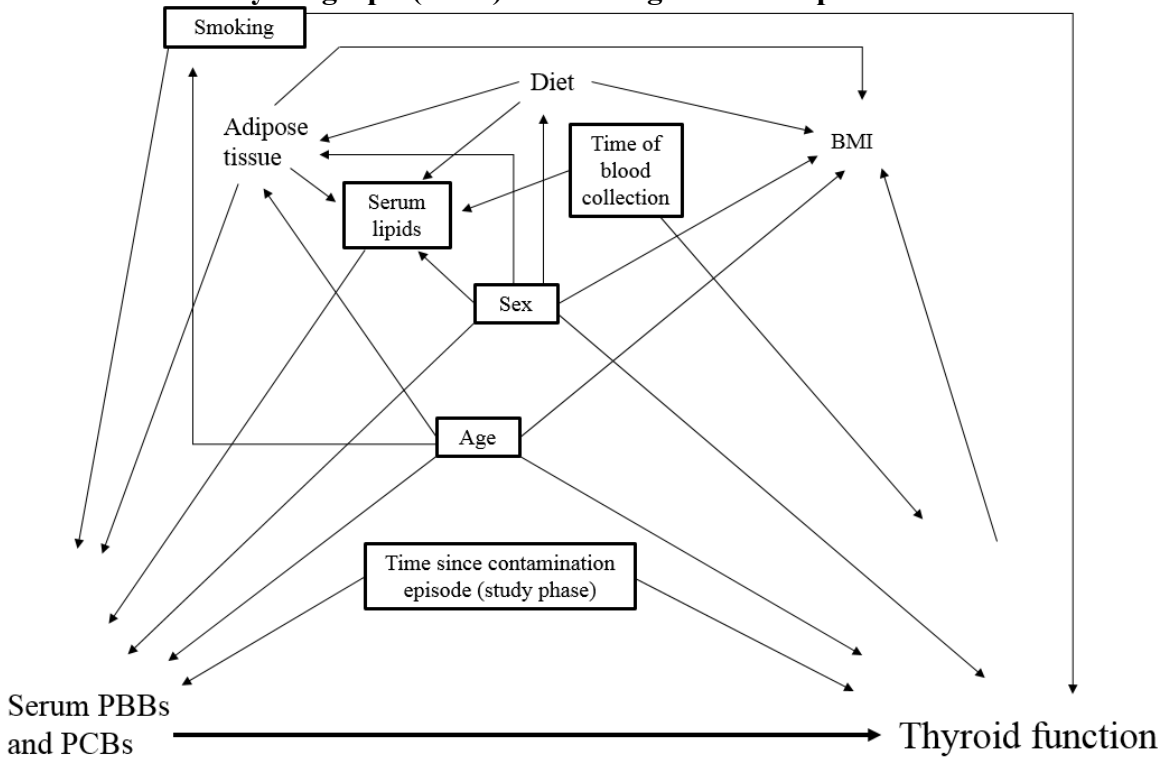


Note: Those individuals in the group "self-reported living in MI in 1973-74" were not able to be identified by electronic files maintained by the Registry.

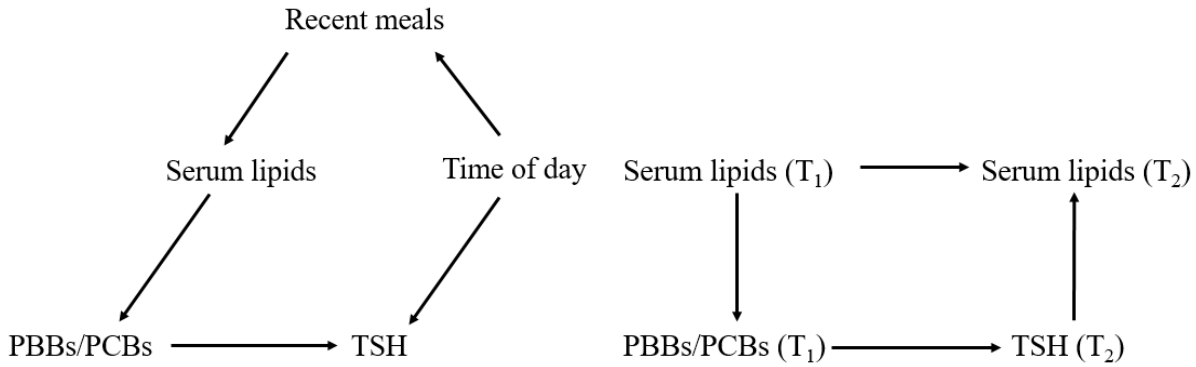
Figure S2. Directed acyclic graph (DAG) illustrating relationships between serum PBBs/PCBs, thyroid function, and covariates



Abbreviations: PBBs: polybrominated biphenyls; PCBs: polychlorinated biphenyls; BMI: body mass index

Figure S3. Directed acyclic graph (DAG) illustrating relationships between PBBs/PCBs, lipids, and thyroid function

A. **B.**



Abbreviations: PBBs: polybrominated biphenyls; PCBs: polychlorinated biphenyls; TSH: thyroid-stimulating hormone; T_1: Time 1; T_2: Time 2.

In DAG A, serum lipids could act as a confounder due to recently eaten meals and the backdoor path due to the diurnal variation in TSH that occurs throughout the day. However, it has been shown that thyroid hormones may influence lipid metabolism (Duntas and Brenta 2012; Pucci et al. 2000; Reinehr 2010; Rizos et al. 2011), although there is some uncertainty as to whether subclinical variation in thyroid hormones affect lipid levels (Tagliaferri et al. 2001). Still, in order to address this, we developed DAG B. Ideally, we would have multiple time measurements (as shown in DAG B), and in our study, we assume we have measured some sort of proxy of the two serum lipid measures shown here. In this scenario, lipids would not be a confounder and thus controlling for it would be unjustified. In this case, models should not adjust for lipids at all (either as a covariate or expressing PBBs/PCBs on the lipid basis (ng/g lipid)), and when we ran all models this way, results were nearly identical to when we expressed PBBs/PCBs on the wet weight basis (ng/mL) and controlled for lipids as

Table S1. Serum PCB congener (ng/mL serum and ng/g lipid) concentrations by population characteristics in Michigan adults, 2004-2015 (n=753 individuals, n=801 samples)

Characteristics	Study sample N (%)	PCB-138 (GM) ng/mL (ng/g lipid)	PCB-153 (GM) ng/mL (ng/g lipid)	PCB-180 (GM) ng/mL (ng/g lipid)
Sex				
Female	455 (60.4%)	0.16 (24.0)*	0.18[#] (26.2)*	0.12* (17.4)*
Male	298 (39.6%)	0.18 (29.1)	0.21 (34.1)	0.17 (27.8)
Age at blood draw[a]				
18-29	100 (13.3%)	0.10* (16.7)*	0.11* (17.4)*	0.06* (9.7)*
30-39	176 (23.4%)	0.10 (15.5)	0.10 (16.9)	0.07 (10.9)
40-49	153 (20.3%)	0.16 (22.9)	0.18 (25.6)	0.12 (17.8)
50-59	150 (19.9%)	0.24 (34.1)	0.28 (39.7)	0.22 (30.8)
≥60	186 (24.7%)	0.31 (47.8)	0.37 (56.4)	0.32 (49.6)
Age at PBB contamination				
≥16 at contamination	226 (30.0%)	0.30* (45.3)*	0.35* (53.3)*	0.30* (46.1)*
0-15 at contamination	315 (41.8%)	0.16 (24.5)	0.19 (27.9)	0.14 (20.2)
Born after contamination	212 (28.2%)	0.10 (15.6)	0.10 (16.5)	0.06 (9.6)
Study years[a]				
2004-2005	79 (10.5%)	0.10* (16.8)*	0.11* (19.1)*	0.08* (13.8)*
2012-2015	683 (90.7%)	0.18 (27.1)	0.20 (30.4)	0.15 (21.8)
Body mass index[a]				
≤Normal	155 (31.1%)	0.13 (20.0)	0.15 (22.8)	0.11 (16.6)
Overweight	156 (31.3%)	0.14 (21.4)	0.16 (23.9)	0.11 (16.0)
Obese	190 (38.2%)	0.14 (22.6)	0.15 (23.9)	0.10 (15.2)
Missing	255			
Smoking status				
Current smokers	120 (16.1%)	0.15* (22.2)*	0.16* (24.7)*	0.12* (17.9)*
Former smokers	182 (24.4%)	0.21 (31.3)	0.24 (35.9)	0.19 (28.2)
Never smokers	444 (59.5%)	0.16 (24.9)	0.18 (27.8)	0.13 (19.3)
Missing	7			

Abbreviations: GM: Geometric mean

*P<0.01; [#]P<0.05; [†]P<0.10; P-values computed using t-tests or ANOVA using log-transformed PCB concentrations for comparison between categories.

[a]N=36 individuals participated twice and N=6 three times over time, thus cell counts sum to >753 and percents sum to >100%.

Table S2. Serum PBB and PCB concentrations (ng/mL and ng/g lipid) by population characteristics in Michigan adults without thyroid disease 2004-2015 (n=551 individuals, n=571 samples)

Characteristic	Study sample N (%)	PBB-153 (GM) ng/mL (ng/g lipid)	PCB-118[a] (GM) ng/mL (ng/g lipid)	PCB-138 (GM) ng/mL (ng/g lipid)	PCB-153 (GM) ng/mL (ng/g lipid)	PCB-180 (GM) ng/mL (ng/g lipid)	∑PCB (di-*ortho*)[b] (GM) ng/mL (ng/g lipid)
Sex							
Female	343 (62.3)	0.12 (18.0)	0.05 (6.8)	0.15 (21.2)	0.16 (23.1)	0.10 (15.0)	0.41 (60.2)
Male	208 (37.7)	0.55 (86.8)	0.06 (9.0)	0.22 (34.5)	0.26 (41.4)	0.23 (36.6)	0.73 (114.9)
Age at blood draw[c]							
18-29	62 (11.3)	0.01 (1.5)	0.03 (4.5)	0.10 (15.5)	0.11 (16.1)	0.06 (8.3)	0.27 (40.3)
30-39	126 (22.9)	0.14 (23.2)	0.03 (4.5)	0.10 (16.2)	0.11 (17.4)	0.07 (11.3)	0.28 (45.6)
40-49	118 (21.4)	0.25 (36.1)	0.05 (6.8)	0.16 (22.2)	0.18 (25.1)	0.12 (17.7)	0.46 (65.9)
50-59	117 (21.2)	0.43 (59.6)	0.06 (7.9)	0.22 (30.7)	0.26 (36.1)	0.21 (28.9)	0.70 (97.1)
≥60	135 (24.5)	0.62 (97.0)	0.09 (13.3)	0.30 (47.1)	0.36 (56.3)	0.33 (50.5)	1.02 (157.8)
Age at contamination							
≥16 years at contamination	167 (30.3)	0.58 (90.0)	0.08 (12.2)	0.28 (43.6)	0.34 (51.8)	0.30 (46.1)	0.94 (145.0)
0-15 years at contamination	254 (46.1)	0.43 (64.1)	0.05 (7.3)	0.16 (23.2)	0.18 (26.6)	0.13 (19.6)	0.47 (70.5)
Born after contamination	130 (23.6)	0.02 (2.4)	0.03 (4.5)	0.11 (15.6)	0.11 (16.1)	0.06 (8.9)	0.28 (41.0)
Study years[c]							
2004-2005	74 (13.4)	1.04 (187.1)	-	0.10 (17.4)	0.11 (19.7)	0.08 (14.3)	0.29 (52.2)
2012-2015	483 (87.7)	0.17 (24.5)	0.05 (7.6)	0.18 (26.8)	0.21 (30.2)	0.15 (21.9)	0.55 (80.6)
Time of blood collection[c]							
7:00am-10:30am	90 (16.4)	0.24 (36.5)	0.04 (6.0)	0.13 (19.3)	0.15 (22.4)	0.11 (16.4)	0.39 (59.2)
10:30am-3:00pm	288 (52.4)	0.26 (40.4)	0.05 (7.5)	0.16 (25.0)	0.19 (28.5)	0.14 (21.8)	0.51 (77.1)
3:00pm-8:00pm	182 (33.1)	0.15 (21.1)	0.06 (8.6)	0.21 (29.8)	0.23 (32.8)	0.15 (21.8)	0.59 (86.0)
Missing	1						
Body mass index[c]							
≤ Normal	125 (34.1)	0.17 (24.7)	0.04 (5.3)	0.13 (19.0)	0.15 (21.7)	0.11 (15.7)	0.40 (57.3)
Overweight	117 (31.9)	0.14 (19.8)	0.04 (5.9)	0.14 (20.2)	0.16 (22.5)	0.11 (15.4)	0.41 (59.1)
Obese	128 (34.9)	0.15 (23.0)	0.04 (6.9)	0.15 (22.9)	0.15 (24.2)	0.10 (15.3)	0.40 (63.3)
Missing	184						
Smoking status							
Current smokers	80 (14.7)	0.14 (20.5)	0.04 (6.3)	0.17 (24.8)	0.19 (27.3)	0.14 (19.8)	0.51 (73.5)
Former smokers	137 (25.2)	0.35 (51.3)	0.06 (8.6)	0.19 (28.7)	0.22 (33.2)	0.18 (27.0)	0.61 (91.1)
Never smokers	327 (60.1)	0.20 (30.3)	0.05 (7.6)	0.16 (24.1)	0.18 (27.2)	0.12 (18.9)	0.47 (71.5)
Missing	7						
Iodine status[d]							
< 100 µg/g creatinine	14 (17.7)	0.05 (7.8)	0.04 (5.3)	0.11 (16.2)	0.12 (17.7)	0.08 (11.86)	0.31 (46.5)
≥ 100 µg/g creatinine	65 (82.3)	0.13 (20.7)	0.04 (5.9)	0.14 (21.2)	0.15 (23.1)	0.10 (14.81)	0.38 (59.8)
< 150 µg/g creatinine	43 (54.4)	0.07 (10.6)	0.04 (5.3)	0.12 (18.5)	0.14 (20.1)	0.09 (12.7)	0.35 (51.9)
≥ 150 µg/g creatinine	37 (46.8)	0.19 (31.2)	0.04 (6.6)	0.14 (22.4)	0.15 (24.5)	0.10 (16.3)	0.40 (64.1)
Pregnancy status[c,e]							
Pregnant	5 (1.5)	0.02 (2.9)	0.05(9.1)	0.09 (16.9)	0.10 (18.4)	0.05 (10.06)	0.25 (46.0)
Not Pregnant	323 (98.8)	0.13 (18.7)	0.05 (6.4)	0.14 (20.8)	0.16 (22.7)	0.10 (14.95)	0.41 (59.4)
Missing	16						
Menopausal status[e]							
Postmenopausal	39 (14.6)	0.32 (41.0)	0.05 (6.9)	0.22 (28.1)	0.25 (32.3)	0.19 (24.07)	0.67 (85.7)
Premenopausal	228 (85.4)	0.09 (14.4)	0.04 (5.3)	0.12 (17.9)	0.13 (19.2)	0.08 (11.93)	0.33 (49.7)
Missing	76						
Current hormonal medication use[c,e,f]							
Yes	74 (27.9)	0.08 (11.4)	0.03(4.5)	0.12 (17.0)	0.12 (17.9)	0.08 (11.27)	0.32 (46.6)
No	194 (73.2)	0.13 (19.4)	0.04 (6.0)	0.13 (20.1)	0.15 (22.0)	0.09 (14.12)	0.38 (57.0)
Missing	78						

Abbreviations: GM: Geometric mean

[a]PCB-118 not reportable (missing) for 15.2% of samples due to unstable retention time on laboratory instrument; includes all samples from 2004-2005

[b]PCB-138+PCB-153+PCB-180

[c]N=14 individuals participated twice and N=3 three times over time, thus cell counts sum to >551 and percents sum to >100%.

[d]Only assessed among 79 women with longitudinally collected urine samples (one woman had two sets of samples over time; n=80)

[e]Only assessed among women (N=343 individuals)

[f]Includes hormonal contraceptives and hormone therapy

Table S3. Adjusted Odds Ratios (aOR) and 95% Confidence Intervals (95% CI) for the association between PBB-153, PCB-118 and ΣPCB (ng/g lipid) and thyroid disease among Michigan females, 2004-2015.

Exposure	All Thyroid Disease[a]				Hypothyroidism		
PBB-153	Total[b]	N (%)[c]	aOR	95% CI	N (%)[d]	aOR	95% CI
PBB-153 ln-transformed (Δ IQR=56.7 ng/g lipid)[e,f]	447	105 (23.5)	1.19	(0.88, 1.59)	49 (11.8)	1.42	(0.92, 2.18)
PBB-153 Q1 (<LOD- ≤4.6 ng/g lipid)	97	10 (10.3)	1.00	reference	7 (7.2)	1.00	reference
PBB-153 Q2 (>4.6- ≤22.7 ng/g lipid)	93	23 (24.7)	2.01	(0.80, 5.04)	10 (11.6)	1.56	(0.51, 4.77)
PBB-153 Q3 (>22.7- ≤44.2 ng/g lipid)	93	24 (25.8)	1.93	(0.73, 5.10)	6 (7.2)	0.85	(0.23, 3.09)
PBB-153 Q4 (>44.2- ≤82.4 ng/g lipid)	90	31 (34.4)	3.21	(1.24, 8.36)	14 (17.5)	3.01	(0.97, 9.40)
PBB-153 Q5 (>82.4- ≤ 22504.5 (maximum) ng/g lipid)	85	20 (23.5)	2.22	(0.80, 6.16)	14 (17.5)	3.50	(1.08, 11.33)
PCB-118							
PCB-118 ln-transformed (Δ IQR=12.3 ng/g lipid)[e]	378	107 (28.3)	1.55	(1.10, 2.19)	48 (14.1)	1.72	(1.11, 2.67)
PCB-118 Q1 (<LOD- <3.5 ng/g lipid)	80	16 (20.0)	1.00	reference	10 (13.0)	1.00	reference
PCB-118 Q2 (≥3.5- <6.2 ng/g lipid),	78	14 (17.9)	0.69	(0.29, 1.60)	8 (10.7)	0.64	(0.22, 1.83)
PCB-118 Q3 (≥6.2- <10.8 ng/g lipid)	79	20 (25.3)	1.02	(0.46, 2.24)	7 (9.5)	0.46	(0.16, 1.32)
PCB-118 Q4 (≥10.8- <18.3 ng/g lipid)	79	24 (30.4)	1.19	(0.56, 2.53)	12 (16.9)	1.05	(0.44, 2.47)
PCB-118 Q5 (≥18.3- < 199.9 (maximum) ng/g lipid)	76	36 (47.4)	2.02	(0.93, 4.43)	14 (23.7)	2.36	(0.91, 6.13)
ΣPCB (di-*ortho*)[g]							
∑PCB ln-transformed (Δ IQR=102.5 ng/g lipid)[e]	455	113 (24.8)	1.36	(0.95, 1.94)	52 (12.4)	1.68	(1.06, 2.64)
∑PCB Q1 (≥3.7- <28.5 ng/g lipid)	96	17 (17.7)	1.00	reference	11 (11.5)	1.00	reference
∑PCB Q2 (≥28.5- <56.4 ng/g lipid)	94	17 (18.1)	0.72	(0.32, 1.65)	6 (6.8)	0.43	(0.14, 1.31)
∑PCB Q3 (≥56.4- <91.5 ng/g lipid)	96	18 (18.8)	0.56	(0.24, 1.30)	9 (9.9)	0.57	(0.21, 1.50)
∑PCB Q4 (≥91.5- <162.8 ng/g lipid)	98	27 (27.6)	0.79	(0.36, 1.74)	12 (13.6)	0.81	(0.35, 1.90)
∑PCB Q5 (≥162.8- < 1466.2 (maximum) ng/g lipid)	93	37 (39.8)	1.28	(0.59, 2.77)	17 (21.8)	1.81	(0.78, 4.21)

Abbreviations: aOR: adjusted odds ratio; 95% CI: 95% Confidence Interval; IQR=interquartile range; Q1-5: quartile 1-5; LOD: limit of detection

Models for PBB-153 and ΣPCB (di-*ortho)* control for age, study phase, and smoking status; models for PCB-118 do not control for study phase because all samples from Phase 1 were not reportable due to instrumentation error. Information on individual PCB congeners (PCB-138, 153, and 180) are shown in the Supplemental Material, Tables S4 and S5.

[a]Includes those who specified physician-diagnosed thyroid disease (N=107) and those who had thyroid hormone concentrations outside clinically normal ranges (N=6); includes 10 hyperthyroid, 52 hypothyroid, 14 other types and 37 type not specified.

[b] PBB-153 analyses excludes 8 women who were diagnosed with thyroid disease before the contamination event; PCB-118 analyses exclude 88 women (89 samples) that had missing values due to unstable retention time on laboratory instrument; ΣPCB (di-*ortho*) analyses include all observations.

[c] 30 women participated multiple times so cell counts may not sum to total and percents may sum to >100%

[d] Hypothyroidism analyses exclude 37 observations due to lack of information on thyroid disease type (32 in PBB-153 model); these are excluded from denominator of percent calculations.

[e]All IQRs and quintiles calculated among women only

[f]PBB-153 concentrations below the LOD were imputed using a distribution-based multiple imputation approach

[g]PCB-138+PCB-153+PCB-180

Table S4. Adjusted Odds Ratios[a] (aOR) and 95% Confidence Intervals (95% CI) for the association between PCB-138, PCB-153, and PCB-180 (ng/ml) and thyroid disease among Michigan females, 2004-2015.

Exposure	All Thyroid Disease[b]				Hypothyroidism		
PCB-138	Total	N (%)[c]	aOR	95% CI	N (%)[d]	aOR	95% CI
PCB-138 ln-transformed (Δ IQR=0.27 ng/ml)[e]	455	113 (24.8)	1.11	(0.77, 1.61)	52 (12.4)	1.44	(0.90, 2.32)
PCB-138 Q1 (0.01- <0.06 ng/ml)	94	16 (17.0)	1.00	reference	11 (11.7)	1.00	reference
PCB-138 Q2 (0.06- <0.13 ng/ml)	94	16 (17.0)	0.80	(0.34, 1.88)	4 (4.4)	0.26	(0.07, 1.00)
PCB-138 Q3 (0.13- <0.24 ng/ml)	97	24 (24.7)	0.90	(0.41, 2.01)	13 (14.6)	0.87	(0.35, 2.19)
PCB-138 Q4 (0.24- <0.40 ng/ml)	97	30 (30.9)	1.16	(0.53, 2.52)	14 (16.5)	1.11	(0.46, 2.72)
PCB-138 Q5 (0.40- <2.58 (maximum) ng/ml)	96	32 (33.3)	1.05	(0.49, 2.26)	13 (15.7)	1.05	(0.42, 2.65)
PCB-153							
PCB-153 ln-transformed (Δ IQR=0.27 ng/ml)[e]	455	113 (24.8)	1.11	(0.75, 1.64)	52 (12.4)	1.42	(0.86, 2.34)
PCB-153 Q1 (0.01- <0.07 ng/ml)	97	16 (16.5)	1.00	reference	11 (11.3)	1.00	reference
PCB-153 Q2 (0.07- <0.16 ng/ml)	92	17 (18.5)	0.78	(0.34, 1.81)	5 (5.7)	0.29	(0.09, 1.02)
PCB-153 Q3 (0.16- <0.26 ng/ml)	95	22 (23.2)	0.84	(0.37, 1.92)	13 (14.8)	0.86	(0.34, 2.19)
PCB-153 Q4 (0.26- <0.43 ng/ml)	97	29 (29.9)	0.98	(0.43, 2.21)	12 (13.9)	0.70	(0.28, 1.77)
PCB-153 Q5 (0.43- <1.97 (maximum) ng/ml)	95	35 (36.8)	1.07	(0.48, 2.37)	15 (18.8)	1.13	(0.45, 2.85)
PCB-180							
PCB-180 ln-transformed (Δ IQR=0.19 ng/ml)[e]	455	113 (24.8)	1.23	(0.83, 1.84)	52 (12.4)	1.58	(0.93, 2.68)
PCB-180 Q1 (0.01- <0.05 ng/ml)	96	16 (16.7)	1.00	reference	10 (10.9)	1.00	reference
PCB-180 Q2 (0.05- <0.10 ng/ml)	94	15 (16.0)	0.87	(0.37, 2.03)	5 (5.2)	0.50	(0.14, 1.77)
PCB-180 Q3 (0.10- <0.17 ng/ml)	97	26 (26.8)	1.19	(0.55, 2.61)	15 (16.7)	1.37	(0.56, 3.40)
PCB-180 Q4 (0.17- <0.28 ng/ml)	96	25 (26.0)	0.82	(0.36, 1.87)	9 (10.3)	0.62	(0.23, 1.67)
PCB-180 Q5 (0.28- <1.40 (maximum) ng/ml)	95	36 (37.9)	1.52	(0.67, 3.41)	16 (21.3)	2.11	(0.80, 5.56)

Abbreviations: aOR: adjusted odds ratio; 95% CI: 95% Confidence Interval; IQR=interquartile range; Q1-5: quartile 1-5.

[a] All models control for lipids, age, study phase, and smoking status.

[b] Includes those who specified physician-diagnosed thyroid disease (N=107) and those who had thyroid hormone concentrations outside clinically normal ranges (N=6); includes 10 hyperthyroid, 52 hypothyroid, 14 other types and 37 type not specified.

[c] 30 women participated multiple times so cell counts may not sum to total and percents may sum to >100%

[d] Hypothyroidism analyses exclude 37 observations due to lack of information on thyroid disease type; these are excluded from denominator of percent calculations.

[e] All IQRs and quintiles calculated among women only

Table S5. Adjusted Odds Ratios[a] (aOR) and 95% Confidence Intervals (95% CI) for the association between PCB-138, PCB-153, and PCB-180 (ng/g lipid) and thyroid disease among Michigan females, 2004-2015.

Exposure		All Thyroid Disease[b]			Hypothyroidism		
PCB-138	Total	N (%)[c]	aOR	95% CI	N (%)[d]	aOR	95% CI
PCB-138 ln-transformed (Δ IQR= 36.9 ng/g lipid)[e]	455	113 (24.8)	1.32	(0.94, 1.85)	52 (12.4)	1.67	(1.06, 2.62)
PCB-138 Q1 (≥1.3- <10.0 ng/g lipid)	98	16 (16.3)	1.00	reference	9 (9.4)	1.00	reference
PCB-138 Q2 (≥10.0- <19.4 ng/g lipid)	92	19 (20.7)	1.02	(0.44,2.36)	8 (9.3)	0.84	(0.29, 2.43)
PCB-138 Q3 (≥19.4- <31.7 ng/g lipid)	97	19 (19.6)	0.69	(0.31, 1.52)	11 (11.7)	0.85	(0.35, 2.09)
PCB-138 Q4 (≥31.7- <56.9 ng/g lipid)	96	27 (28.1)	1.05	(0.48, 2.30)	10 (12.0)	0.98	(0.38, 2.54)
PCB-138 Q5 (≥56.9- <635.8 (maximum) ng/g lipid)	94	36 (38.3)	1.47	(0.70, 3.08)	17 (21.0)	2.13	(0.92, 4.92)
PCB-153							
PCB-153 ln-transformed (Δ IQR= 39.9 ng/g lipid)[e]	455	113 (24.8)	1.34	(0.93, 1.93)	52 (12.4)	1.69	(1.04, 2.72)
PCB-153 Q1 (≥1.6- <11.0 ng/g lipid)	97	17 (17.5)	1.00	reference	11 (11.5)	1.00	reference
PCB-153 Q2 (≥11.0- <21.3 ng/g lipid)	96	19 (19.8)	0.75	(0.33, 1.70)	6 (6.7)	0.41	(0.13, 1.27)
PCB-153 Q3 (≥21.3- <35.1 ng/g lipid)	94	15 (16.0)	0.49	(0.21, 1.13)	8 (18.8)	0.47	(0.17, 1.26)
PCB-153 Q4 (≥35.1- <61.8 ng/g lipid)	99	28 (28.3)	0.80	(0.37, 1.74)	13 (14.9)	0.84	(0.36, 1.97)
PCB-153 Q5 (≥61.8- <486.4 (maximum) ng/g lipid)	92	38 (41.3)	1.32	(0.61, 2.83)	17 (21.8)	1.69	(0.72, 3.97)
PCB-180							
PCB-180 ln-transformed (Δ IQR= 25.5 ng/g lipid)[e]	455	113 (24.8)	1.47	(1.01, 2.13)	52 (12.4)	1.84	(1.10, 3.05)
PCB-180 Q1 (≥0.62- <7.6 ng/g lipid)	97	17 (17.5)	1.00	reference	11 (11.5)	1.00	reference
PCB-180 Q2 (≥7.6- <15.3 ng/g lipid)	95	18 (18.9)	0.73	(0.33, 1.63)	6 (6.7)	0.43	(0.14, 1.27)
PCB-180 Q3 (≥15.3- <24.6 ng/g lipid)	94	15 (16.0)	0.43	(0.18, 1.03)	9 (9.9)	0.49	(0.18, 1.29)
PCB-180 Q4 (≥24.6- <40.1 ng/g lipid)	98	25 (25.5)	0.70	(0.31, 1.58)	12 (13.3)	0.79	(0.33, 1.92)
PCB-180 Q5 (≥40.1- <344.1 (maximum) ng/g lipid)	91	41 (45.1)	1.38	(0.61, 3.08)	16 (22.2)	1.85	(0.74, 4.63)

Abbreviations: aOR: adjusted odds ratio; 95% CI: 95% Confidence Interval; IQR=interquartile range; Q1-5: quartile 1-5.

[a] All models control for age, study phase, and smoking status.

[b] Includes those who specified physician-diagnosed thyroid disease (N=107) and those who had thyroid hormone concentrations outside clinically normal ranges (N=6); includes 10 hyperthyroid, 52 hypothyroid, 14 other types and 37 type not specified

[c] 30 women participated multiple times so cell counts may not sum to total and percents may sum to >100%

[d] Hypothyroidism analyses exclude 37 observations due to lack of information on thyroid disease type; these are excluded from denominator of percent calculations.

[e] All IQRs and quintiles calculated among women only

Table S6. Thyroid hormone levels by population characteristics in Michigan adults without thyroid disease, 2004-2015 (n=551 individuals, n=571 samples)

	Study sample N (%)	TSH (μIU/mL) (GM (GSD))	Total T4 (μg/dL) (Mean (SE))	Total T_3 (ng/dL) (Mean (SE))	Free T_4 (ng/dL) (Mean (SE))	Free T_3 (pg/mL) (Mean (SE))
Sex						
Female	343 (62.3)	1.53 (0.04)	9.21# (0.08)	109.3* (1.3)	0.78 (0.01)	3.21 (0.02)
Male	208 (37.7)	1.62 (0.06)	8.88 (0.11)	102.0 (1.7)	0.80 (0.01)	3.26 (0.03)
Age at blood draw[a]						
18-29	62 (11.3)	1.41 (0.10)	9.23 (0.22)	120.2* (4.3)	0.83# (0.04)	3.24* (0.07)
30-39	126 (22.9)	1.62 (0.07)	9.31 (0.14)	113.4 (2.0)	0.77 (0.01)	3.37 (0.04)
40-49	118 (21.4)	1.56 (0.07)	8.89 (0.13)	104.4 (2.1)	0.77 (0.01)	3.24 (0.04)
50-59	117 (21.2)	1.53 (0.08)	9.03 (0.15)	103.0 (1.8)	0.78 (0.01)	3.18 (0.04)
≥60	135 (24.5)	1.62 (0.07)	9.05 (0.13)	99.1 (2.1)	0.81 (0.01)	3.13 (0.04)
Age at PBB contamination						
≥16 years at contamination	167 (30.3)	1.59 (0.07)	9.05 (0.12)	99.1* (1.8)	0.81# (0.01)	3.12* (0.04)
0-15 years at contamination	254 (46.1)	1.60 (0.05)	9.11 (0.09)	109.1 (1.37)	0.77 (0.01)	3.31 (0.03)
Born after contamination	130 (23.6)	1.47 (0.06)	9.10 (0.15)	111.3 (2.5)	0.80 (0.02)	3.21 (0.04)
Study years[a]						
2004-2005	74 (13.4)	1.64 (0.11)	9.66* (0.16)	126.0* (2.2)	0.76# (0.01)	3.59* (0.05)
2012-2015	483 (87.7)	1.55 (0.04)	9.00 (0.07)	103.8 (1.1)	0.79 (0.01)	3.18 (0.02)
Time of blood collection[a]						
7:00am-10:30am	90 (16.4)	1.78# (0.08)	9.16 (0.16)	108.7 (2.4)	0.79 (0.01)	3.31 (0.05)
10:30am-3:00pm	288 (52.4)	1.50 (0.05)	9.16 (0.09)	108.0 (1.6)	0.79 (0.01)	3.23 (0.03)
3:00pm-8:00pm	182 (33.1)	1.56 (0.06)	8.94 (0.12)	103.5 (1.7)	0.78 (0.01)	3.19 (0.03)
Missing	1					
Body mass index[a]						
≤ Normal	125 (34.1)	1.51 (0.07)	9.09 (0.14)	111.4 (2.4)	0.79 (0.02)	3.29 (0.04)
Overweight	117 (31.9)	1.57 (0.07)	8.99 (0.15)	106.5 (2.3)	0.77 (0.01)	3.25 (0.04)
Obese	128 (34.9)	1.54 (0.07)	9.32 (0.12)	110.9 (2.0)	0.79 (0.01)	3.29 (0.04)
Missing	184					
Smoking status						
Current smokers	80 (14.7)	1.44 (0.08)	9.19 (0.18)	106.6† (2.6)	0.82 (0.03)	3.20† (0.05)
Former smokers	137 (25.2)	1.52 (0.07)	9.15 (0.13)	102.4 (2.1)	0.79 (0.01)	3.17 (0.04)
Never smokers	327 (60.1)	1.61 (0.05)	9.05 (0.08)	108.4 (1.3)	0.78 (0.01)	3.26 (0.03)
Missing	7					
Iodine status[b]						
< 100 μg/g creatinine	14 (17.7)	1.71 (0.27)	9.25 (0.33)	106.4 (4.91)	0.75 (0.04)	3.43 (0.16)
≥ 100 μg/g creatinine	65 (82.3)	1.46 (0.11)	8.83 (0.15)	107.5 (2.4)	0.77 (0.01)	3.28 (0.05)
< 150 μg/g creatinine	43 (54.4)	1.55 (0.14)	8.87 (0.22)	106.9 (3.2)	0.76 (0.02)	3.31 (0.08)
≥ 150 μg/g creatinine	37 (46.8)	1.44 (0.15)	8.94 (0.17)	107.7 (2.9)	0.77 (0.01)	3.29 (0.07)
Pregnancy status[a,c]						
Pregnant	5 (1.5)	1.99 (0.44)	10.10 (0.81)	121.6 (11.9)	0.72 (0.06)	2.86† (0.12)
Not Pregnant	323 (98.8)	1.51 (0.04)	9.19 (0.08)	109.7 (1.4)	0.78 (0.01)	3.23 (0.02)
Missing	16					
Menopausal status[c]						
Postmenopausal	39 (14.6)	1.57 (0.13)	9.18 (0.25)	103.7# (3.1)	0.81 (0.02)	3.09* (0.05)
Premenopausal	228 (85.4)	1.48 (0.05)	9.23 (0.10)	112.8 (1.7)	0.78 (0.01)	3.29 (0.03)
Missing	76					
Current hormonal medication use[a,c,d]						
Yes	74 (27.9)	1.44 (0.08)	9.95* (0.20)	124.3* (3.5)	0.82 (0.03)	3.31 (0.05)
No	194 (73.2)	1.51 (0.06)	8.95 (0.10)	106.6 (1.5)	0.77 (0.01)	3.24 (0.03)
Missing	78					

Abbreviations: GM: Geometric mean; GSD: geometric standard deviation; SE: standard error; TSH: thyroid-stimulating hormone; T4: thyroxine; T3: triiodothyronine

*P<0.01; #P<0.05; †P<0.10; P-values computed using t-tests or ANOVA for comparison between categories (TSH log-transformed in all statistical tests).

[a]N=14 individuals participated twice and N=3 three times over time, thus cell counts sum to >551 and percents sum to >100%.

[b]Only assessed among 79 women with longitudinally collected urine samples (one woman had two sets of samples over time; n=80 sets of observations)

[c]Only assessed among women (N=343 individuals)

[d]Includes hormonal contraceptives and hormone therapy

Table S7. β-Coefficients and 95% confidence intervals (95% CI) from regression models[a] for associations of ln-transformed PBB and PCB congeners (ng/g lipid) with thyroid-stimulating hormone (TSH)[b] and other thyroid hormones[c] among Michigan adults without thyroid disease (N=571 samples, 551 individuals), 2004-2015

Exposure	ln TSH (μIU/mL)		Total T_4 (μg/dL)		Total T_3 (ng/dL)		Free T_4 (ng/dL)		Free T_3 (pg/mL)	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
PBB-153[d]	0.00 (-0.03, 0.03)	-0.02 (-0.07, 0.04)	0.04 (-0.05, 0.12)	0.01 (-0.15, 0.18)	1.35 (0.06, 2.63)	0.47 (-1.98, 2.92)	0.00 (-0.01, 0.00)	0.00 (-0.01, 0.02)	0.05 (0.03, 0.07)	0.01 (-0.04, 0.06)
PCB-118	0.02 (-0.04. 0.08)	-0.04 (-0.13, 0.06)	0.28 (0.09, 0.47)	-0.08 (-0.35, 0.19)	5.05 (2.14, 7.95)	3.94 (-0.10, 7.99)	0.02 (0.01, 0.04)	0.00 (-0.02, 0.02)	0.05 (0.01, 0.09)	0.09 (0.00, 0.17)
PCB-138	-0.01 (-0.07, 0.05)	-0.02 (-0.11, 0.07)	0.18 (0.00, 0.36)	-0.06 (-0.31, 0.20)	4.01 (0.82, 7.2)	4.23 (0.46, 8.01)	0.03 (0.02, 0.04)	0.01 (-0.01, 0.03)	0.03 (-0.02, 0.07)	0.06 (-0.01, 0.14)
PCB-153	-0.02 (-0.08, 0.05)	-0.03 (-0.13, 0.06)	0.19 (-0.01, 0.38)	-0.04 (-0.32, 0.24)	4.65 (1.28, 8.02)	4.65 (0.56, 8.75)	0.03 (0.02, 0.04)	0.01 (-0.01, 0.03)	0.03 (-0.02, 0.09)	0.08 (0.00, 0.17)
PCB-180	-0.02 (-0.09, 0.04)	0.00 (-0.11, 0.10)	0.16 (-0.03, 0.36)	-0.02 (-0.32, 0.29)	4.11 (0.74, 7.49)	5.28 (0.77, 9.78)	0.03 (0.01, 0.04)	0.00 (-0.02, 0.03)	0.04 (-0.01, 0.10)	0.09 (0.00, 0.19)
ΣPCB (di-*ortho*)[e]	-0.02 (-0.08, 0.05)	-0.02 (-0.12, 0.08)	0.18 (-0.01, 0.38)	-0.04 (-0.33, 0.24)	4.42 (1.03, 7.81)	5.08 (0.90, 9.26)	0.04 (0.02, 0.06)	0.01 (-0.02, 0.03)	0.03 (-0.02, 0.08)	0.09 (0.00, 0.18)

Abbreviations: TSH: thyroid-stimulating hormone; T4: thyroxine; T3: triiodothyronine; 95% CI: 95% Confidence Interval.

[a] Models control for age at blood draw (indicator variables for each decade), time of blood collection (indicator variables for morning, midday, afternoon/evening), current smoking status (yes/no).

[b] TSH is ln-transformed and thus β-coefficients should be interpreted as follows: a log-unit increase in a given congener is associated with a multiplicative change in TSH of e^{β}. In terms of changes in PBB and PCB levels (not logged), a p% change in a given congener is associated with a multiplicative change in TSH of $e^{\beta \cdot [\log([100+p]/100)]}$.

[c] Other thyroid hormones are not transformed and thus β-coefficients should be interpreted as follows: a log-unit increase in a given PBB or PCB congener is associated with an additive change in each hormone of β. In terms of changes in PBB and PCB levels (not logged), a p% change in a given congener is associated with an additive change in each hormone of $\beta \cdot [\log([100+p]/100)]$.

[d] PBB-153 measures below the LOD were multiply imputed (n=10) based on a lognormal probability distribution whose parameters were determined by maximum likelihood estimation.

[e] PCB-138+PCB-153+PCB-180

Table S8. Distribution of thyroid hormones among Michigan women and men without thyroid disease, 2004-2015

Hormone	Women (n=343)					Men (n=208)					Coefficient of variation (%)[b]		
	25th percentile	Median	75th percentile	Maximum	Mean[a]	25th percentile	Median	75th percentile	Maximum	Mean[a]	Low	Medium	High
TSH (μIU/mL)	1.1	1.5	2.1	7.6	1.5	1.1	1.7	2.4	7.2	1.6	5.8	7.4	7.3
Total T_4 (μg/dL)[c]	8.1	9.2	10.2	13.1	9.2	7.8	8.7	10.0	15.4	8.9	5.9	4.7	3.2
Total T_3 (ng/dL)	92	107	123	211	109	85	100	112	209	102	10.2	5.8	6.9
Free T_4 (ng/dL)	0.70	0.77	0.84	3.10	0.78	0.71	0.79	0.87	1.26	0.80	8.6	6.8	8.0
Free T_3 (pg/mL)	2.9	3.2	3.5	5.0	3.2	2.9	3.2	3.5	5.6	3.3	4.8	2.8	2.7

Abbreviations: TSH: thyroid-stimulating hormone; T4: thyroxine; T3: triiodothyronine

[a] GM reported for TSH; arithmetic means reported for all other hormones

[b] Inter-assay coefficients of variation computed as: [(standard deviation / mean) × 100]

[c] Total T_4 missing for 1 woman

Table S9. β-Coefficients and 95% confidence intervals (95% CI) from regression models[a] for associations of PBB-153, PCB-118 and ΣPCB (ng/mL) deciles with TSH[b] and other thyroid hormones[c] among women without a history of thyroid disease (N=343 women, 363 samples)

Exposure	Comparison	ln TSH (μIU/mL)	Total T_4 (μg/dL)	Total T_3 (ng/dL)	Free T_4 (ng/dL)	Free T_3 (pg/mL)
		β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
PBB-153	Decile 2 vs. 1	0.01 (-0.24, 0.25)	0.03 (-0.81, 0.87)	-16.23 (-29.80, -2.67)	0.08 (-0.07, 0.23)	-0.22 (-0.44, 0.01)
	Decile 3 vs. 1	0.07 (-0.17, 0.31)	0.12 (-0.66, 0.90)	-10.46 (-23.38, 2.46)	0.02 (-0.04, 0.07)	0.00 (-0.19, 0.18)
	Decile 4 vs. 1	-0.06 (-0.32, 0.20)	-0.38 (-1.17, 0.40)	-4.49 (-18.89, 9.91)	0.00 (-0.08, 0.07)	0.08 (-0.12, 0.29)
	Decile 5 vs. 1	0.06 (-0.19, 0.30)	-0.28 (-1.06, 0.50)	-4.57 (-19.91, 10.78)	0.02 (-0.05, 0.09)	0.08 (-0.12, 0.29)
	Decile 6 vs. 1	-0.18 (-0.45, 0.09)	-0.09 (-0.89, 0.70)	-0.14 (-13.85, 13.57)	0.01 (-0.06, 0.09)	0.21 (-0.01, 0.42)
	Decile 7 vs. 1	-0.03 (-0.28, 0.22)	-0.10 (-0.89, 0.70)	0.84 (-12.13, 13.81)	0.02 (-0.06, 0.09)	0.22 (0.00, 0.44)
	Decile 8 vs. 1	-0.05 (-0.32, 0.22)	-0.31 (-1.15, 0.52)	-8.61 (-22.02, 4.80)	0.01 (-0.06, 0.08)	0.15 (-0.07, 0.37)
	Decile 9 vs. 1	-0.11 (-0.36, 0.13)	0.10 (-0.68, 0.88)	1.67 (-13.20, 16.55)	0.03 (-0.04, 0.09)	0.08 (-0.13, 0.29)
	Decile 10 vs. 1	0.02 (-0.29, 0.33)	0.27 (-0.59, 1.12)	6.23 (-7.85, 20.32)	-0.01 (-0.08, 0.06)	0.29 (0.07, 0.51)
PCB-118	Decile 2 vs. 1	0.01 (-0.26, 0.28)	0.89 (-0.03, 1.80)	4.94 (-7.78, 17.66)	-0.02 (-0.09, 0.06)	0.09 (-0.09, 0.27)
	Decile 3 vs. 1	0.00 (-0.23, 0.23)	0.78 (-0.14, 1.70)	10.68 (-2.09, 23.45)	0.03 (-0.03, 0.09)	0.11 (-0.06, 0.28)
	Decile 4 vs. 1	-0.19 (-0.46, 0.08)	0.85 (-0.06, 1.75)	7.06 (-5.46, 19.59)	0.13 (-0.02, 0.28)	0.08 (-0.18, 0.34)
	Decile 5 vs. 1	-0.12 (-0.39, 0.15)	0.64 (-0.21, 1.49)	13.03 (-0.09, 26.15)	0.08 (0.02, 0.13)	0.11 (-0.04, 0.27)
	Decile 6 vs. 1	0.03 (-0.27, 0.32)	0.49 (-0.43, 1.41)	12.19 (-1.58, 25.97)	0.05 (-0.01, 0.10)	0.11 (-0.07, 0.28)
	Decile 7 vs. 1	-0.02 (-0.27, 0.23)	1.10 (0.16, 2.03)	14.63 (1.85, 27.42)	0.10 (0.03, 0.17)	0.20 (0.01, 0.39)
	Decile 8 vs. 1	0.11 (-0.16, 0.38)	0.92 (0.05, 1.78)	20.10 (7.31, 32.89)	0.07 (0.01, 0.13)	0.28 (0.05, 0.51)
	Decile 9 vs. 1	0.08 (-0.20, 0.36)	0.96 (0.08, 1.84)	10.40 (-1.79, 22.60)	0.07 (0.01, 0.13)	0.05 (-0.12, 0.21)
	Decile 10 vs. 1	0.05 (-0.18, 0.29)	1.07 (0.24, 1.90)	17.59 (4.60, 30.58)	0.06 (-0.01, 0.13)	0.05 (-0.13, 0.22)
ΣPCB (di-*ortho*)[d]	Decile 2 vs. 1	0.00 (-0.24, 0.24)	0.10 (-0.73, 0.94)	3.42 (-8.56, 15.40)	0.03 (-0.03, 0.09)	0.09 (-0.11, 0.29)
	Decile 3 vs. 1	-0.13 (-0.37, 0.12)	-0.11 (-0.91, 0.68)	11.08 (-0.88, 23.04)	0.05 (-0.01, 0.12)	0.19 (0.00, 0.37)
	Decile 4 vs. 1	-0.01 (-0.26, 0.25)	0.05 (-0.75, 0.85)	7.87 (-3.73, 19.48)	0.05 (0.00, 0.11)	0.18 (0.00, 0.36)
	Decile 5 vs. 1	-0.04 (-0.33, 0.25)	-0.01 (-0.81, 0.79)	11.65 (0.22, 23.07)	0.04 (-0.01, 0.10)	0.13 (-0.06, 0.32)
	Decile 6 vs. 1	-0.09 (-0.33, 0.15)	0.23 (-0.57, 1.03)	14.61 (1.71, 27.52)	0.10 (0.04, 0.16)	0.16 (-0.03, 0.34)
	Decile 7 vs. 1	-0.17 (-0.45, 0.11)	0.47 (-0.37, 1.31)	8.54 (-4.01, 21.09)	0.12 (-0.03, 0.28)	0.05 (-0.19, 0.30)
	Decile 8 vs. 1	-0.07 (-0.34, 0.20)	0.50 (-0.35, 1.34)	17.34 (4.44, 30.23)	0.09 (0.03, 0.16)	0.15 (-0.03, 0.34)
	Decile 9 vs. 1	0.02 (-0.23, 0.27)	0.00 (-0.82, 0.83)	12.29 (-1.79, 26.37)	0.12 (0.06, 0.18)	0.12 (-0.09, 0.33)
	Decile 10 vs. 1	-0.07 (-0.34, 0.20)	0.57 (-0.22, 1.36)	11.03 (-1.91, 23.98)	0.09 (0.02, 0.16)	0.03 (-0.18, 0.23)

Abbreviations: TSH: thyroid-stimulating hormone; T4: thyroxine; T3: triiodothyronine; 95% CI: 95% Confidence Interval.

For PBB-153: Decile 1= ≤0.01, Decile 2= >0.01- ≤0.03, Decile3= >0.03- ≤0.06, Decile 4= >0.06- ≤0.14, Decile 5= >0.14- ≤0.21, Decile 6= >0.21- ≤0.27, Decile 7= >0.27- ≤0.41, Decile 8= >0.41- ≤0.63, Decile 9= >0.63- ≤1.42, Decile 10= >1.42

For PCB-118: Decile 1= ≤0.02, Decile 2= >0.02- ≤0.02, Decile3= >0.02- ≤0.03, Decile 4= >0.03- ≤0.04, Decile 5= >0.04- ≤0.05, Decile 6= >0.05- ≤0.07, Decile 7= >0.07- ≤0.08, Decile 8= >0.08- ≤0.11, Decile 9= >0.11- ≤0.15, Decile 10= >0.15

For ΣPCB (di-*ortho*): Decile 1= ≤0.11, Decile 2= >0.11- ≤0.18, Decile3= >0.18- ≤0.24, Decile 4= >0.24- ≤0.35, Decile 5= >0.35- ≤0.46, Decile 6= >0.46- ≤0.62, Decile 7= >0.62- ≤0.77, Decile 8= >0.77- ≤0.98, Decile 9= >0.98- ≤1.32, Decile 10= >1.32

[a] β-coefficients and 95% CIs are shown graphically in Figure 1. All models adjusted for age, time of blood collection, and smoking status.

[b] TSH is ln-transformed and thus β-coefficients should be interpreted as follows: compared with exposure in decile 1, exposure in other deciles are associated with multiplicative changes in TSH of e^{β}

[c] Other thyroid hormones and parameters are not transformed and thus β-coefficients should be interpreted as follows: compared with exposure in decile 1, exposure in other deciles are associated with additive changes in each hormone of β.

[d] PCB-138+PCB-153+PCB-180

Table S10. β-Coefficients and 95% confidence intervals (95% CI) from regression models for associations of PBB-153, PCB-118 and ΣPCB (ng/mL) deciles with TSH and other thyroid hormones among men without a history of thyroid disease (N=208)

Exposure	Comparison	ln TSH (μIU/mL)	Total T_4 (μg/dL)	Total T_3 (ng/dL)	Free T_4 (ng/dL)	Free T_3 (pg/mL)
		β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
PBB-153	Decile 2 vs. 1	-0.10 (-0.49, 0.29)	1.43 (0.30, 2.57)	7.46 (-9.58, 24.50)	0.00 (-0.10, 0.09)	0.32 (-0.03, 0.67)
	Decile 3 vs. 1	-0.01 (-0.41, 0.39)	0.64 (-0.52, 1.81)	2.23 (-15.24, 19.71)	0.00 (-0.09, 0.10)	0.03 (-0.33, 0.39)
	Decile 4 vs. 1	0.05 (-0.35, 0.45)	0.69 (-0.47, 1.85)	-0.30 (-17.75, 17.15)	-0.05 (-0.15, 0.04)	0.06 (-0.30, 0.42)
	Decile 5 vs. 1	-0.11 (-0.51, 0.30)	1.20 (0.02, 2.38)	0.27 (-17.37, 17.90)	0.02 (-0.08, 0.11)	0.18 (-0.18, 0.54)
	Decile 6 vs. 1	-0.52 (-0.93, -0.12)	1.35 (0.16, 2.55)	4.66 (-13.23, 22.56)	0.04 (-0.06, 0.13)	0.25 (-0.12, 0.62)
	Decile 7 vs. 1	-0.07(-0.47, 0.33)	0.59 (-0.58, 1.77)	2.73 (-14.85, 20.30)	-0.02 (-0.12, 0.07)	0.25 (-0.11, 0.61)
	Decile 8 vs. 1	-0.28 (-0.68, 0.11)	0.93 (-0.21, 2.08)	6.06 (-11.15, 23.26)	-0.04 (-0.13 0.05)	0.19 (-0.17, 0.54)
	Decile 9 vs. 1	0.02 (-0.39, 0.42)	0.30 (-0.88, 1.48)	-2.26 (-19.95, 15.44)	-0.02 (-0.12, 0.07)	0.13 (-0.23, 0.50)
	Decile 10 vs. 1	-0.16 (-0.56, 0.25)	0.85 (-0.34, 2.04)	-0.80 (-18.60, 16.99)	0.02 (-0.08, 0.12)	0.07 (-0.29, 0.44)
PCB-118	Decile 2 vs. 1	-0.17 (-0.51, 0.18)	-0.06 (-1.04, 0.93)	-2.06 (-17.13, 13.01)	0.03 (-0.05, 0.11)	-0.04 (-0.35, 0.28)
	Decile 3 vs. 1	-0.11 (-0.45, 0.22)	0.01 (-0.92, 0.95)	0.88 (-13.44, 15.19)	0.00 (-0.08, 0.08)	-0.01 (-0.30, 0.29)
	Decile 4 vs. 1	-0.16 (-0.51, 0.19)	-0.70 (-1.69, 0.28)	3.97 (-11.12, 19.06)	-0.04 (-0.12, 0.04)	0.11 (-0.20, 0.42)
	Decile 5 vs. 1	-0.41 (-0.76, -0.05)	0.22 (-0.78, 1.22)	7.63 (-7.65, 22.90)	0.05 (-0.03, 0.13)	0.23 (-0.09, 0.54)
	Decile 6 vs. 1	-0.34 (-0.67, 0.00)	0.15 (-0.81, 1.11)	4.30 (-10.35, 18.95)	0.00 (-0.08, 0.08)	0.05 (-0.25, 0.35)
	Decile 7 vs. 1	-0.37 (-0.72, -0.02)	-0.68 (-1.67, 0.30)	-0.38 (-15.40, 14.64)	-0.01 (-0.09, 0.07)	0.08 (-0.23, 0.39)
	Decile 8 vs. 1	-0.22 (-0.57 0.13)	0.12 (-0.86, 1.11)	7.07 (-8.02, 22.16)	0.03 (-0.05, 0.11)	0.04 (-0.28, 0.35)
	Decile 9 vs. 1	-0.06 (-0.41, 0.29)	-0.86 (-1.84, 0.13)	1.11 (-13.93, 16.16	-0.01 (-0.09, 0.07)	0.11 (-0.20, 0.42)
	Decile 10 vs. 1	-0.04 (-0.38, 0.31)	-0.58 (-1.57, 0.41)	0.48 (-14.68, 15.64)	-0.01 (-0.09, 0.07)	-0.02 (-0.34, 0.29)
ΣPCB (di-*ortho*)[d]	Decile 2 vs. 1	-0.03 (-0.37, 0.31)	0.63 (-0.35, 1.61)	4.12 (-10.33, 18.57)	0.04 (-0.04, 0.12)	0.26 (-0.04, 0.55)
	Decile 3 vs. 1	-0.15 (-0.49, 0.19)	0.21 (-0.77, 1.20)	4.74 (-9.75, 19.24)	-0.01 (-0.08, 0.07)	0.18 (-0.12, 0.47)
	Decile 4 vs. 1	0.07 (-0.31, 0.44)	-0.27 (-1.36, 0.81)	2.64 (-13.28, 18.56)	-0.03 (-0.12, 0.06)	0.15 (-0.18, 0.47)
	Decile 5 vs. 1	-0.15 (-0.51, 0.21)	0.00 (-1.04, 1.03)	3.71 (-11.54, 18.95)	0.04 (-0.05, 0.12)	0.42 (0.10, 0.73)
	Decile 6 vs. 1	-0.16 (-0.52, 0.21)	0.69 (-0.35, 1.74)	5.25 (-10.14, 20.64)	0.03 (-0.05, 0.11)	0.17 (-0.14, 0.49)
	Decile 7 vs. 1	-0.35 (-0.73, 0.02)	-0.17 (-1.24, 0.91)	6.81 (-9.07, 22.68)	0.06 (-0.03, 0.14)	0.16 (-0.16, 0.49)
	Decile 8 vs. 1	-0.12 (-0.48, 0.25)	-0.11 (-1.17, 0.94)	-0.60 (-16.09, 14.89)	-0.03 (-0.11, 0.06)	0.12 (-0.20, 0.44)
	Decile 9 vs. 1	-0.13 (-0.51, 0.24)	0.08 (-1.01, 1.16)	17.35 (1.35, 33.36)	0.03 (-0.06, 0.12)	0.39 (0.06, 0.72)
	Decile 10 vs. 1	0.12 (-0.24, 0.49)	-0.54 (-1.60, 0.52)	4.15 (-11.44, 19.74)	-0.01 (-0.09, 0.08)	0.11 (-0.21, 0.43)

Abbreviations: TSH: thyroid-stimulating hormone; T4: thyroxine; T3: triiodothyronine; 95% CI: 95% Confidence Interval.

For PBB-153: Decile 1= ≤0.10, Decile 2= >0.10- ≤0.19, Decile 3= >0.19- ≤0.30, Decile 4= >0.30- ≤0.39, Decile 5= >0.39- ≤0.47, Decile 6= >0.47- ≤0.68, Decile 7= >0.68- ≤0.91, Decile 8= >0.91- ≤1.41, Decile 9= >1.41- ≤3.51, Decile 10= 3.51

For PCB-118: Decile 1= ≤0.02, Decile 2= >0.02- ≤0.03, Decile 3= >0.03- ≤0.04, Decile 4= >0.04- ≤0.05, Decile 5= >0.05- ≤0.06, Decile 6= >0.06- ≤0.07, Decile 7= >0.07- ≤0.08, Decile 8= >0.08- ≤0.10, Decile 9= >0.10- ≤0.16, Decile 10= >0.16

For ΣPCB (di-*ortho*): Decile 1= ≤0.25, Decile 2= >0.25- ≤0.37, Decile 3= >0.37- ≤0.52, Decile 4= >0.52- ≤0.64, Decile 5= >0.64- ≤0.78, Decile 6= >0.78- ≤0.94, Decile 7= >0.94- 1.14, Decile 8= >1.14- ≤1.45, Decile 9= >1.45- ≤1.78, Decile 10= >1.78

[a] β-coefficients and 95% CIs are shown graphically in Figure 1. All models adjusted for age, time of blood collection, and smoking status.

[b] TSH is ln-transformed and thus β-coefficients should be interpreted as follows: compared with exposure in decile 1, exposure in other deciles are associated with multiplicative changes in TSH of e^{β}

[c] Other thyroid hormones and parameters are not transformed and thus β-coefficients should be interpreted as follows: compared with exposure in decile 1, exposure in other deciles are associated with additive changes in each hormone of β.

[d] PCB-138+PCB-153+PCB-180

Table S11. β-Coefficients and 95% confidence intervals (95% CI) from regression models[a] for associations of PCB-138, 153, and 180 (ng/mL) deciles with TSH[b] and other thyroid hormones[c] among women without a history of thyroid disease (N=343 women, 363 samples)

	Comparison	ln TSH (μIU/mL)			Total T_4 (μg/dL)			Total T_3 (ng/dL)			Free T_4 (ng/dL)			Free T_3 (pg/mL)		
		β	95% CI		β	95% CI		β	95% CI		β	95% CI		β	95% CI	
PCB-138	Decile 2 vs. 1	0.01	-0.24	0.26	-0.04	-0.90	0.82	5.44	-6.60	17.48	0.03	-0.02	0.09	0.20	0.01	0.39
	Decile 3 vs. 1	-0.09	-0.36	0.17	-0.09	-0.82	0.65	9.43	-1.02	19.87	0.02	-0.04	0.08	0.17	0.00	0.34
	Decile 4 vs. 1	0.08	-0.18	0.34	-0.20	-0.98	0.57	12.14	-0.07	24.35	0.02	-0.03	0.08	0.27	0.09	0.46
	Decile 5 vs. 1	0.01	-0.26	0.28	0.17	-0.62	0.95	13.58	2.48	24.68	0.03	-0.03	0.08	0.26	0.09	0.43
	Decile 6 vs. 1	-0.04	-0.31	0.23	-0.11	-0.91	0.69	10.36	-0.59	21.32	0.09	0.03	0.14	0.12	-0.05	0.30
	Decile 7 vs. 1	0.00	-0.28	0.27	0.93	0.13	1.72	17.61	5.17	30.06	0.07	0.02	0.13	0.21	0.04	0.38
	Decile 8 vs. 1	-0.13	-0.38	0.12	-0.09	-0.92	0.73	17.19	5.18	29.20	0.13	-0.02	0.28	0.11	-0.13	0.35
	Decile 9 vs. 1	-0.01	-0.25	0.23	0.29	-0.50	1.08	14.62	0.76	28.48	0.10	0.04	0.16	0.22	0.01	0.42
	Decile 10 vs. 1	0.00	-0.27	0.27	0.22	-0.54	0.97	9.54	-2.13	21.20	0.09	0.02	0.15	0.03	-0.16	0.21
PCB-153	Decile 2 vs. 1	-0.06	-0.30	0.18	0.30	-0.54	1.13	0.74	-11.16	12.64	0.04	-0.01	0.10	0.11	-0.08	0.30
	Decile 3 vs. 1	-0.11	-0.35	0.14	0.00	-0.76	0.76	5.81	-5.98	17.59	0.04	-0.02	0.09	0.09	-0.08	0.26
	Decile 4 vs. 1	-0.07	-0.34	0.20	0.19	-0.58	0.96	6.61	-4.74	17.97	0.04	-0.01	0.09	0.23	0.04	0.42
	Decile 5 vs. 1	-0.06	-0.34	0.21	0.25	-0.48	0.98	11.12	0.48	21.76	0.04	0.00	0.09	0.20	0.03	0.38
	Decile 6 vs. 1	-0.10	-0.37	0.18	0.25	-0.56	1.07	12.18	-0.80	25.15	0.07	0.02	0.13	0.08	-0.10	0.26
	Decile 7 vs. 1	-0.24	-0.48	-0.01	0.87	0.07	1.67	8.38	-3.70	20.45	0.15	0.01	0.30	0.13	-0.12	0.37
	Decile 8 vs. 1	-0.09	-0.35	0.16	0.33	-0.48	1.13	14.12	1.52	26.73	0.07	0.02	0.13	0.15	-0.01	0.31
	Decile 9 vs. 1	0.00	-0.26	0.26	0.17	-0.64	0.98	9.33	-4.99	23.65	0.10	0.05	0.16	0.11	-0.11	0.32
	Decile 10 vs. 1	-0.09	-0.36	0.18	0.60	-0.17	1.38	10.47	-2.08	23.01	0.09	0.03	0.15	0.03	-0.18	0.23
PCB-180	Decile 2 vs. 1	-0.18	-0.41	0.05	0.45	-0.38	1.27	0.49	-12.13	13.12	0.05	-0.01	0.11	0.11	-0.08	0.31
	Decile 3 vs. 1	-0.02	-0.27	0.23	0.09	-0.71	0.89	11.49	-0.06	23.03	0.04	-0.02	0.10	0.18	-0.01	0.36
	Decile 4 vs. 1	-0.06	-0.32	0.21	0.11	-0.66	0.89	8.71	-1.94	19.36	0.06	0.01	0.12	0.26	0.09	0.42
	Decile 5 vs. 1	-0.14	-0.41	0.13	0.11	-0.66	0.89	9.15	-2.98	21.29	0.08	0.02	0.13	0.08	-0.11	0.27
	Decile 6 vs. 1	-0.05	-0.33	0.23	0.64	-0.15	1.44	14.38	1.12	27.63	0.14	0.00	0.27	0.11	-0.12	0.34
	Decile 7 vs. 1	-0.21	-0.46	0.05	0.30	-0.57	1.16	9.60	-4.19	23.38	0.08	0.02	0.13	0.22	0.02	0.42
	Decile 8 vs. 1	-0.08	-0.36	0.20	0.26	-0.57	1.09	9.69	-3.05	22.43	0.09	0.03	0.15	0.09	-0.09	0.27
	Decile 9 vs. 1	-0.07	-0.34	0.19	0.55	-0.26	1.36	10.38	-1.73	22.49	0.10	0.04	0.15	0.19	-0.01	0.39
	Decile 10 vs. 1	-0.10	-0.39	0.19	0.57	-0.29	1.43	11.78	-1.52	25.08	0.10	0.04	0.16	0.08	-0.14	0.30

Abbreviations: TSH: thyroid-stimulating hormone; T4: thyroxine; T3: triiodothyronine; 95% CI: 95% Confidence Interval.

For PCB-138: Decile 1= ≤0.037, Decile 2= >0.037- ≤0.057, Decile3= >0.057- ≤0.085, Decile 4= >0.085- ≤0.113, Decile 5= >0.113- ≤0.156, Decile 6= >0.156- ≤0.212, Decile 7= >0.212- ≤0.276, Decile 8= >0.276- ≤0.358, Decile 9= >0.358- ≤0.521, Decile 10= >0.521

For PCB-153: Decile 1= ≤0.042, Decile 2= >0.042- ≤0.067, Decile3= >0.067- ≤0.094, Decile 4= >0.094- ≤0.128, Decile 5= >0.128- ≤0.175, Decile 6= >0.175- ≤0.235, Decile 7= >0.235- ≤0.293, Decile 8= >0.293- ≤0.377, Decile 9= >0.377- ≤0.503, Decile 10= >0.503

For PCB-180: Decile 1= ≤0.025, Decile 2= >0.025- ≤0.046, Decile3= >0.046- ≤0.066, Decile 4= >0.066- ≤0.091, Decile 5= >0.091- ≤0.116, Decile 6= >0.116- ≤0.154, Decile 7= >0.154- ≤0.195, Decile 8= >0.195- ≤0.250, Decile 9= >0.250- ≤0.317, Decile 10= >0.317

[a] All models adjusted for age, time of blood collection, and smoking status.

[b] TSH is ln-transformed and thus β-coefficients should be interpreted as follows: compared with exposure in decile 1, exposure in other deciles are associated with multiplicative changes in TSH of e^{β}

[c] Other thyroid hormones and parameters are not transformed and thus β-coefficients should be interpreted as follows: compared with exposure in decile 1, exposure in other deciles are associated with additive changes in each hormone of β.

Table S12. β-Coefficients and 95% confidence intervals (95% CI) from regression models[a] for associations of PCB-138, 153, and 180 (ng/mL) deciles with TSH[b] and other thyroid hormones[c] among men without a history of thyroid disease (N=208)

	Comparison	ln TSH (μIU/mL)			Total T_4 (μg/dL)			Total T_3 (ng/dL)			Free T_4 (ng/dL)			Free T_3 (pg/mL)		
		β	95% CI		β	95% CI		β	95% CI		β	95% CI		β	95% CI	
PCB-138	Decile 2 vs. 1	-0.27	-0.62	0.08	0.35	-0.66	1.36	-2.60	-17.24	12.03	0.00	-0.08	0.08	0.25	-0.06	0.55
	Decile 3 vs. 1	-0.09	-0.43	0.25	0.49	-0.50	1.48	3.41	-10.94	17.77	0.02	-0.07	0.10	0.03	-0.27	0.33
	Decile 4 vs. 1	-0.25	-0.60	0.10	0.08	-0.94	1.10	-1.38	-16.15	13.39	0.01	-0.07	0.10	0.15	-0.16	0.46
	Decile 5 vs. 1	-0.15	-0.50	0.21	0.02	-1.00	1.05	3.31	-11.62	18.23	0.03	-0.06	0.11	0.22	-0.10	0.53
	Decile 6 vs. 1	-0.34	-0.69	0.01	0.49	-0.53	1.52	10.75	-4.09	25.58	0.01	-0.07	0.09	0.17	-0.14	0.49
	Decile 7 vs. 1	-0.28	-0.64	0.08	0.26	-0.77	1.30	12.36	-2.65	27.36	0.01	-0.07	0.10	0.29	-0.02	0.60
	Decile 8 vs. 1	-0.21	-0.56	0.15	-0.48	-1.51	0.56	-6.78	-21.74	8.18	-0.01	-0.10	0.07	0.01	-0.31	0.32
	Decile 9 vs. 1	-0.14	-0.50	0.22	0.00	-1.05	1.05	4.84	-10.38	20.06	0.03	-0.06	0.11	0.15	-0.17	0.47
	Decile 10 vs. 1	0.01	-0.35	0.36	-0.28	-1.30	0.75	5.14	-9.70	19.98	0.01	-0.07	0.10	0.12	-0.20	0.43
PCB-153	Decile 2 vs. 1	0.00	-0.34	0.33	0.70	-0.28	1.69	-0.18	-14.49	14.12	0.05	-0.03	0.12	0.18	-0.12	0.48
	Decile 3 vs. 1	0.06	-0.28	0.40	0.54	-0.45	1.52	1.59	-12.75	15.92	0.01	-0.07	0.09	0.15	-0.15	0.45
	Decile 4 vs. 1	-0.31	-0.67	0.05	0.06	-0.99	1.10	-0.76	-15.96	14.43	0.00	-0.08	0.09	0.27	-0.05	0.58
	Decile 5 vs. 1	-0.02	-0.37	0.34	0.19	-0.85	1.23	1.33	-13.75	16.42	0.05	-0.03	0.14	0.26	-0.06	0.57
	Decile 6 vs. 1	-0.27	-0.63	0.08	0.50	-0.54	1.54	5.31	-9.80	20.41	0.03	-0.05	0.11	0.22	-0.09	0.54
	Decile 7 vs. 1	-0.20	-0.56	0.16	0.40	-0.66	1.46	10.07	-5.31	25.45	0.07	-0.02	0.15	0.23	-0.09	0.55
	Decile 8 vs. 1	-0.21	-0.56	0.15	-0.22	-1.25	0.81	-5.36	-20.31	9.59	-0.01	-0.09	0.08	0.08	-0.23	0.39
	Decile 9 vs. 1	-0.14	-0.51	0.23	0.27	-0.81	1.36	15.24	-0.50	30.99	0.03	-0.05	0.12	0.40	0.07	0.73
	Decile 10 vs. 1	0.14	-0.21	0.50	-0.28	-1.33	0.77	1.41	-13.79	16.61	0.02	-0.06	0.11	0.11	-0.20	0.43
PCB-180	Decile 2 vs. 1	-0.12	-0.47	0.23	0.10	-0.89	1.08	-1.55	-16.11	13.00	0.03	-0.05	0.11	0.19	-0.12	0.49
	Decile 3 vs. 1	-0.07	-0.44	0.30	-0.95	-2.00	0.11	-1.87	-17.41	13.66	-0.04	-0.12	0.05	0.14	-0.18	0.46
	Decile 4 vs. 1	-0.05	-0.43	0.33	-0.09	-1.17	0.99	8.01	-7.89	23.91	0.01	-0.08	0.10	0.36	0.03	0.69
	Decile 5 vs. 1	-0.25	-0.63	0.14	0.09	-1.00	1.18	0.01	-16.11	16.12	0.04	-0.05	0.12	0.17	-0.17	0.50
	Decile 6 vs. 1	-0.02	-0.41	0.36	-0.23	-1.31	0.86	-2.44	-18.45	13.57	0.05	-0.04	0.14	0.07	-0.26	0.41
	Decile 7 vs. 1	-0.15	-0.54	0.23	-0.21	-1.31	0.88	0.58	-15.56	16.72	0.07	-0.02	0.15	0.18	-0.16	0.51
	Decile 8 vs. 1	-0.16	-0.54	0.23	0.12	-0.99	1.22	12.40	-3.92	28.73	0.04	-0.05	0.13	0.28	-0.05	0.62
	Decile 9 vs. 1	0.04	-0.37	0.44	-0.51	-1.66	0.64	-0.97	-17.91	15.97	-0.03	-0.12	0.07	0.09	-0.26	0.45
	Decile 10 vs. 1	-0.05	-0.44	0.33	-0.84	-1.93	0.26	1.24	-14.91	17.38	-0.02	-0.11	0.07	0.17	-0.17	0.50

Abbreviations: TSH: thyroid-stimulating hormone; T4: thyroxine; T3: triiodothyronine; 95% CI: 95% Confidence Interval.

For PCB-138: Decile 1= ≤0.064, Decile 2= >0.064- ≤0.105, Decile3= >0.105- ≤0.149, Decile 4= >0.149- ≤0.187, Decile 5= >0.187- ≤0.237, Decile 6= >0.237- ≤0.285, Decile 7= >0.285- ≤0.355, Decile 8= >0.355- ≤0.450, Decile 9= >0.450- ≤0.647, Decile 10= >0.647

For PCB-153: Decile 1= ≤0.082, Decile 2= >0.082- ≤0.134, Decile3= >0.134- ≤0.195, Decile 4= >0.195- ≤0.240, Decile 5= >0.240- ≤0.287, Decile 6= >0.287- ≤0.335, Decile 7= >0.335- ≤0.417, Decile 8= >0.417- ≤0.523, Decile 9= >0.523- ≤0.668, Decile 10= >0.668

For PCB-180: Decile 1= ≤0.076, Decile 2= >0.076- ≤0.129, Decile3= >0.129- ≤0.168, Decile 4= >0.168- ≤0.207, Decile 5= >0.207- ≤0.249, Decile 6= >0.249- ≤0.299, Decile 7= >0.299- ≤0.356, Decile 8= >0.356- ≤0.433, Decile 9= >0.433- ≤0.566, Decile 10= >0.566

[a] All models adjusted for age, time of blood collection, and smoking status.

[b] TSH is ln-transformed and thus β-coefficients should be interpreted as follows: compared with exposure in decile 1, exposure in other deciles are associated with multiplicative changes in TSH of e^{β}

[c] Other thyroid hormones and parameters are not transformed and thus β-coefficients should be interpreted as follows: compared with exposure in decile 1, exposure in other deciles are associated with additive changes in each hormone of β.

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