

Supplementary Material

Early-life associations between per- and polyfluoroalkyl substances and serum lipids in a longitudinal birth cohort

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Supplemental Tables

Table S1: Count of missing baseline covariates in the study population (n = 490).

Characteristic	N (%)
Child sex	0 (0)
Maternal education	13 (2.7)
Maternal smoking	2 (0.41)
Parity	2 (0.41)
Maternal BMI	1 (0.20)

Table S2: Characteristics of the Faroese mother-child pairs at birth (n = 459), 18 months (n = 334) and nine years (n = 366).

Visit	Characteristic	Overall	Female	Male	p-value*
Birth	Sex		219	240	
	Female	219 (47.7)			
	Male	240 (52.3)			
	Maternal education				
	Low	151 (32.9)	81 (37.0)	70 (29.2)	0.141
	Medium	119 (25.9)	57 (26.0)	62 (25.8)	
	High	189 (41.2)	81 (37.0)	108 (45.0)	
	Maternal smoking				
	Yes	70 (15.3)	35 (16.0)	35 (14.6)	0.775
	No	389 (84.7)	184 (84.0)	205 (85.4)	
	Parity				
Primiparous	135 (29.4)	75 (34.2)	60 (25.0)	0.039	
Multiparous	324 (70.6)	144 (65.8)	180 (75.0)		
Maternal BMI	23.66 [21.23, 25.93]	23.15 [21.00, 25.79]	24.03 [21.54, 26.38]	0.064	
Maternal whale consumption					
Yes	89 (19.7)	35 (16.3)	54 (22.9)	0.101	
No	362 (80.3)	180 (83.7)	182 (77.1)		
18 months	Breastfeed duration (months)	5.00 [4.00, 6.00]	5.00 [4.00, 6.00]	5.00 [4.00, 6.00]	0.341
Nine years	Child whale consumption				
	Yes	154 (42.3)	64 (36.6)	90 (47.6)	0.043
	No	210 (57.7)	111 (63.4)	99 (52.4)	

* p-values are for chi-square tests with continuity correction (categorical) or Wilcoxon rank-sum tests (non-normal continuous) tests when comparing population characteristics between males and females.

Table S3: Differences in PFAS distribution (ng/ml) by study characteristics.

Visit	Characteristics	N (%)	Median [IQR]				
			PFOA	PFHxS	PFNA	PFOS	PFDA
Birth	Overall	459	0.9 [0.63, 1.34]	0.17 [0.13, 0.22]	0.32 [0.25, 0.42]	2.87 [2.13, 4.04]	0.09 [0.07, 0.12]
	Sex						
	Female	219 (47.7)	0.93 [0.65, 1.42]	0.16 [0.12, 0.22]	0.32 [0.25, 0.43]	2.82 [2.04, 3.86]	0.09 [0.07, 0.12]
	Male	240 (52.3)	0.87 [0.61, 1.22]	0.17 [0.13, 0.22]	0.31 [0.25, 0.41]	2.93 [2.19, 4.10]	0.09 [0.07, 0.12]
	p-value*		0.213	0.286	0.81	0.194	0.091
	Maternal education						
	Low	151 (32.9)	0.97 [0.67, 1.43]	0.16 [0.12, 0.21]	0.30 [0.24, 0.41]	2.89 [2.15, 4.06]	0.08 [0.07, 0.11]
	Medium	119 (25.9)	0.96 [0.67, 1.36]	0.17 [0.13, 0.21]	0.34 [0.27, 0.43]	2.98 [2.24, 4.05]	0.10 [0.07, 0.12]
	High	189 (41.2)	0.84 [0.57, 1.18]	0.17 [0.13, 0.23]	0.32 [0.25, 0.42]	2.76 [2.01, 4.03]	0.09 [0.07, 0.12]
	p-value		0.025	0.317	0.17	0.208	0.031
	Maternal smoking						
	Yes	70 (15.3)	1.00 [0.77, 1.44]	0.20 [0.15, 0.25]	0.32 [0.27, 0.45]	3.28 [2.45, 4.22]	0.10 [0.08, 0.13]
	No	389 (84.7)	0.86 [0.61, 1.29]	0.16 [0.12, 0.22]	0.31 [0.25, 0.41]	2.83 [2.10, 3.94]	0.09 [0.07, 0.12]
	p-value		0.007	0.008	0.161	0.057	0.06
	Parity						
	Primiparous	135 (29.4)	1.34 [0.96, 1.88]	0.18 [0.15, 0.27]	0.33 [0.27, 0.45]	3.25 [2.41, 4.43]	0.09 [0.07, 0.12]
	Multiparous	324 (70.6)	0.76 [0.57, 1.08]	0.16 [0.12, 0.21]	0.31 [0.24, 0.40]	2.76 [2.02, 3.84]	0.09 [0.07, 0.12]
	p-value		<0.001	<0.001	0.008	<0.001	0.627
	Maternal BMI						
	Underweight	10 (2.2)	0.99 [0.52, 1.37]	0.16 [0.12, 0.28]	0.34 [0.26, 0.41]	2.16 [1.76, 2.55]	0.10 [0.08, 0.12]
	Normal	292 (63.6)	0.87 [0.59, 1.24]	0.16 [0.12, 0.22]	0.30 [0.23, 0.39]	2.71 [2.01, 3.85]	0.09 [0.07, 0.12]
	Overweight	111 (24.2)	0.94 [0.72, 1.35]	0.18 [0.13, 0.22]	0.34 [0.27, 0.42]	3.26 [2.41, 4.29]	0.10 [0.07, 0.12]
	Obese	46 (10.0)	0.91 [0.68, 1.38]	0.18 [0.14, 0.24]	0.35 [0.27, 0.53]	3.32 [2.49, 4.39]	0.09 [0.07, 0.13]
p-value		0.373	0.592	0.046	0.001	0.487	
Maternal whale consumption							
Yes	89 (19.7)	0.91 [0.63, 1.22]	0.17 [0.12, 0.22]	0.34 [0.26, 0.48]	3.18 [2.16, 4.56]	0.10 [0.08, 0.14]	
No	362 (80.3)	0.89 [0.63, 1.33]	0.17 [0.13, 0.22]	0.31 [0.25, 0.41]	2.84 [2.13, 3.89]	0.09 [0.07, 0.12]	
p-value		0.677	0.709	0.068	0.105	0.009	

Visit	Characteristics	N (%)	Median [IQR]				
			PFOA	PFHxS	PFNA	PFOS	PFDA
18 months	Overall	334	2.74 [1.98, 4.45]	0.23 [0.09, 0.41]	0.96 [0.64, 1.46]	6.81 [4.38, 9.82]	0.28 [0.21, 0.41]
	Breastfeed Duration						
	<5	126 (37.8)	2.05 [1.33, 2.95]	0.11 [0.01, 0.23]	0.69 [0.44, 0.98]	4.79 [3.23, 6.77]	0.23 [0.18, 0.29]
	5	69 (20.7)	2.88 [2.26, 4.25]	0.26 [0.15, 0.43]	1.07 [0.83, 1.49]	7.05 [5.70, 9.51]	0.30 [0.23, 0.42]
	6	119 (35.7)	3.84 [2.62, 5.35]	0.34 [0.20, 0.52]	1.26 [0.92, 1.74]	8.50 [6.69, 11.47]	0.35 [0.24, 0.48]
	>6	19 (5.7)	3.20 [1.87, 4.29]	0.27 [0.14, 0.37]	0.95 [0.57, 1.67]	7.65 [3.84, 10.29]	0.27 [0.18, 0.41]
	p-value		<0.001	<0.001	<0.001	<0.001	<0.001
Nine years	Overall	366	1.43 [1.19, 1.74]	0.26 [0.2, 0.34]	0.63 [0.49, 0.86]	3.08 [2.42, 4.31]	0.23 [0.17, 0.31]
	Whale Consumption						
	Yes	154 (42.3)	1.38 [1.18, 1.65]	0.30 [0.23, 0.38]	0.76 [0.58, 1.00]	3.87 [2.78, 5.25]	0.28 [0.22, 0.38]
	No	210 (57.7)	1.47 [1.22, 1.79]	0.24 [0.19, 0.30]	0.58 [0.48, 0.74]	2.73 [2.20, 3.63]	0.20 [0.16, 0.26]
	p-value		0.128	<0.001	<0.001	<0.001	<0.001

* p-values are for Wilcoxon rank-sum tests (non-normal continuous) comparing PFAS distributions between population subgroups.

Table S4: Lipid concentrations (mmol/L) at birth, 18 months, and nine years, displayed as median [IQR].

Visit	Lipid	Overall	Female	Male	p-Value*
Birth	HDL-C	0.71 [0.59, 0.89]	0.73 [0.62, 0.89]	0.70 [0.57, 0.87]	0.065
	LDL-C	0.62 [0.48, 0.81]	0.67 [0.51, 0.87]	0.58 [0.46, 0.74]	<0.001
	TG	0.43 [0.33, 0.56]	0.42 [0.32, 0.58]	0.43 [0.33, 0.55]	0.902
	TC	1.68 [1.37, 2.00]	1.76 [1.43, 2.11]	1.58 [1.36, 1.90]	0.002
18 months	HDL-C	0.72 [0.54, 0.86]	0.68 [0.56, 0.85]	0.74 [0.54, 0.86]	0.462
	LDL-C	1.89 [1.46, 2.36]	2.01 [1.52, 2.51]	1.80 [1.39, 2.14]	0.002
	TG	1.09 [0.79, 1.50]	1.16 [0.79, 1.59]	1.01 [0.80, 1.35]	0.065
	TC	3.48 [2.92, 4.11]	3.68 [3.04, 4.19]	3.33 [2.81, 3.94]	0.004
9 years	HDL-C	1.45 [1.26, 1.65]	1.44 [1.21, 1.59]	1.51 [1.29, 1.70]	0.027
	LDL-C	2.24 [1.93, 2.65]	2.34 [2.00, 2.74]	2.16 [1.83, 2.57]	0.001
	TG	0.88 [0.65, 1.27]	0.91 [0.71, 1.27]	0.82 [0.61, 1.26]	0.019
	TC	4.24 [3.82, 4.70]	4.29 [3.93, 4.82]	4.22 [3.67, 4.63]	0.048

* p-values are for Wilcoxon rank-sum tests (non-normal continuous) comparing lipid distributions between males and females.

Table S5: Estimated change in serum lipid concentrations (mmol/L) per a doubling in serum PFAS concentrations.

Outcome	Exposure	Effect Estimate (95% CI)			p-interaction
		Overall [†]	Females [‡]	Males [‡]	
PFAS at birth and lipids at birth (n = 459)					
TC	PFOA	-0.013 (-0.077, 0.051)	0.00037 (-0.086, 0.087)	-0.026 (-0.11, 0.061)	0.66
	PFHxS	0.027 (-0.038, 0.092)	0.053 (-0.034, 0.14)	-0.0034 (-0.098, 0.091)	0.383
	PFNA	-0.0077 (-0.082, 0.067)	0.053 (-0.048, 0.15)	-0.076 (-0.18, 0.032)	0.0862
	PFOS	-0.0083 (-0.073, 0.056)	0.016 (-0.074, 0.11)	-0.032 (-0.12, 0.057)	0.451
	PFDA	-0.034 (-0.11, 0.045)	0.048 (-0.069, 0.16)	-0.1 (-0.21, 0.0043)	0.0628
HDL-C	PFOA	0.0058 (-0.024, 0.036)	0.0026 (-0.037, 0.042)	0.0091 (-0.031, 0.05)	0.812
	PFHxS	-0.02 (-0.05, 0.01)	-0.012 (-0.052, 0.029)	-0.03 (-0.074, 0.014)	0.539
	PFNA	-0.0073 (-0.042, 0.028)	-0.0043 (-0.051, 0.043)	-0.011 (-0.062, 0.04)	0.854
	PFOS	-0.02 (-0.05, 0.01)	-0.026 (-0.068, 0.016)	-0.014 (-0.055, 0.028)	0.672
	PFDA	-0.00094 (-0.038, 0.036)	0.0077 (-0.047, 0.062)	-0.0084 (-0.059, 0.042)	0.671
LDL-C	PFOA	-0.0016 (-0.04, 0.037)	-0.0016 (-0.053, 0.05)	-0.0016 (-0.053, 0.05)	1
	PFHxS	0.0066 (-0.032, 0.045)	0.019 (-0.033, 0.07)	-0.0079 (-0.064, 0.048)	0.486
	PFNA	0.00043 (-0.044, 0.045)	0.035 (-0.025, 0.095)	-0.039 (-0.1, 0.025)	0.0978
	PFOS	0.0068 (-0.031, 0.045)	0.024 (-0.03, 0.078)	-0.0093 (-0.062, 0.043)	0.382
	PFDA	-0.019 (-0.066, 0.029)	0.024 (-0.046, 0.094)	-0.055 (-0.12, 0.0094)	0.105
TG	PFOA	0.2 (-4.8, 5.5)	3.5 (-3.4, 11)	-2.9 (-9.3, 3.9)	0.17
	PFHxS	11 (5.9, 17)**	13 (5.5, 21)**	9.7 (1.9, 18)*	0.564
	PFNA	2.8 (-3.1, 9.1)	5.6 (-2.6, 15)	-0.25 (-8.4, 8.6)	0.338
	PFOS	4.4 (-0.83, 9.9)	6.4 (-1, 14)	2.5 (-4.5, 10)	0.465
	PFDA	2.2 (-4.1, 8.8)	7.3 (-2.3, 18)	-1.9 (-9.9, 6.8)	0.167
PFAS at birth and lipids at 18 months (n = 325)					
TC	PFOA	-0.094 (-0.22, 0.031)	-0.13 (-0.3, 0.032)	-0.051 (-0.22, 0.12)	0.485
	PFHxS	-0.036 (-0.18, 0.1)	-0.026 (-0.22, 0.17)	-0.047 (-0.24, 0.15)	0.881
	PFNA	-0.016 (-0.17, 0.13)	0.026 (-0.18, 0.23)	-0.063 (-0.28, 0.15)	0.555
	PFOS	-0.017 (-0.15, 0.11)	-0.041 (-0.21, 0.13)	0.012 (-0.18, 0.2)	0.683
	PFDA	-0.1 (-0.26, 0.059)	-0.019 (-0.26, 0.22)	-0.17 (-0.39, 0.045)	0.351
HDL-C	PFOA	-0.029 (-0.061, 0.0029)	-0.031 (-0.073, 0.012)	-0.027 (-0.072, 0.017)	0.91
	PFHxS	0.00064 (-0.036, 0.037)	-0.023 (-0.073, 0.026)	0.026 (-0.024, 0.077)	0.16
	PFNA	-0.0061 (-0.045, 0.033)	-0.021 (-0.074, 0.032)	0.01 (-0.045, 0.066)	0.419
	PFOS	-0.023 (-0.057, 0.011)	-0.029 (-0.074, 0.016)	-0.016 (-0.065, 0.034)	0.688
	PFDA	-0.0078 (-0.049, 0.034)	-0.0072 (-0.069, 0.054)	-0.0083 (-0.064, 0.048)	0.98

Outcome	Exposure	Effect Estimate (95% CI)			
		Overall [†]	Females [‡]	Males [‡]	p-interaction
LDL-C	PFOA	-0.074 (-0.17, 0.024)	-0.1 (-0.23, 0.027)	-0.043 (-0.18, 0.092)	0.515
	PFHxS	-0.045 (-0.15, 0.064)	-0.054 (-0.2, 0.095)	-0.036 (-0.19, 0.12)	0.872
	PFNA	-0.011 (-0.13, 0.11)	0.04 (-0.12, 0.2)	-0.066 (-0.23, 0.1)	0.368
	PFOS	-0.031 (-0.13, 0.07)	-0.05 (-0.19, 0.086)	-0.0092 (-0.16, 0.14)	0.692
	PFDA	-0.094 (-0.22, 0.032)	-0.031 (-0.22, 0.15)	-0.15 (-0.32, 0.022)	0.364
TG	PFOA	0.72 (-5.7, 7.6)	-5.5 (-13, 3.1)	7.8 (-1.5, 18)	0.0318
	PFHxS	3.5 (-3.9, 11)	7.9 (-2.5, 19)	-0.87 (-11, 9.9)	0.244
	PFNA	-2 (-9.5, 6.2)	-5.9 (-16, 5.1)	2.3 (-8.6, 14)	0.296
	PFOS	3.8 (-3.2, 11)	1.2 (-7.8, 11)	6.9 (-3.3, 18)	0.424
	PFDA	0.33 (-7.9, 9.3)	-2.8 (-15, 11)	2.8 (-8.2, 15)	0.518
PFAS at birth and lipids at 9 years (n = 356)					
TC	PFOA	0.027 (-0.086, 0.14)	-0.073 (-0.22, 0.077)	0.12 (-0.024, 0.27)	0.0523
	PFHxS	-0.022 (-0.14, 0.095)	-0.053 (-0.21, 0.1)	0.016 (-0.15, 0.19)	0.554
	PFNA	0.048 (-0.083, 0.18)	-0.06 (-0.24, 0.12)	0.17 (-0.018, 0.36)	0.0799
	PFOS	-0.0084 (-0.12, 0.1)	-0.077 (-0.23, 0.079)	0.059 (-0.096, 0.21)	0.221
	PFDA	0.024 (-0.12, 0.17)	-0.12 (-0.33, 0.083)	0.15 (-0.042, 0.34)	0.0578
HDL-C	PFOA	0.0055 (-0.038, 0.049)	-0.012 (-0.071, 0.047)	0.022 (-0.036, 0.08)	0.399
	PFHxS	0.021 (-0.024, 0.066)	0.0028 (-0.057, 0.063)	0.044 (-0.022, 0.11)	0.362
	PFNA	0.023 (-0.028, 0.074)	-0.011 (-0.08, 0.057)	0.062 (-0.011, 0.13)	0.15
	PFOS	0.027 (-0.016, 0.071)	-0.004 (-0.064, 0.056)	0.058 (-0.0014, 0.12)	0.145
	PFDA	0.053 (-0.0017, 0.11)	0.0064 (-0.074, 0.086)	0.092 (0.018, 0.17)*	0.123
LDL-C	PFOA	-0.011 (-0.098, 0.076)	-0.051 (-0.17, 0.066)	0.027 (-0.088, 0.14)	0.326
	PFHxS	-0.055 (-0.14, 0.034)	-0.057 (-0.18, 0.062)	-0.052 (-0.18, 0.078)	0.96
	PFNA	0.025 (-0.075, 0.13)	0.018 (-0.12, 0.15)	0.034 (-0.11, 0.18)	0.875
	PFOS	-0.047 (-0.13, 0.039)	-0.045 (-0.17, 0.075)	-0.05 (-0.17, 0.069)	0.958
	PFDA	-0.019 (-0.13, 0.09)	-0.046 (-0.21, 0.11)	0.0037 (-0.14, 0.15)	0.652
TG	PFOA	-1.2 (-7.6, 5.6)	-4.5 (-13, 4.4)	2 (-6.6, 11)	0.275
	PFHxS	-1.8 (-8.3, 5.2)	2.6 (-6.3, 12)	-6.8 (-16, 3)	0.156
	PFNA	-0.079 (-7.5, 7.9)	-3.8 (-13, 6.8)	4.3 (-6.7, 17)	0.297
	PFOS	-2 (-8.3, 4.7)	-3 (-12, 6.3)	-1 (-9.6, 8.4)	0.757
	PFDA	2.3 (-5.9, 11)	-1.4 (-13, 11)	5.5 (-5.7, 18)	0.424

Outcome	Exposure	Effect Estimate (95% CI)			
		Overall [†]	Females [‡]	Males [‡]	p-interaction
PFAS at 18 months and lipids at 18 months (n = 334)					
TC	PFOA	0.0021 (-0.1, 0.11)	0.028 (-0.12, 0.18)	-0.025 (-0.18, 0.13)	0.616
	PFHxS	0.012 (-0.041, 0.065)	0.024 (-0.051, 0.098)	0.00057 (-0.072, 0.074)	0.66
	PFNA	0.061 (-0.046, 0.17)	0.1 (-0.041, 0.24)	0.011 (-0.14, 0.17)	0.395
	PFOS	0.051 (-0.06, 0.16)	0.078 (-0.082, 0.24)	0.027 (-0.13, 0.18)	0.654
	PFDA	0.086 (-0.046, 0.22)	0.14 (-0.041, 0.32)	0.025 (-0.17, 0.22)	0.391
HDL-C	PFOA	-0.0027 (-0.03, 0.024)	0.0022 (-0.035, 0.04)	-0.0077 (-0.046, 0.03)	0.716
	PFHxS	0.0081 (-0.0052, 0.022)	0.0049 (-0.014, 0.024)	0.011 (-0.0072, 0.03)	0.635
	PFNA	0.027 (-0.00041, 0.054)	0.027 (-0.0097, 0.063)	0.026 (-0.013, 0.066)	0.994
	PFOS	0.0054 (-0.023, 0.034)	0.0026 (-0.038, 0.043)	0.008 (-0.031, 0.047)	0.85
	PFDA	0.042 (0.0087, 0.076)*	0.058 (0.012, 0.1)*	0.025 (-0.023, 0.073)	0.323
LDL-C	PFOA	0.0031 (-0.08, 0.086)	0.029 (-0.086, 0.14)	-0.024 (-0.14, 0.094)	0.528
	PFHxS	0.0024 (-0.039, 0.044)	0.0079 (-0.05, 0.066)	-0.003 (-0.06, 0.054)	0.79
	PFNA	0.047 (-0.036, 0.13)	0.092 (-0.019, 0.2)	-0.0065 (-0.13, 0.11)	0.235
	PFOS	0.028 (-0.06, 0.11)	0.05 (-0.075, 0.17)	0.0074 (-0.11, 0.13)	0.629
	PFDA	0.071 (-0.032, 0.17)	0.12 (-0.024, 0.26)	0.02 (-0.13, 0.17)	0.35
TG	PFOA	1 (-4.4, 6.8)	0.24 (-7.2, 8.3)	1.8 (-5.7, 10)	0.774
	PFHxS	1.3 (-1.4, 4.1)	2.7 (-1.2, 6.8)	0.052 (-3.6, 3.9)	0.332
	PFNA	1.2 (-4.2, 7)	1.1 (-6.2, 8.9)	1.4 (-6.4, 9.8)	0.954
	PFOS	4.5 (-1.4, 11)	7.4 (-1.3, 17)	2 (-5.6, 10)	0.376
	PFDA	0.35 (-6.3, 7.5)	1.8 (-7.4, 12)	-1.2 (-10, 9)	0.673
PFAS at 18 months and lipids at 9 years (n = 276)					
TC	PFOA	0.023 (-0.087, 0.13)	0.0099 (-0.14, 0.16)	0.036 (-0.12, 0.19)	0.812
	PFHxS	-0.047 (-0.1, 0.0059)	-0.032 (-0.11, 0.042)	-0.062 (-0.14, 0.013)	0.581
	PFNA	-0.009 (-0.12, 0.1)	0.016 (-0.13, 0.16)	-0.04 (-0.2, 0.12)	0.615
	PFOS	-0.041 (-0.15, 0.071)	-0.019 (-0.18, 0.14)	-0.061 (-0.21, 0.093)	0.713
	PFDA	-0.02 (-0.16, 0.12)	-0.029 (-0.22, 0.16)	-0.01 (-0.21, 0.19)	0.894
HDL-C	PFOA	0.012 (-0.028, 0.053)	0.024 (-0.032, 0.081)	-0.00019 (-0.057, 0.057)	0.546
	PFHxS	0.01 (-0.0091, 0.03)	0.025 (-0.0023, 0.052)	-0.0042 (-0.032, 0.023)	0.14
	PFNA	0.025 (-0.015, 0.066)	0.027 (-0.027, 0.08)	0.024 (-0.036, 0.084)	0.944
	PFOS	0.025 (-0.016, 0.066)	0.047 (-0.012, 0.11)	0.0049 (-0.051, 0.061)	0.313
	PFDA	0.027 (-0.022, 0.077)	0.027 (-0.041, 0.095)	0.028 (-0.044, 0.1)	0.98

Outcome	Exposure	Effect Estimate (95% CI)			p-interaction
		Overall [†]	Females [‡]	Males [‡]	
LDL-C	PFOA	0.011 (-0.07, 0.092)	-0.0041 (-0.12, 0.11)	0.026 (-0.088, 0.14)	0.71
	PFHxS	-0.031 (-0.07, 0.0081)	-0.022 (-0.077, 0.033)	-0.04 (-0.095, 0.015)	0.651
	PFNA	0.029 (-0.052, 0.11)	0.061 (-0.047, 0.17)	-0.011 (-0.13, 0.11)	0.379
	PFOS	-0.025 (-0.11, 0.057)	-0.013 (-0.13, 0.11)	-0.036 (-0.15, 0.077)	0.783
	PFDA	0.031 (-0.069, 0.13)	0.036 (-0.1, 0.17)	0.026 (-0.12, 0.17)	0.928
TG	PFOA	-0.58 (-6.7, 6)	0.51 (-8.1, 9.9)	-1.7 (-10, 7.5)	0.73
	PFHxS	-1.8 (-4.7, 1.3)	-1.1 (-5.2, 3.3)	-2.5 (-6.6, 1.8)	0.642
	PFNA	-2.4 (-8.5, 4)	1.2 (-7, 10)	-6.8 (-15, 2.5)	0.205
	PFOS	-3.1 (-9.2, 3.4)	-0.35 (-9.3, 9.5)	-5.6 (-14, 3.2)	0.415
	PFDA	-2.3 (-9.7, 5.7)	3.5 (-7, 15)	-8.5 (-18, 2.6)	0.124
PFAS at 5 years and lipids at 9 years (n = 291)					
TC	PFOA	-0.042 (-0.2, 0.12)	0.051 (-0.17, 0.27)	-0.14 (-0.37, 0.088)	0.237
	PFHxS	0.071 (-0.045, 0.19)	0.15 (-0.00093, 0.31)	-0.034 (-0.21, 0.14)	0.117
	PFNA	0.11 (0.0085, 0.21)*	0.22 (0.074, 0.36)*	0.0047 (-0.14, 0.15)	0.0399
	PFOS	0.13 (-0.014, 0.27)	0.2 (0.016, 0.38)*	0.025 (-0.19, 0.24)	0.232
	PFDA	0.088 (-0.0069, 0.18)	0.19 (0.05, 0.33)*	0.0014 (-0.13, 0.13)	0.0544
HDL-C	PFOA	-0.023 (-0.091, 0.045)	-0.02 (-0.11, 0.074)	-0.025 (-0.12, 0.071)	0.935
	PFHxS	0.016 (-0.033, 0.064)	0.044 (-0.021, 0.11)	-0.02 (-0.092, 0.053)	0.205
	PFNA	0.026 (-0.017, 0.07)	-0.013 (-0.074, 0.048)	0.065 (0.0044, 0.13)*	0.0771
	PFOS	0.052 (-0.0073, 0.11)	0.043 (-0.034, 0.12)	0.063 (-0.027, 0.15)	0.738
	PFDA	0.018 (-0.022, 0.058)	-0.0068 (-0.066, 0.053)	0.04 (-0.015, 0.094)	0.265
LDL-C	PFOA	0.088 (-0.045, 0.22)	0.15 (-0.029, 0.33)	0.018 (-0.17, 0.21)	0.308
	PFHxS	0.04 (-0.055, 0.14)	0.097 (-0.029, 0.22)	-0.031 (-0.17, 0.11)	0.188
	PFNA	0.08 (-0.0047, 0.16)	0.2 (0.079, 0.31)*	-0.037 (-0.15, 0.08)	0.00605
	PFOS	0.089 (-0.026, 0.2)	0.18 (0.029, 0.33)*	-0.033 (-0.21, 0.14)	0.0727
	PFDA	0.073 (-0.0048, 0.15)	0.18 (0.067, 0.3)*	-0.018 (-0.12, 0.086)	0.0127
TG	PFOA	-7.6 (-17, 2.7)	0.32 (-13, 16)	-15 (-27, -1.7)*	0.107
	PFHxS	-0.98 (-8.2, 6.8)	0.069 (-9.6, 11)	-2.3 (-13, 9.4)	0.761
	PFNA	0.49 (-6.1, 7.6)	5.8 (-3.8, 16)	-4.5 (-13, 5)	0.133
	PFOS	-0.089 (-8.9, 9.6)	0.97 (-11, 14)	-1.5 (-15, 13)	0.793
	PFDA	0.6 (-5.5, 7.1)	3.4 (-5.8, 13)	-1.7 (-9.7, 7)	0.433

Outcome	Exposure	Effect Estimate (95% CI)			p-interaction
		Overall [†]	Females [‡]	Males [‡]	
PFAS at 9 years and lipids at 9 years (n = 366)					
TC	PFOA	0.16 (-0.041, 0.35)	0.18 (-0.1, 0.46)	0.14 (-0.14, 0.41)	0.832
	PFHxS	0.056 (-0.089, 0.2)	0.15 (-0.051, 0.36)	-0.04 (-0.24, 0.16)	0.188
	PFNA	0.16 (0.026, 0.29)*	0.21 (0.01, 0.4)*	0.12 (-0.06, 0.3)	0.509
	PFOS	0.15 (0.025, 0.27)*	0.25 (0.077, 0.43)*	0.05 (-0.12, 0.22)	0.104
	PFDA	0.19 (0.066, 0.32)*	0.2 (0.0098, 0.39)*	0.19 (0.017, 0.36)*	0.931
HDL-C	PFOA	0.02 (-0.056, 0.097)	2.8e-06 (-0.11, 0.11)	0.041 (-0.068, 0.15)	0.601
	PFHxS	0.034 (-0.022, 0.089)	0.039 (-0.04, 0.12)	0.029 (-0.05, 0.11)	0.856
	PFNA	0.063 (0.012, 0.11)*	0.018 (-0.058, 0.095)	0.098 (0.03, 0.17)*	0.129
	PFOS	0.077 (0.03, 0.12)*	0.07 (0.0017, 0.14)*	0.083 (0.018, 0.15)*	0.788
	PFDA	0.1 (0.054, 0.15)**	0.057 (-0.016, 0.13)	0.14 (0.075, 0.21)**	0.0967
LDL-C	PFOA	0.14 (-0.0062, 0.3)	0.23 (0.022, 0.45)*	0.054 (-0.16, 0.27)	0.242
	PFHxS	0.07 (-0.04, 0.18)	0.21 (0.054, 0.36)*	-0.064 (-0.22, 0.088)	0.0144
	PFNA	0.12 (0.018, 0.22)*	0.23 (0.076, 0.38)*	0.033 (-0.1, 0.17)	0.0619
	PFOS	0.093 (-0.00048, 0.19)	0.25 (0.11, 0.38)**	-0.047 (-0.17, 0.08)	0.0019
	PFDA	0.12 (0.023, 0.22)*	0.19 (0.038, 0.33)*	0.072 (-0.059, 0.2)	0.259
TG	PFOA	-2.5 (-14, 9.9)	-1.2 (-17, 17)	-3.8 (-19, 14)	0.826
	PFHxS	-3.4 (-11, 5.3)	-3.2 (-14, 9.5)	-3.6 (-15, 8.9)	0.963
	PFNA	-1.4 (-9, 6.9)	-0.38 (-12, 12)	-2.2 (-12, 8.9)	0.823
	PFOS	0.25 (-6.9, 8)	0.43 (-9.8, 12)	0.082 (-9.7, 11)	0.964
	PFDA	-0.16 (-7.6, 7.9)	2.9 (-8.4, 16)	-2.5 (-12, 8.2)	0.496

* p-value < 0.05; ** p-value < 0.001

[†] Overall effect estimates are calculated from the fully-adjusted primary models. Significance for each effect estimate is illustrated using asterisks.

[‡] Effect estimates for females and males are calculated from models that include an interaction term between sex and PFAS concentrations. Significance for each effect estimate, illustrated using asterisks, denotes whether the sex-specific estimate is significantly different from zero. The significance of the interaction term is included in the column “p-interaction.”

Supplemental Figures

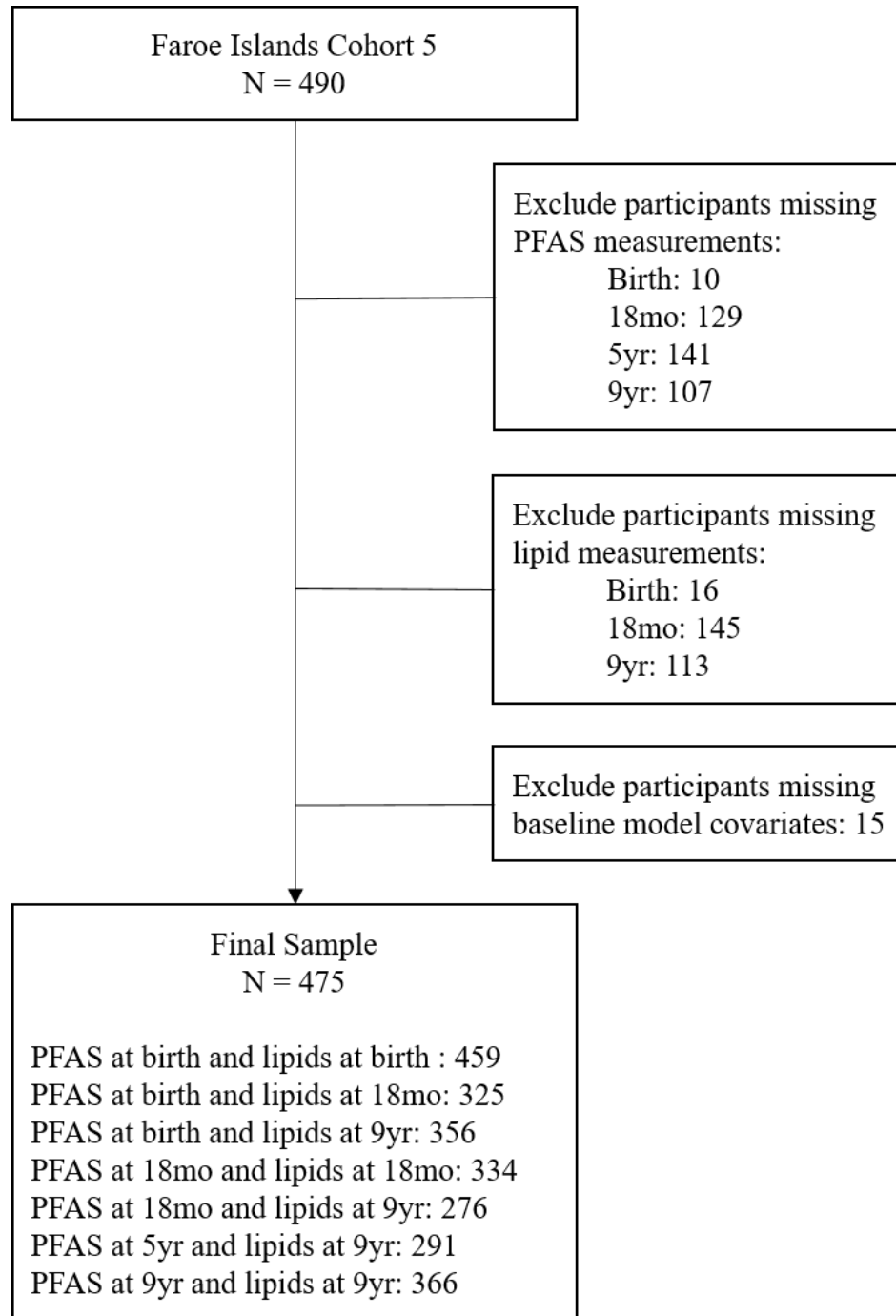


Figure S1: Study selection flow diagram.

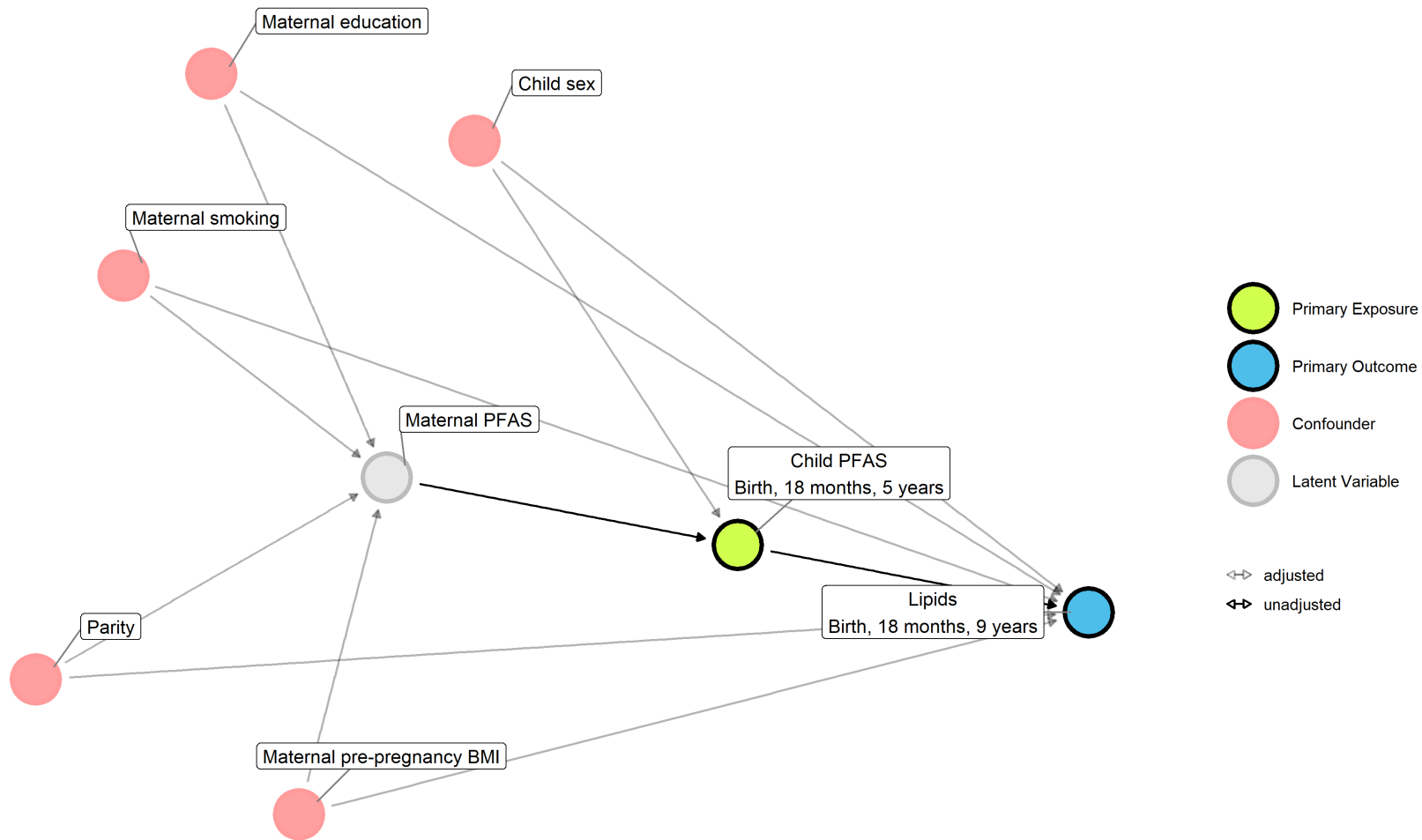


Figure S2: Directed acyclic graph of the hypothesized causal pathway between child PFAS, measured at birth in cord serum, and child lipid levels measured at birth, 18 months, and nine years.

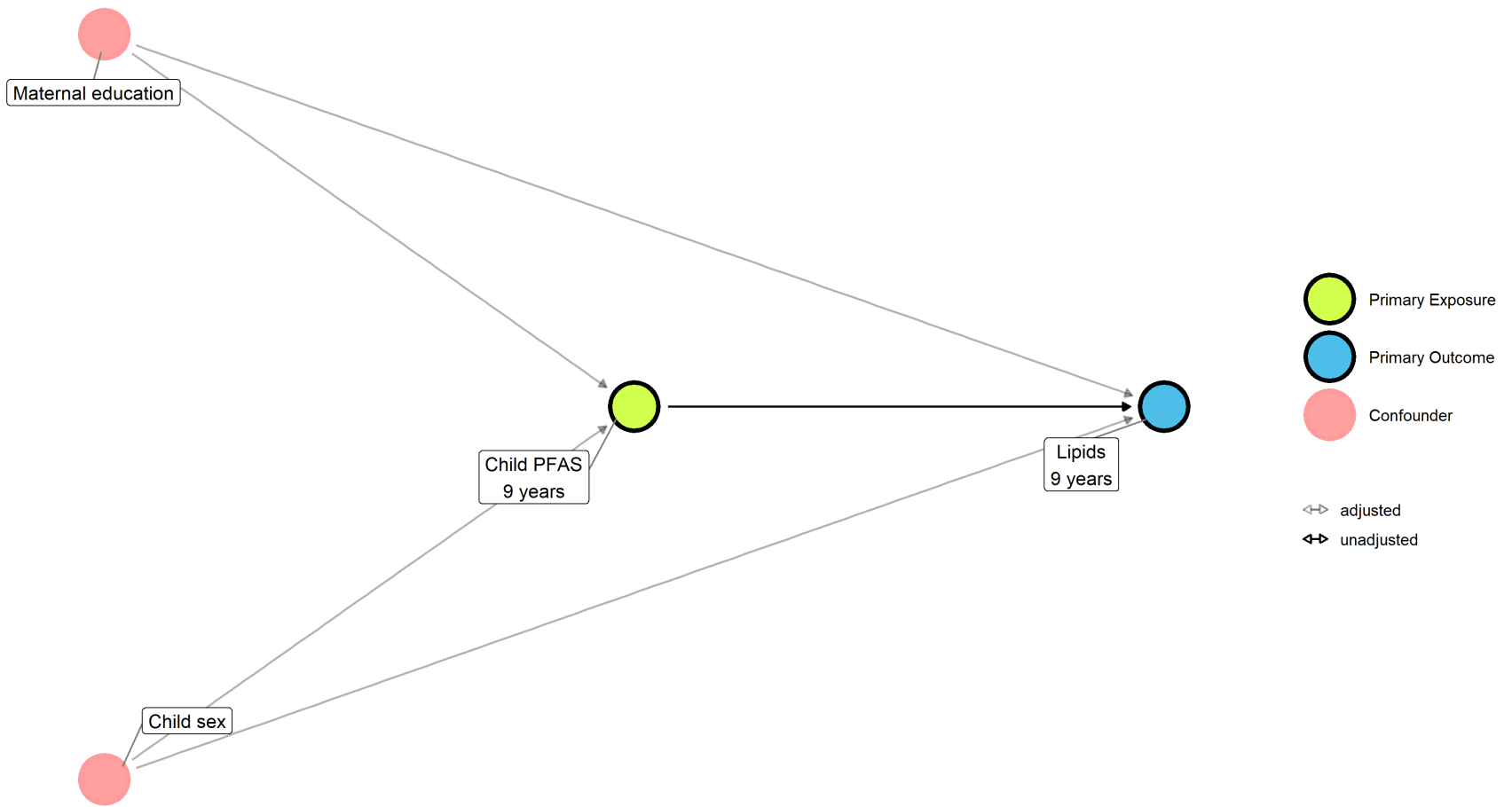


Figure S3: Directed acyclic graph of the hypothesized causal pathway between child PFAS at nine years and lipids at nine years.

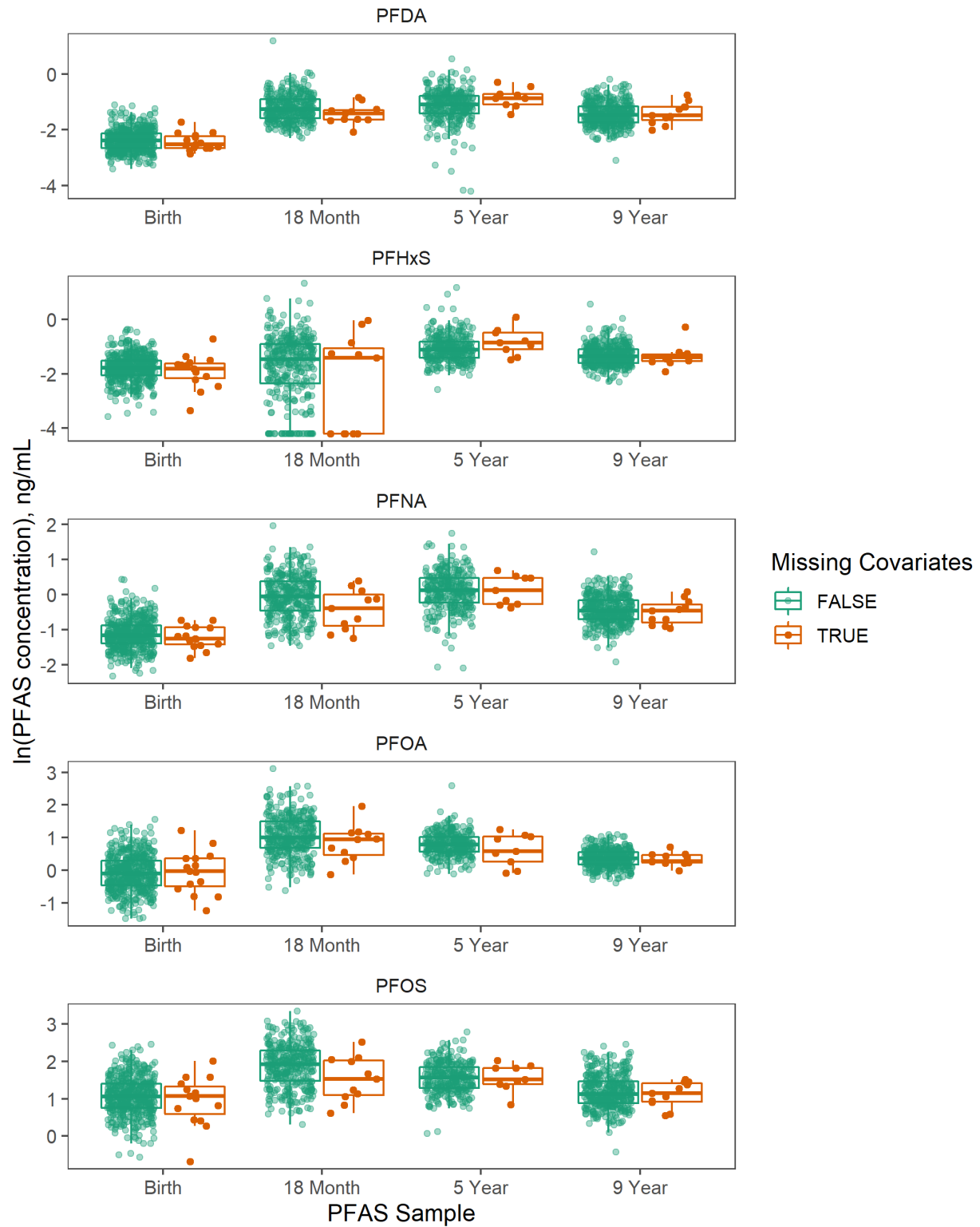


Figure S4: Distribution of PFASs for participants with and without missing covariate information.

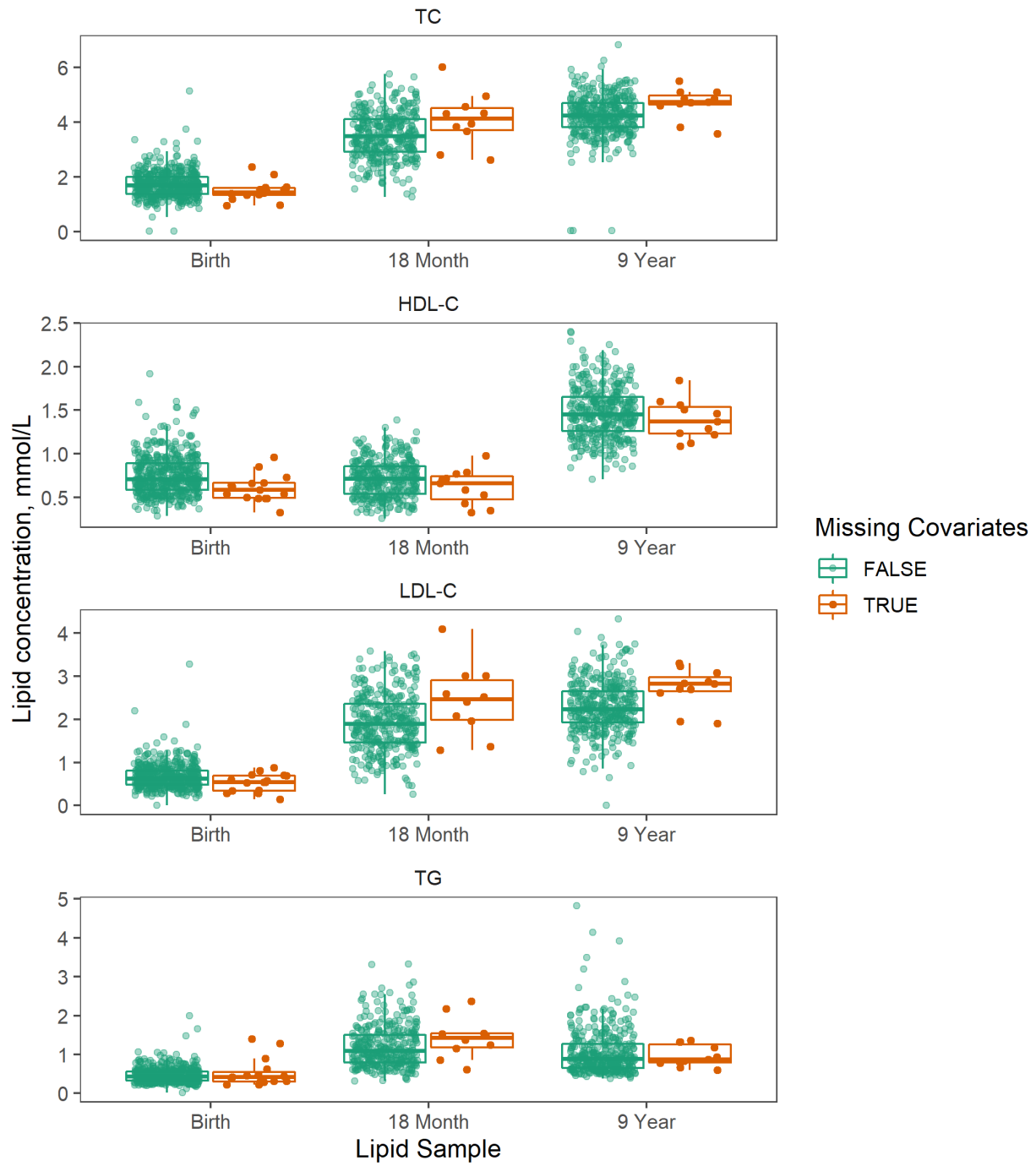


Figure S5: Distribution of lipids for participants with and without missing covariate information.

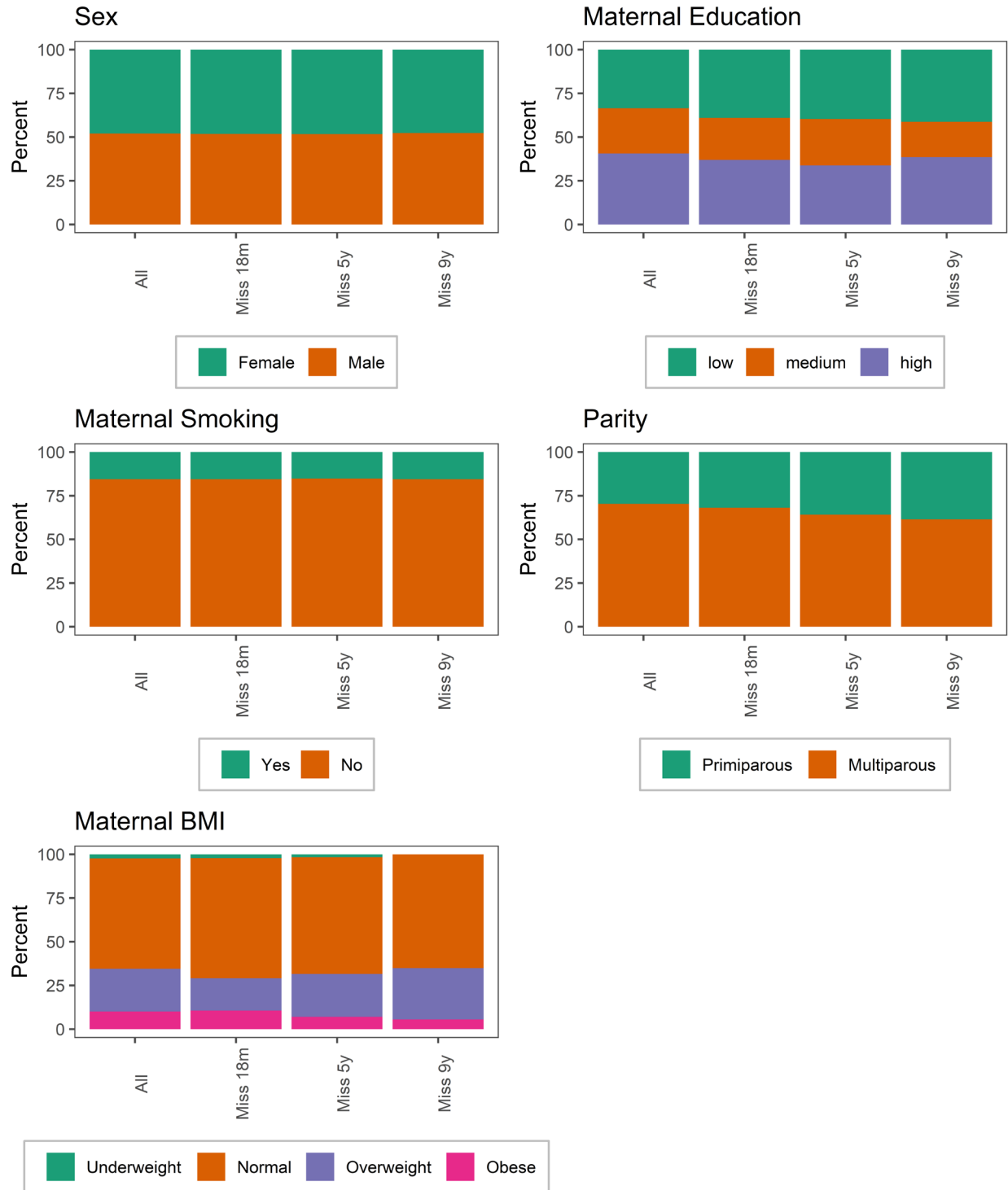


Figure S6: Baseline covariate distribution for the study population (n = 475) and participants who miss follow-up at 18 months (n = 141), 5 years (n = 184) and 9 years (n = 109).

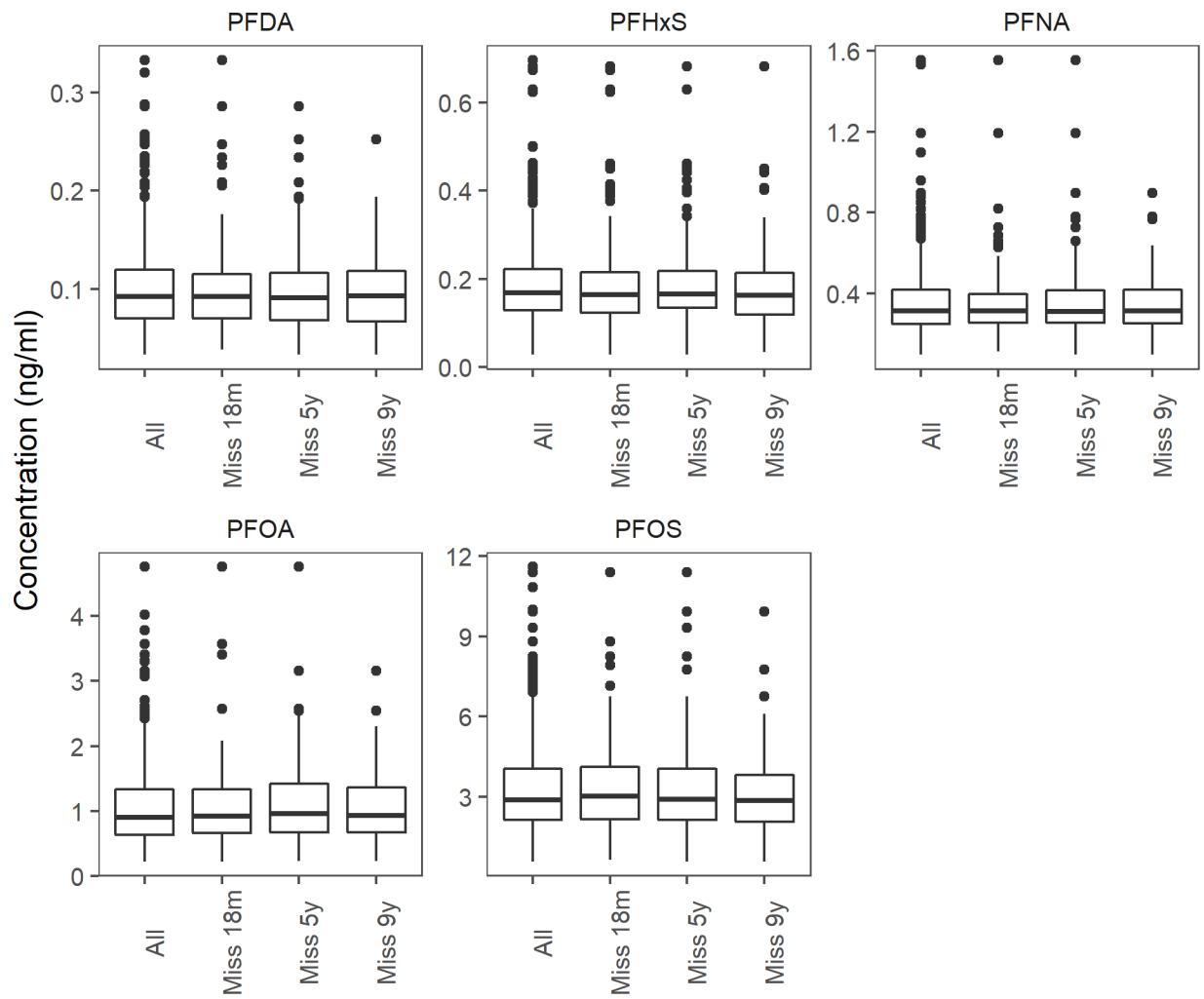
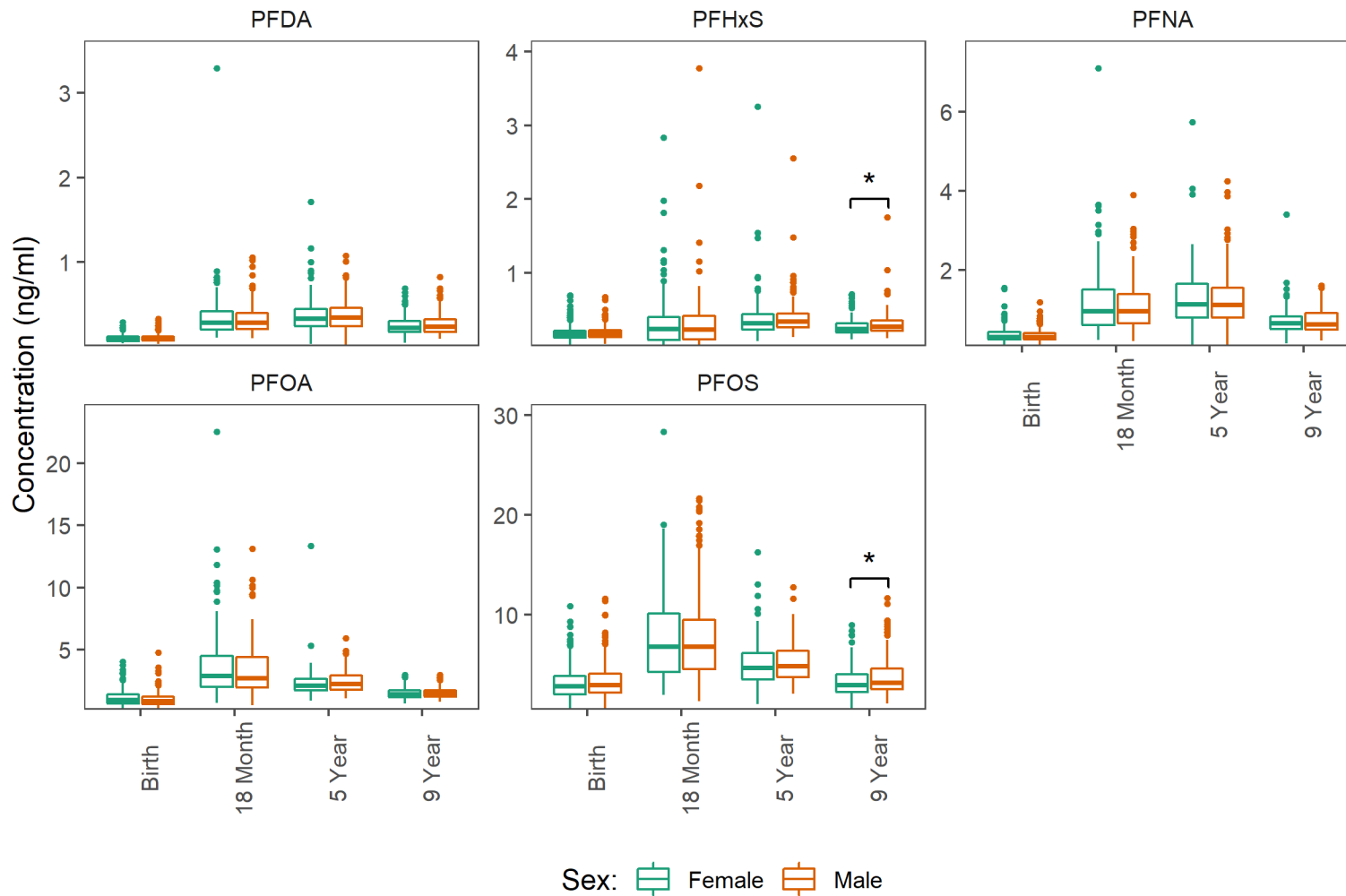


Figure S7: Cord blood PFAS concentrations in the study population (n = 475) and participants who miss follow-up at 18 months (n = 141), 5 years (n = 184) and 9 years (n = 109).



* p-value < 0.05 from Wilcoxon rank-sum test.

Figure S8: Distribution of serum PFAS concentrations by visit and sex.

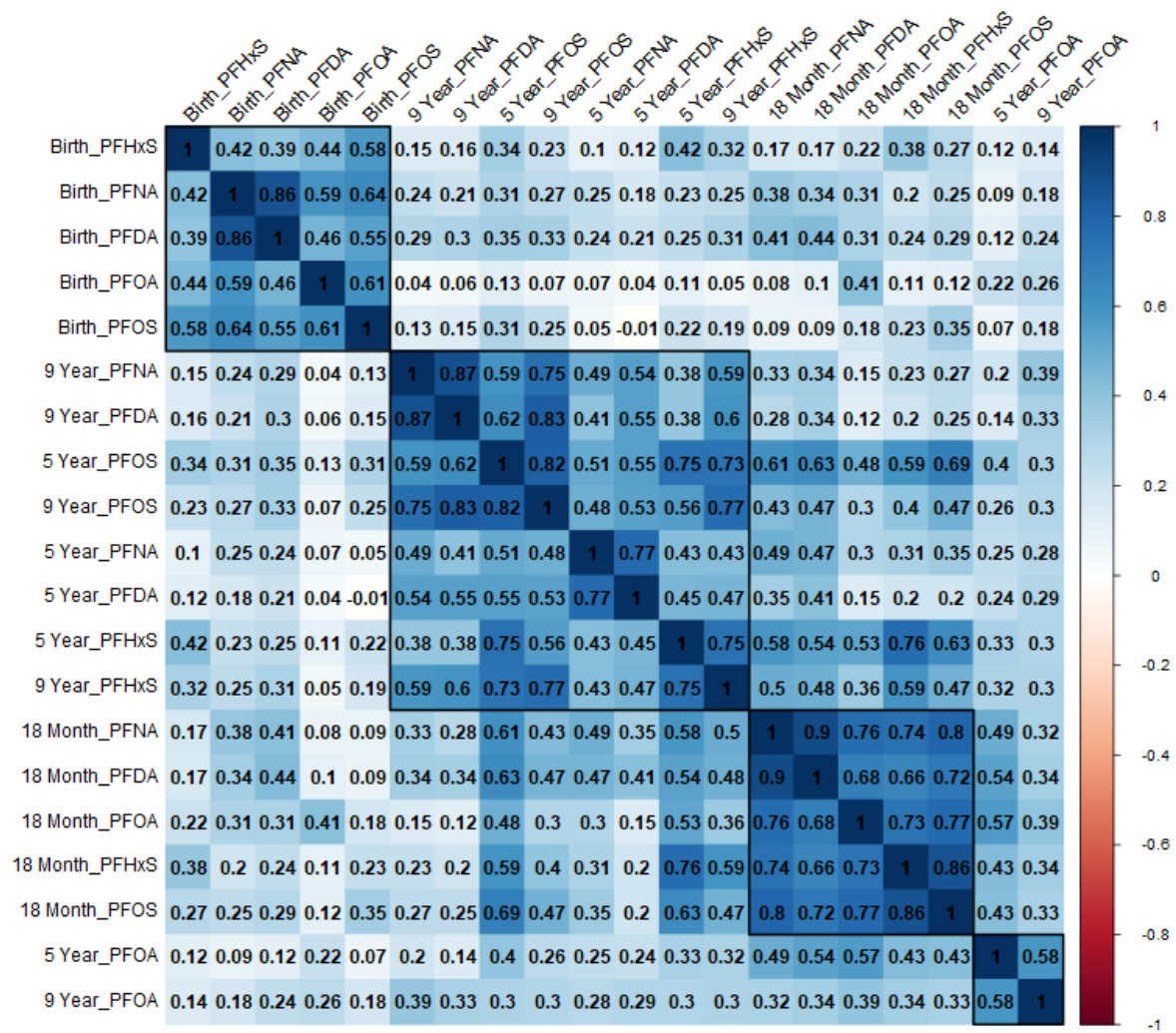


Figure S9: Correlations of PFAS within and across visits.

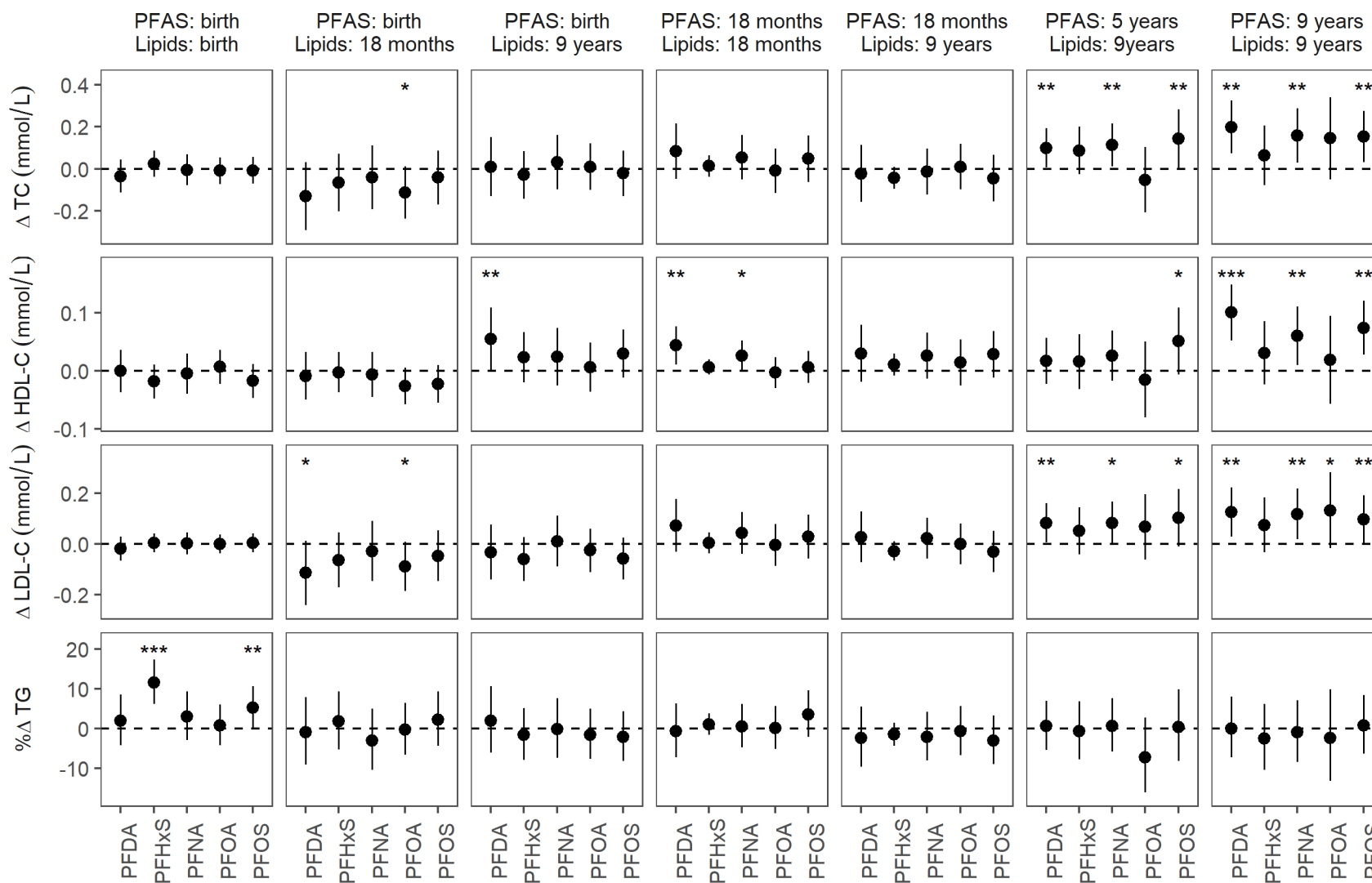
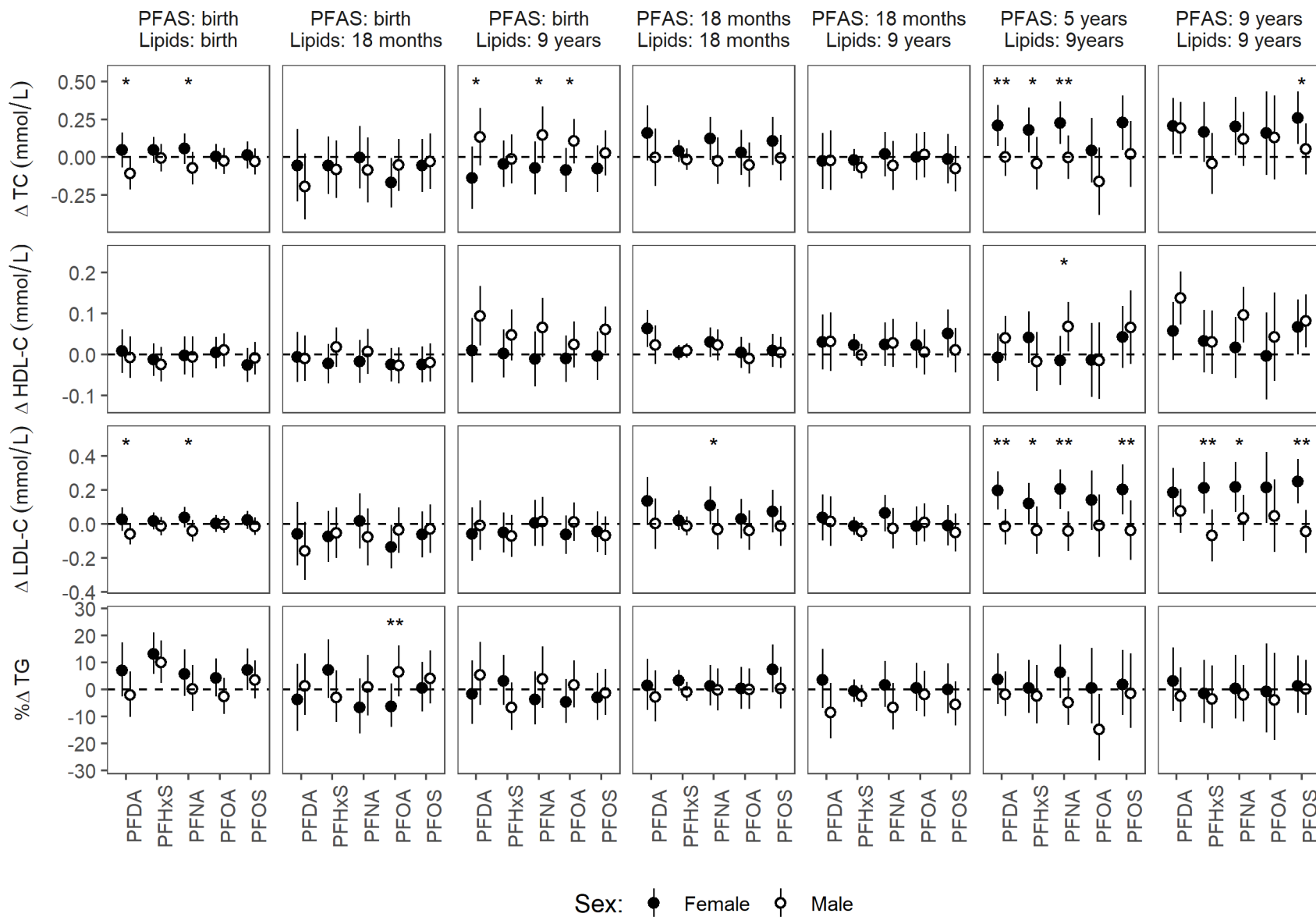


Figure S10: Associations between PFAS exposures and lipids, presented as the estimated change in serum lipid concentrations for a doubling in serum PFAS concentrations. All models were adjusted for child sex and maternal education. Models for PFAS at birth, 18 months and 5 years were further adjusted for smoking, education, parity, and pre-pregnancy BMI.



* p-interaction < 0.01; ** p-interaction < 0.05

Figure S11: Associations between PFASs and lipids by sex, calculated from a model that includes an interaction term between PFAS and sex.

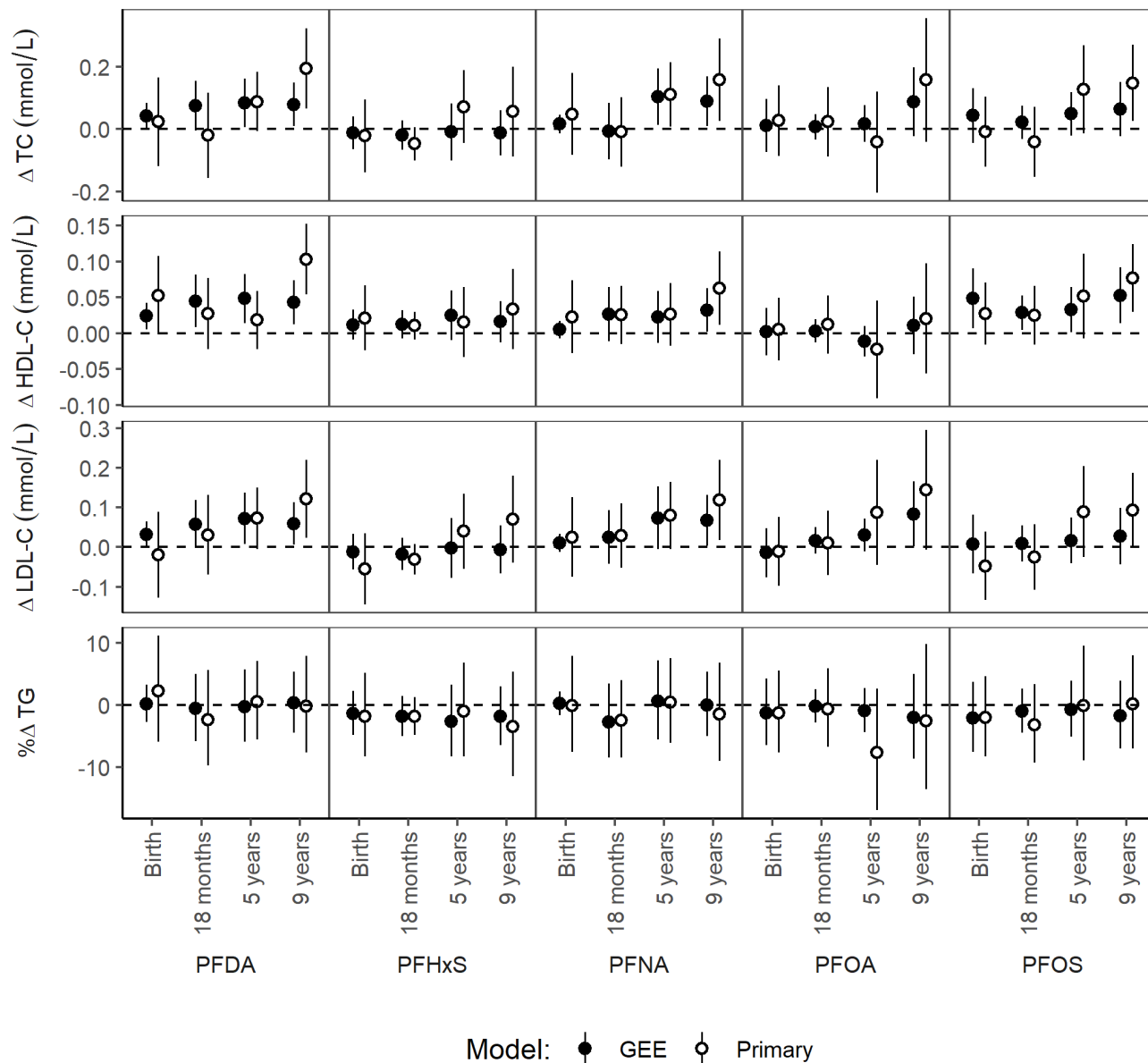


Figure S12: GEE model results for associations between PFAS exposures and lipid outcomes at nine years, compared to primary model results. Results are presented as the estimated difference in serum lipid concentrations for a doubling in serum PFAS concentrations. GEE models were adjusted for child sex, maternal education, smoking, education, parity and pre-pregnancy BMI.

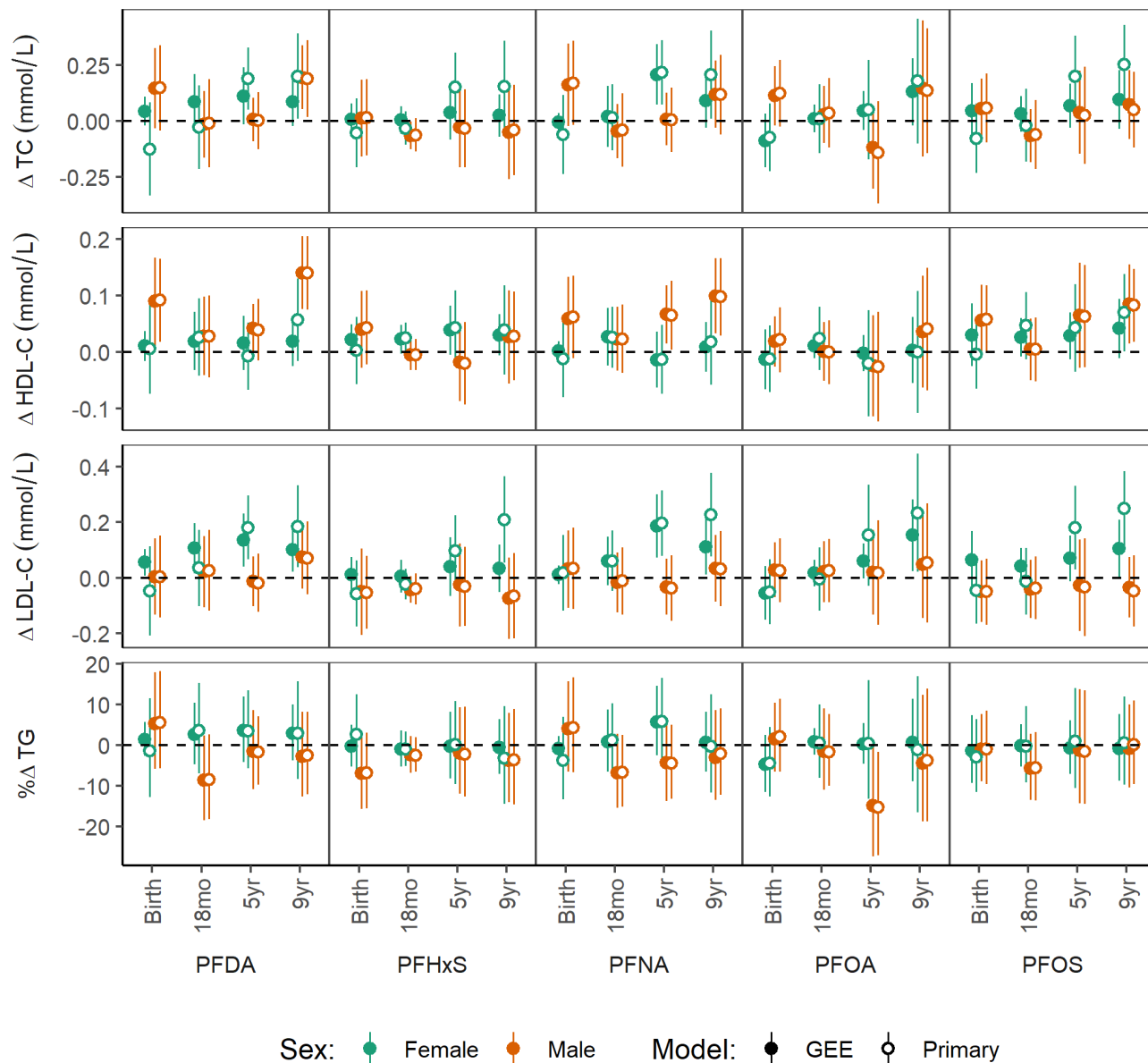


Figure S13: GEE model results for sex-specific associations between PFAS exposures and lipid outcomes at nine years, compared to primary model results. Results are presented as the estimated difference in serum lipid concentrations for a doubling in serum PFAS concentrations. GEE models were adjusted for maternal education, smoking, education, parity and pre-pregnancy BMI.

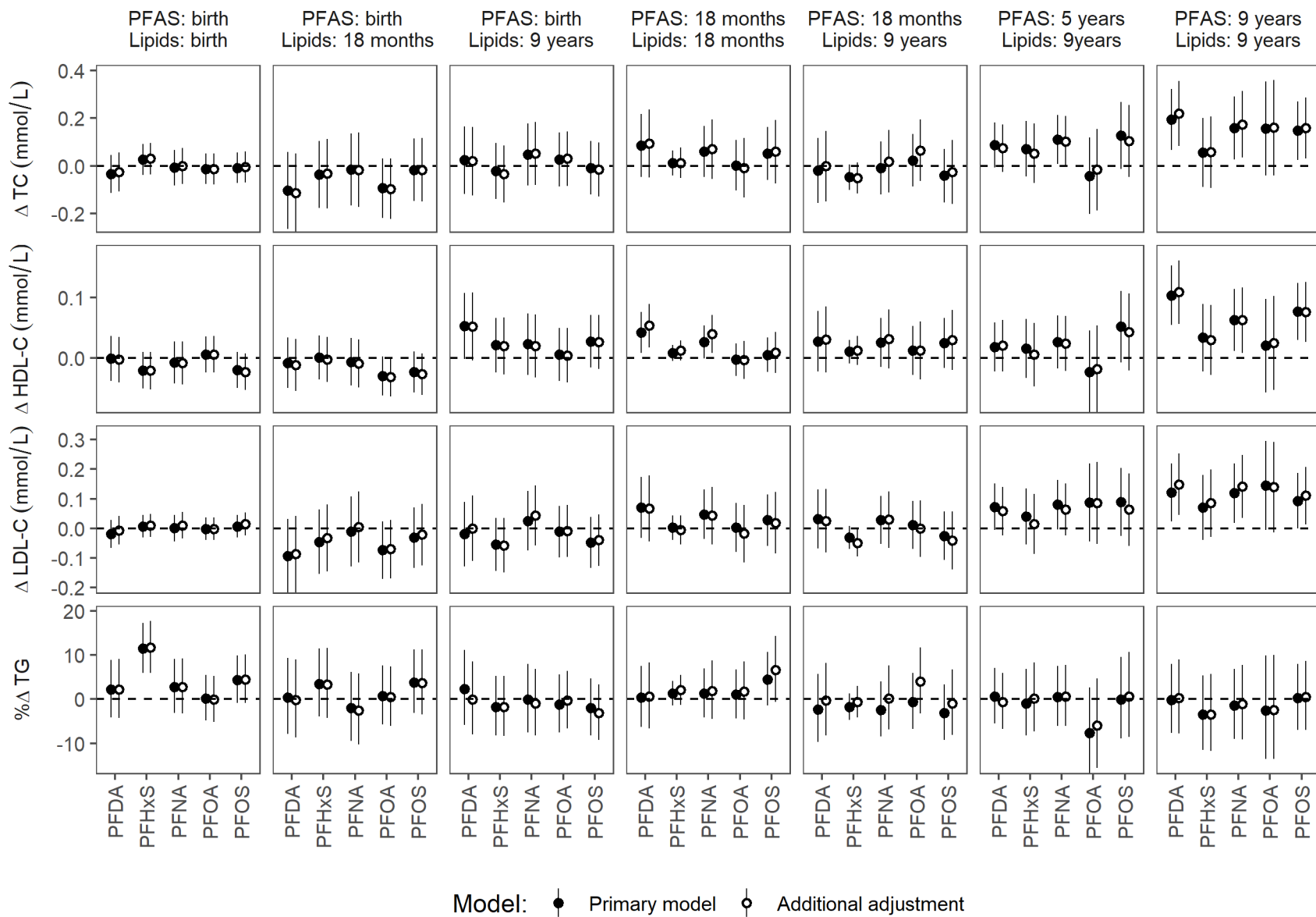


Figure S14: Estimated change in serum lipid concentrations for a doubling in serum PFAS concentrations, with and without additional adjustment for PFAS sources (maternal whale consumption during pregnancy, breastfeed duration and childhood whale consumption)

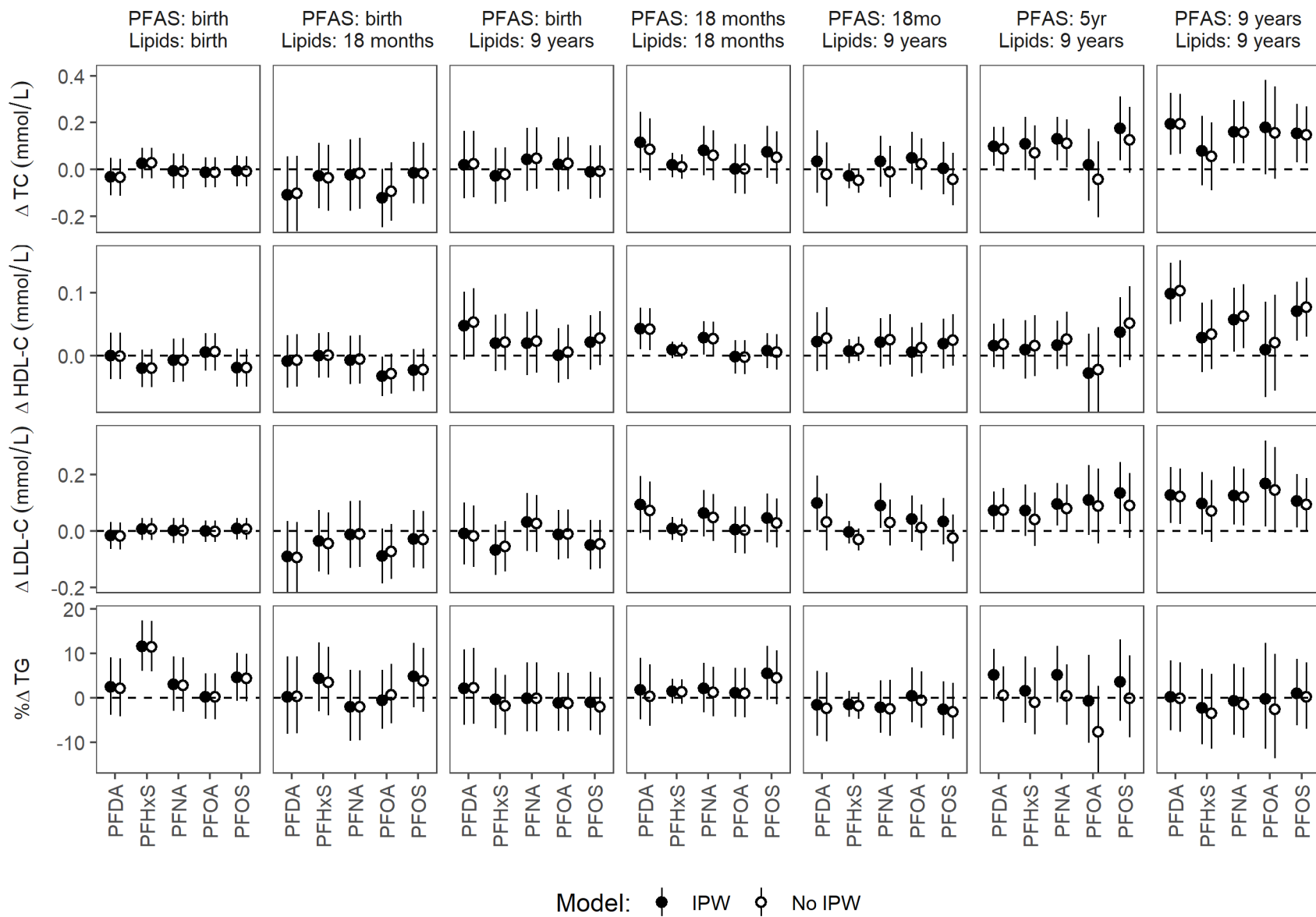


Figure S15: Estimated difference in serum lipid concentrations for a doubling in serum PFAS concentrations, with and without inclusion of stabilized inverse probability weights (IPW) to account for potential loss to follow-up.

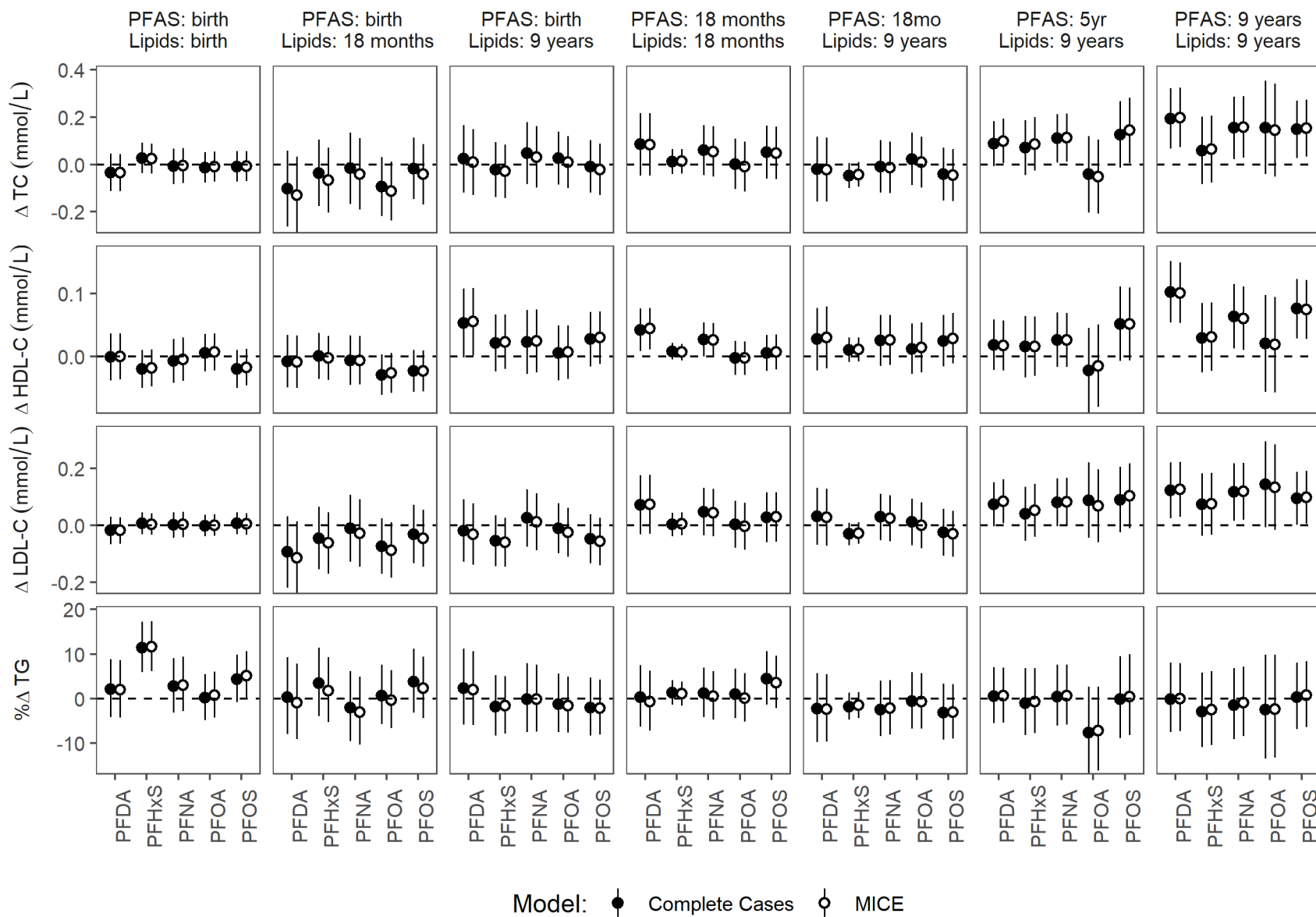


Figure S16: Estimated change in serum lipid concentrations for a doubling in serum PFAS concentrations, estimated using complete cases and our imputed datasets.

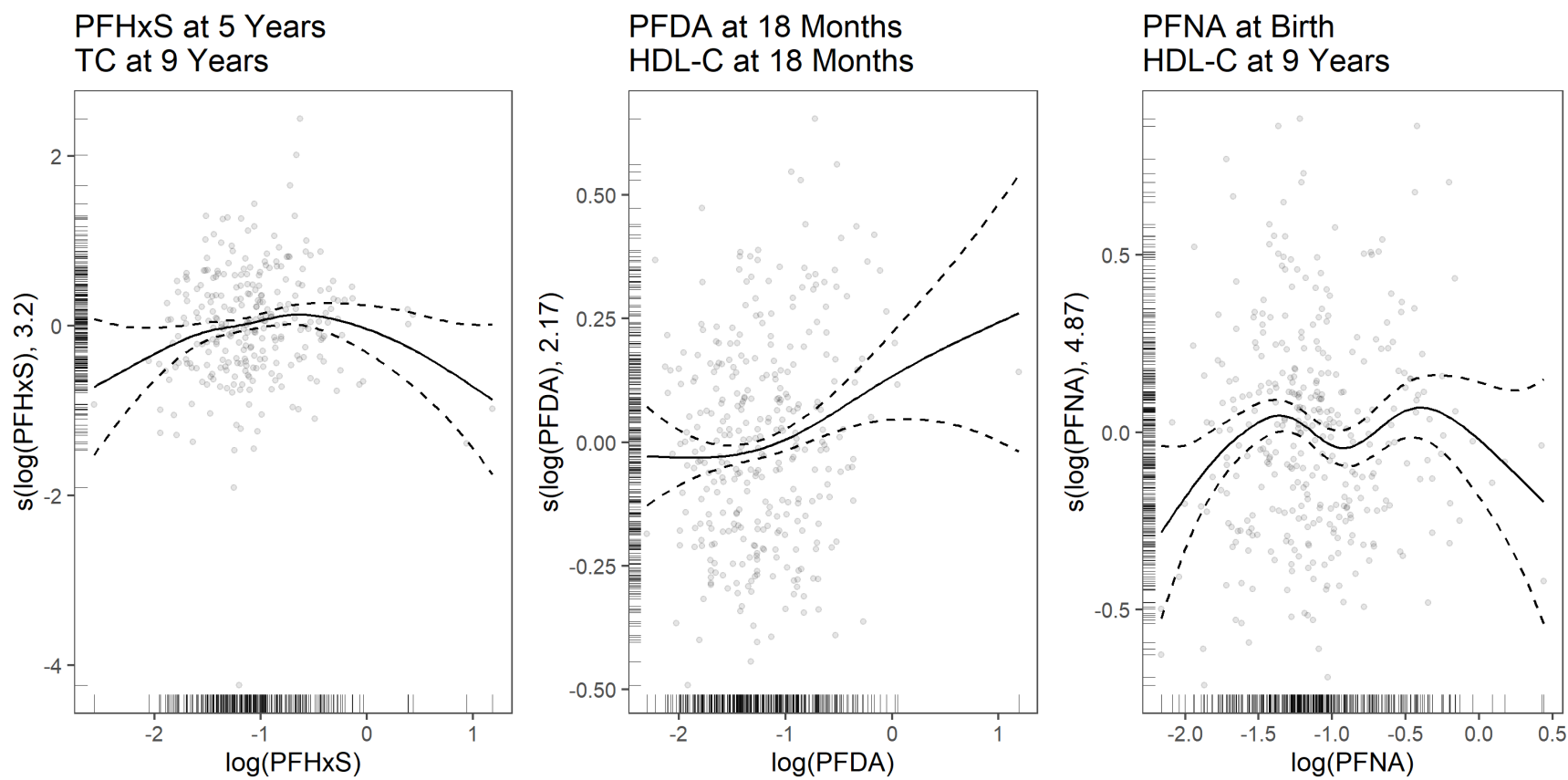


Figure S17: Estimated thin-plate splines for significant nonlinear PFAS terms.