

Changes in serum concentrations of maternal poly- and perfluoroalkyl substances over the course of pregnancy and predictors of exposure in a multiethnic cohort of Cincinnati, Ohio pregnant women during 2003–2006

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SUPPORTING INFORMATION

Table S1. Median concentrations ($\mu\text{g/L}$) of PFASs and frequency of detection for maternal sera (at each collection point) and cord sera.^a

Analyte	Maternal, 16 weeks (N=182) [Frequency of detection, %]	Maternal, birth (N=78) [Frequency of detection, %]	Infant, cord (n=202) [Frequency of detection, %]
Et-PFOSA-ACOH	<LOD [27.5]	<LOD [10.3]	<LOD [21.3]
Me-PFOSA-ACOH	0.50 [99.5]	0.2 [89.7]	0.3 [92.1]
PFOSA	<LOD [1.0]	<LOD [0]	<LOD [4.5]
PFHxS	1.50 [99.5]	1.1 [93.6]	0.7 [99.0]
PFOS	14.25 [100.0]	8.6 [100.0]	4.25 [99.5]
PFOA	5.35 [100.0]	3.5 [100.0]	3.3 [100.0]
PFNA	0.82 [100.0]	0.66 [100.0]	0.33 [99.5]
PFDeA	0.20 [96.2]	0.20 [90.0]	<LOD [13.4]

^aThe limits of detection (LODs) were 0.087 $\mu\text{g/L}$ (Me-PFOSA-AcOH), 0.082 $\mu\text{g/L}$ (PFNA), 0.1 $\mu\text{g/L}$ (PFHxS, PFOA, PFDeA, PFOSA, Et-PFOSA-AcOH), and 0.2 $\mu\text{g/L}$ (PFOS).

Table S2. Geometric mean serum concentrations (in µg/L) for select PFASs for 71 paired samples.^a

		GM (95% Confidence interval)
Me-PFOSA-AcOH	Maternal, 16 weeks	0.49 (0.42-0.58)
	Maternal, delivery	0.25 (0.21-0.29)
	Infant, cord	0.27 (0.23-0.32)
PFHxS	Maternal, 16 weeks	1.33 (1.11-1.58)
	Maternal, delivery	1.15 (0.96-1.37)
	Infant, cord	0.61 (0.51-0.73)
PFOS	Maternal, 16 weeks	11.57 (9.90-13.53)
	Maternal, delivery	8.20 (7.01-9.58)
	Infant, cord	3.32 (2.84 -3.89)
PFOA	Maternal, 16 weeks	4.91 (4.32-5.59)
	Maternal, delivery	3.43 (3.01-3.90)
	Infant, cord	2.85 (2.51-3.24)
PFNA	Maternal, 16 weeks	0.99 (0.90-1.1)
	Maternal, delivery	0.76 (0.69-0.85)
	Infant, cord	0.49 (0.44-0.54)

^a Selected PFASs were those detected in >60% of samples at all time points.

Table S3. Geometric means of serum concentration ratios for select PFASs for 71 paired samples.^a

Geometric mean of concentration ratios (95 % Confidence interval)			
Analyte	Maternal at 16 weeks/Maternal at delivery	Maternal at delivery/Cord	Maternal at 16 weeks/Cord
Me-PFOA-AcOH	2.10 (1.92 ,2.30)	0.90 (0.83 ,0.99)	1.90 (1.74 ,2.08)
PFHxS	1.26 (1.14 ,1.40)	1.70 (1.54 ,1.89)	2.15 (1.94 ,2.38)
PFOS	1.41 (1.33 ,1.50)	2.47 (2.32 ,2.63)	3.49 (3.28 ,3.71)
PFOA	1.43 (1.37 ,1.50)	1.20 (1.15 ,1.26)	1.72 (1.65 ,1.80)
PFNA	1.30 (1.23 ,1.38)	1.56 (1.47 ,1.65)	2.03 (1.92 ,2.15)

^a Selected PFASs were those detected in >60% of samples at all time points.

Table S4. Percent change of geometric mean serum concentration for select PFASs for 71 paired samples.^a

Percent change of geometric mean concentrations (95% Confidence Interval)			
Analyte	Maternal at 16 wks vs delivery	Maternal at delivery vs cord	Maternal at 16 wks vs cord
MePFOSA-AcOH	-110.37 (-92.28,-130.15)	9.52 (17.3,1.01)	-90.34 (-73.98,-108.24)
PFHxS	-26.11 (-13.97,-39.54)	-70.41 (-54.01,-88.56)	-114.91 (-94.23,-137.8)
PFOS	-41.21 (-32.89,-50.04)	-147.04 (-132.49,-162.5)	-248.83 (-228.28,-270.66)
PFOA	-43.31 (-36.89,-50.03)	-20.26 (-14.87,-25.9)	-72.34 (-64.62,-80.42)
PFNA	-30.23 (-23.01,-37.86)	-55.83 (-47.2,-64.96)	-102.93 (-91.69,-114.83)

^a Selected PFASs were those detected in >60% of samples at all time points. Percent change between two concentrations = $[1-(\text{geometric mean}_1/\text{geometric mean}_2)]*100$. A negative change represents a decline

Table S5. Geometric mean concentrations of PFOS, PFOA, PFNA, PFHxS, and Me-PFOSA-AcOH in umbilical cord serum ($\mu\text{g/L}$) according to demographic, perinatal and lifestyle factors. ^a

Variables	N (%)	PFOS GM (95% CI)	GM ratio (95% CI)	PFOA GM (95% CI)	GM ratio (95% CI)	PFNA GM (95% CI)	GM ratio (95% CI)	PFHxS GM (95% CI)	GM ratio (95% CI)	Me-PFOSA-AcOH GM (95% CI)	GM ratio (95% CI)
Maternal Age (years)											
< 25	43 (21)	3.42 (2.83-4.14)	0.81 (0.65-1.01)	3.04 (2.57-3.6)	0.94 (0.78-1.15)	0.33 (0.29-0.38)	0.92 (0.79-1.08)	0.5 (0.41-0.62)	0.69 (0.54-0.88) ^b	0.32 (0.25-0.4)	1.25 (0.96-1.64)
> 35	31 (15)	5.18 (4.14-6.47)	1.23 (0.95-1.57)	4.32 (3.54-5.27)	1.34 (1.07-1.67) ^b	0.43 (0.37-0.51)	1.21 (1.01-1.45)	0.84 (0.66-1.08)	1.16 (0.87-1.53)	0.29 (0.22-0.39)	1.17 (0.86-1.59)
25-34	128(64)	4.22 (3.78-4.72)	Reference	3.23 (2.92-3.56)	Reference	0.36 (0.33-0.39)	Reference	0.73 (0.64-0.82)	Reference	0.25 (0.22-0.29)	Reference
Race											
Non-Hispanic black	61(31.5)	3.49 (2.97-4.1)	0.78 (0.65-0.95) ^b	3.49 (2.97-4.1)	0.78 (0.65-0.95) ^b	0.35 (0.31-0.39)	0.95 (0.83-1.09)	0.43 (0.36-0.5)	0.52 (0.43-0.64) ^b	0.28 (0.23-0.34)	1.08 (0.85-1.37)
Other	11(5.5)	5.31 (3.64-7.74)	1.19 (0.81-1.77)	5.31 (3.64-7.74)	1.19 (0.81-1.77)	0.44 (0.33-0.57)	1.2 (0.9-1.59)	1.12 (0.76-1.65)	1.36 (0.91-2.04)	0.34 (0.21-0.54)	1.31 (0.81-2.12)
non-Hispanic white	128 (64)	4.45 (3.98-4.97)	Reference	4.45 (3.98-4.97)	Reference	0.37 (0.34-0.4)	Reference	0.82 (0.73-0.92)	Reference	0.26 (0.23-0.3)	Reference
Household income											
< \$20,000	34 (17)	3.17 (2.56-3.93)	0.69 (0.52-0.9) ^b	2.75 (2.27-3.33)	0.76 (0.59-0.96)	0.3 (0.26-0.35)	0.83 (0.69-1.01)	0.43 (0.34-0.55)	0.53 (0.4-0.71) ^b	0.31 (0.24-0.41)	1.1 (0.79-1.53)
\$20,000- \$40,000	40 (20)	4.11 (3.38-5.01)	0.89 (0.69-1.15)	3.24 (2.71-3.87)	0.89 (0.71-1.12)	0.38 (0.33-0.44)	1.05 (0.88-1.26)	0.62 (0.5-0.77)	0.76 (0.58-1.01)	0.26 (0.2-0.33)	0.9 (0.66-1.23)
\$40,000- \$80,000	68 (34)	4.41 (3.79-5.14)	0.95 (0.76-1.19)	3.47 (3.03-3.97)	0.95 (0.78-1.17)	0.39 (0.35-0.44)	1.09 (0.93-1.28)	0.79 (0.67-0.93)	0.96 (0.76-1.23)	0.25 (0.2-0.3)	0.86 (0.66-1.13)
> \$80,000	58 (29)	4.62 (3.92-5.45)	Reference	3.64 (3.14-4.21)	Reference	0.36 (0.32-0.41)	Reference	0.82 (0.68-0.98)	Reference	0.28 (0.23-0.35)	Reference
BMI^c											
Obese ($\geq 30 \text{ Kg/m}^2$)	51 (25)	3.82 (3.19-4.56)	0.88 (0.7-1.11)	3.26 (2.78-3.82)	0.94 (0.76-1.15)	0.34 (0.3-0.39)	0.94 (0.8-1.1)	0.62 (0.51-0.75)	0.93 (0.72-1.19)	0.29 (0.23-0.36)	1.06 (0.8-1.39)
Overweight ($25- 29.9 \text{ Kg/m}^2$)	70 (35)	4.27 (3.67-4.97)	0.99 (0.8-1.21)	3.26 (2.85-3.73)	0.94 (0.78-1.13)	0.38 (0.34-0.42)	1.03 (0.89-1.19)	0.79 (0.67-0.94)	1.19 (0.95-1.5)	0.26 (0.21-0.31)	0.94 (0.73-1.21)
Normal ($< 24.9 \text{ Kg/m}^2$)	79 (39)	4.33 (3.75-4.99)	Reference	3.48 (3.07-3.96)	Reference	0.37 (0.33-0.41)	Reference	0.67 (0.57-0.78)	Reference	0.27 (0.23-0.32)	Reference
Breast feeding history											
Yes	82 (40)	3.58 (3.12-4.1)	0.77 (0.65-0.92) ^b	2.74 (2.43-3.09)	0.72 (0.62-0.84) ^b	0.35 (0.32-0.39)	0.94 (0.83-1.07)	0.6 (0.52-0.7)	0.8 (0.65-0.98) ^b	0.27 (0.23-0.32)	1 (0.81-1.25)
No	120 (60)	4.62 (4.13-5.18)	Reference	3.81 (3.45-4.21)	Reference	0.37 (0.34-0.4)	Reference	0.75 (0.66-0.86)	Reference	0.27 (0.23-0.31)	Reference
Education											
< 12 years	15 (7.5)	3.81 (2.75-5.29)	0.89 (0.63-1.26)	3.19 (2.38-4.28)	0.95 (0.7-1.29)	0.35 (0.28-0.45)	0.96 (0.75-1.22)	0.47 (0.33-0.68)	0.64 (0.44-0.94) ^b	0.3 (0.2-0.45)	1.18 (0.78-1.79)
12 years	27(13.5)	3.84 (3.01-4.9)	0.9 (0.69-1.17)	3.21 (2.58-3.99)	0.95 (0.75-1.21)	0.34 (0.29-0.41)	0.93 (0.77-1.12)	0.55 (0.42-0.72)	0.74 (0.55-1)	0.33 (0.25-0.45)	1.29 (0.94-1.78)
> 12 years	158 (79)	4.27 (3.86-4.72)	Reference	3.37 (3.08-3.69)	Reference	0.37 (0.34-0.4)	Reference	0.74 (0.66-0.83)	Reference	0.26 (0.23-0.29)	Reference

Gestational age											
preterm (< 37 weeks)	16 (8)	3.06 (2.24-4.19)	0.72 (0.52-0.99) ^b	2.72 (2.05-3.59)	0.8 (0.6-1.07)	0.3 (0.24-0.38)	0.81 (0.64-1.03)	0.55 (0.39-0.79)	0.79 (0.55-1.14)	0.34 (0.23-0.5)	1.3 (0.87-1.93)
Term (≥ 37 weeks)	186 (92)	4.28 (3.9-4.69)	Reference	3.39 (3.12-3.68)	Reference	0.37 (0.34-0.39)	Reference	0.7 (0.63-0.78)	Reference	0.26 (0.24-0.3)	Reference
Serum cotinine (µg/L)											
active smoker (≥3)	90 (44.5)	3.89 (2.89-5.23)	0.85 (0.61-1.17)	3.18 (2.44-4.15)	0.93 (0.69-1.24)	0.36 (0.29-0.44)	0.95 (0.75-1.19)	0.62 (0.45-0.87)	0.79 (0.55-1.14)	0.3 (0.21-0.43)	1.1 (0.74-1.64)
secondhand smoker (0.015-3)	94 (46.5)	3.85 (3.38-4.38)	0.84 (0.7-1.01)	3.27 (2.91-3.68)	0.95 (0.81-1.13)	0.35 (0.32-0.38)	0.93 (0.81-1.06)	0.62 (0.53-0.71)	0.79 (0.64-0.97) ^b	0.27 (0.23-0.31)	1 (0.79-1.25)
non smoker (<0.015)	18 (9)	4.59 (4.02-5.24)	Reference	3.43 (3.04-3.86)	Reference	0.38 (0.34-0.41)	Reference	0.78 (0.68-0.91)	Reference	0.27 (0.23-0.32)	Reference
Parity											
>1	52 (26)	4.01 (3.43-4.7)	0.75 (0.6-0.94) ^b	2.99 (2.58-3.48)	0.75 (0.62-0.9) ^b	0.35 (0.31-0.4)	0.92 (0.79-1.08)	0.61 (0.5-0.74)	0.77 (0.6-0.99) ^a	0.35 (0.28-0.44)	1.18 (0.9-1.55)
1	63 (31)	4.72 (4.13-5.39)	0.85 (0.69-1.05)	2.81 (2.45-3.22)	0.7 (0.58-0.84) ^b	0.35 (0.31-0.39)	0.92 (0.79-1.07)	0.62 (0.52-0.75)	0.79 (0.62-1) ^b	0.3 (0.25-0.36)	1 (0.78-1.29)
0	87 (43)	3.55 (2.98-4.22)	Reference	4.02 (3.58-4.51)	Reference	0.38 (0.34-0.42)	Reference	0.79 (0.68-0.92)	Reference	0.3 (0.25-0.35)	Reference

^a Ratios are the exponentiated beta coefficients from a linear regression model with the PFAS concentrations in cord serum as the outcome. Ratios represent the multiplicative difference in PFAS concentrations from the reference category. Thus, numeric estimates indicate that GM concentrations were higher (>1) or lower (<1) for the predictor (variable) in that category compared with the reference category. Each predictor was run in a separate model. ^bP <0.05. ^cWe excluded two underweight participants with BMI <18 Kg/m².