

# Supplementary Material

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## **Materials and methods**

### **Supplementary Text S1: Covariate collection and definitions**

During participant enrollment, key information was collected through questionnaires including: (1) general demographic characteristics (maternal age, educational attainment, monthly per capita household income, and pre-pregnancy BMI); (2) health and reproductive-related information (maternal medical history, obstetric history, and recent health status); and (3) lifestyle factors (movement behaviors, combustible tobacco utilization including passive exposure quantification, and ethanol consumption levels of both the pregnant woman and her spouse). At delivery, hospital records provided additional data on: (1) delivery information (parity and gestational age) and (2) neonatal outcomes (birth date, weight, sex, and perinatal outcomes). Potential adjustment variables were included based on biological considerations if they altered the effect estimate by >10%. We adjusted for maternal education attainment, maternal age, gestational age, parity, pre-pregnancy BMI, and pre-pregnancy passive smoking exposure ( $\geq 15$  minutes daily indoor secondhand smoke exposure in the three months before conception).

### **Supplementary Text S2: Maternal plasma PFAS detection**

#### **Chemicals and Reagents**

The 53 PFAS standards and 23 isotope internal standards used in this study were purchased from Wellington Laboratory (Canada), Alta Scientific Co., Ltd. (China), Tan-Mo Technology Co., Ltd. (China), ANPEL Laboratory Technologies (Shanghai) Inc. (China) and AccuStandard (USA), respectively. All solvents and reagents, including tertbutyl ammonium hydrogen sulfate (TBAHS), sodium carbonate ( $\text{Na}_2\text{CO}_3$ ), ammonium acetate, methyl-tert-butyl ether (MTBE), acetonitrile, methanol, were of high-

performance liquid chromatography (HPLC) grade and purchased from Fisher Scientific (Waltham, MA, USA).

### **Sample pretreatment**

200  $\mu$ L of plasma was spiked with 2 ng of internal standards, followed by the addition of 0.4 mL TBAHS (pH=10) and 1 mL of 0.5 M NaCO<sub>3</sub>. The mixture was extracted with 2 mL of MTBE, then vortexed and shake for 40 min. After centrifuged for 5 min at 3800 $\times$ g at 4 $^{\circ}$ C, the supernatant was transferred into a new tube. The precipitation was redissolved with another 2 mL of MTBE and extracted again. The combined 4 mL of extract solution was concentrated with nitrogen at 35 $^{\circ}$ C and diluted to 200  $\mu$ L of acetonitrile. The extractants were subsequently measured using high-performance liquid chromatography-triple quadrupole mass spectrometry (HPLC-QqQ-MS/MS).

### **QA/QC**

Quantitative analysis of PFAS was performed using isotope-labeled internal standards. An 11-point standard curve (0.05 – 100.00 ng/mL) was employed for each target compound. All calibration curves for all analytes showed good linearity in the concentration range, with correlation coefficients ( $R^2$ )  $\geq$  0.99. Quality assurance measures included the insertion of procedural blanks and quality control samples after every 20 plasma samples. Procedural blank measurements demonstrated PFAS concentrations ranging from below detection limits to 0.148 ng/mL, representing levels significantly lower than those detected in study samples. All analyzed PFAS showed good inter-day precision (RSD <15%) across multiple batch measurements. Recovery tests (n=3) were conducted on matrix-spiked samples (10 ng/mL), with the recovery of the target PFAS ranging from 70 % to 114 % (Table S3). The limits of quantification

(LOQ) for target PFAS, established at a signal-to-noise ratio  $\geq 10$ , varied from 0.01 to 0.27 ng/mL.

**Supplementary Text S3: Inter-rater reliability**

To ensure standardized and blinded measurements, two trained physicians used a standardized caliper for AGD assessments, with each newborn measured only once. Inter-rater reliability, evaluated on a subset of 30 newborns, was moderate to good, with intraclass correlation coefficients (ICCs) ranging from 0.624 to 0.836 across the four AGD metrics ( $AGD_{AP}$ ,  $AGD_{AS}$ ,  $AGD_{AC}$ ,  $AGD_{AF}$ ).

**Supplementary Table S1.** Demographic characteristics of the study population

Characters	Eligible participants ( <i>n</i> = 375)
<b>Continuous variable</b>	Mean±SD
Maternal age (years)	28.08±4.36
Gestational age(weeks)	38.92±1.14
<b>Categorical variable</b>	N (%)
Parity	
0	162(42.97)
≥1	189(50.13)
Educational attainment	
Junior high school or below	135(35.81)
High school/Vocational diploma	87(23.08)
College/University or above	152(40.32)
Monthly per capita household income	
<4000	63(16.71)
4000~7999	139(36.07)
≥8000	65(17.24)
Pre-pregnancy BMI	
<18.5	53(14.06)
18.5~23.9	231(61.27)
≥24	54(14.32)
Pre-pregnancy passive smoking	
Yes	154(40.85)
No	120(31.83)
Newborns sex	
Boy	192(51.20)
Girl	183(48.80)

*Note:* Pregnant women were enrolled between September 2016 and April 2018; BMI, body mass index; SD, standard deviation. Missing data included parity (N=24), educational attainment (N=1), monthly per capita household income (N=108), pre-pregnancy BMI (N=37) and Pre-pregnancy passive smoking (N=101).

**Supplementary Table S2.** The analyte formula, acronym and optimum LC-MS/MS parameters for multiple reaction monitoring (MRM) acquisition conditions of individual PFAS

	Compound	Acronym	Corresponding IS	Formula	Precursor	Product ion <sup>a</sup>	Cone voltage	Collision energy	Cas number
PFCAs	Perfluorobutanoic acid	PFBA	MPFBA	C4HF7O2	213.00	<b>169</b>	-40	-11	375-22-4
	Perfluoropentanoic acid	PFPeA	MPFPeA	C5HF9O2	263.00	<b>219</b>	-20	-11	2706-90-3
	Perfluorohexanoic acid	PFHxA	MPFHxA	C6HF11O2	313.00	<b>269/119</b>	-35	-13/-26	307-24-4
	Perfluoroheptanoic acid	PFHpA	MPFHpA	C7HF13O2	363.00	<b>319/169</b>	-40	-15/-21	375-85-9
	Perfluorooctanoic acid	PFOA	MPFOA	C8HF15O2	413.00	<b>369/169</b>	-60	-25/-15	335-67-1
	Perfluorononanoic acid	PFNA	MPFNA	C9HF17O2	463.00	<b>419/219</b>	-20	-14/-23	375-95-1
	Perfluorodecanoic acid	PFDA	MPFDA	C10HF19O2	513.00	<b>469/219</b>	-20	-16/-24	335-76-2
	Perfluoroundecanoic acid	PFUnDA	MPFUA	C11HF21O2	563.00	<b>519/269</b>	-20	-19/-26	2058-94-8
	Sodium perfluoro-n-dodecanoate	PFDoDA	MPFDoA	C12HF23O2	613.00	<b>569/169</b>	-20	-19/-31	307-55-1
	Perfluorotridecanoic acid	PFTTrDA	MPFTeDA	C13HF25O2	663.00	<b>619/169</b>	-60	-17/-34	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	MPFTeDA	C14HF27O2	713.00	<b>669/169</b>	-20	-17/-34	376-06-7
	Perfluorohexadecanoic acid	PFHxDA	MPFOA	C16HF31O2	813.00	<b>769/169</b>	-20	-20/-35	67905-19-5
	Perfluorooctadecanoic acid	PFODA	MPFOA	C18HF35O2	913.00	<b>869/169</b>	-60	-22/-38	16517-11-6
	Sodium perfluoro-1-propanesulfonate	PFPrS	MPFBS	C3H2F7NaO3S	249.00	<b>80/99</b>	-60	-55/-33	359868-82-9
PFSAAs	Perfluorobutane sulfonic acid	PFBS	MPFBS	C4HF9O3S	299.00	<b>80/99</b>	-80/-40	-60/-48	375-73-5
	Perfluoropentane sulfonic acid	PFPeS	MPFBS	C5HF11O3S	349.00	<b>80</b>	-20	-80	630402-22-1
	Perfluorohexane sulfonic acid	PFHxS	MPFHxS	C6HF13O3S	399.00	<b>80/99</b>	-60/-20	-80/-80	355-46-4
	Perfluoroheptane sulfonic acid	PFHpS	MPFHxS	C7HF15O3S	449.00	<b>80/99</b>	-20/-80	-92/-81	21934-50-9
	Perfluorooctane sulfonic acid	PFOS	MPFOS	C8HF17O3S	499.00	<b>80/99</b>	-20	-100/-95	1763-23-1
	Perfluorononane sulfonic acid	PFNS	MPFOS	C9HF19O3S	549.00	<b>80/99</b>	-80	-100/-95	98789-57-2
	Perfluorodecane sulfonic acid	PFDS	MPFOS	C10HF21O3S	599.00	<b>80/99</b>	-20	-100/-100	335-77-3
	Perfluoroethylcyclohexane sulfonate	PFECHS	MPFHxS	C8HF15O3S	461.00	<b>381/99</b>	-60/-20	-38/-35	646-83-3

	Sodium bis(1H,1H,2H,2H-perfluorooctyl) phosphate	6:2 diPAP	M6:2 diPAP	C16H9F26O4P	789.00	<b>97/443</b>	-20	-85/-29	407582-79-0
PFPAs & PFPiAs	Sodium bis(1H,1H,2H,2H-perfluorodecyl) phosphate	8:2 diPAP	M8:2 diPAP	C20H9F34O4P	989.00	<b>97/543</b>	-40/-20	-104/-34	114519-85-6
	Sodium bis(perfluorohexyl)phosphinate	6:6 PFPi	M6:2 diPAP	C12HF26O2P	701.00	<b>401/63</b>	-20	-73/-170	70609-44-8
	Sodium perfluorohexyl(perfluorooctyl) phosphinate	6:8 PFPi	M6:2 diPAP	C14HF30O2P	801.00	<b>501/401</b>	-60	-77/-76	2361298-14-6
	Sodium bis(perfluorooctyl)phosphinate	8:8 PFPi	M6:2 diPAP	C16HF34O2P	901.00	<b>501/63</b>	-40	-83/-170	500776-69-2
FTSAs	4:2 Fluorotelomer sulfonic acid	4:2 FTS	M6:2 FTS	C6H5F9O3S	327.00	<b>307/81</b>	-20	-29/-52	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2 FTS	M6:2 FTS	C8H5F13O3S	427.00	<b>407/81</b>	-20	-34/-74	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2 FTS	M8:2 FTS	C10H5F17O3S	527.00	<b>507/81</b>	-20	-37/-100	39108-34-4
	10:2 Fluorotelomer sulfonic acid	10:2 FTS	M8:2 FTS	C12H5F21O3S	627.00	<b>607/81</b>	-20	-44/-95	120226-60-0
	2-Perfluorooctyl ethanoic acid (8:2)	8:2 FTCA	MPFOA	C10H3F17O2	477.00	<b>393/63</b>	-40/-20	-24/-11	27854-31-5
FTCAs & FTUCAs	6:2 Fluorotelomer unsaturatedcarboxylic acid	6:2 FTUCA	M6:2 FTUCA	C8H2F12O2	357.00	<b>293/243</b>	-40	-18/-46	70887-88-6
	8:2 Fluorotelomer unsaturatedcarboxylic acid	8:2 FTUCA	M8:2 FTUCA	C10H2F16O2	457.00	<b>393/343</b>	-20	-23/-52	70887-84-2
	10:2 Fluorotelomer unsaturatedcarboxylic acid	10:2 FTUCA	M10:2 FTUCA	C12H2F20O2	557.00	<b>493</b>	-20	-23	70887-94-4
FASAs & derivatives	Perfluorooctane sulfonamide	PFOSA	MPFOSA	C8H2F17NO2S	498.00	<b>78/478</b>	-30	-95/-38	754-91-6
	N-ethylperfluorooctanesulfonamide	N-EtFOSA	d3-N-MeFOSAA	C10H6F17NO2S	526.00	<b>169/219</b>	-40	-36/-34	4151-50-2
	N-Methyl perfluorooctane sulfonamido acetic acid	N-MeFOSAA	d3-N-MeFOSAA	C11H6F17NO4S	570.00	<b>419/219</b>	-40	-27/-38	2355-31-9
	N-Ethyl perfluorooctane sulfonamidoacetic acid	N-EtFOSAA	d3-N-MeFOSAA	C12H8F17NO4S	584.00	<b>419/219</b>	-40	-27/-35	2991-50-6

H-PFCAs	5H-Octafluoropentanoic acid	5H-PFPeA	MPFPeA	C5H2F8O2	245.00	<b>181</b>	-20	-15	376-72-7
	7H-Perfluoroheptanoic acid	7H-PFHpA	MPFHpA	C7H2F12O2	345.00	<b>281</b>	-20	-17	1546-95-8
	8H-Perfluorooctanoic acid	8H-PFOA	MPFOA	C8H2F14O2	395.00	<b>331</b>	-40	-17	13973-14-3
PFECAs	9H-Hexadecafluorononanoic acid	9H-PFNA	MPFNA	C9H2F16O2	445.00	<b>381/119</b>	-40	-20/-28	76-21-1
	Perfluoro(4-methoxybutanoic) acid	PFECA-A	MPFOA	C5HF9O3	279.00	<b>85</b>	-60	-13	863090-89-5
	Nonafluoro-3,6-dioxahheptanoic acid	PFECA-B	MPFOA	C5HF9O4	295.00	<b>201</b>	-20	-11	151772-58-6
	Perfluoro(3,6-dioxadecanoic) acid	PFECA-C	MPFOA	C8HF15O4	445.00	<b>351</b>	-22	-11	137780-69-9
	Perfluoro(3,6,9-trioxadecanoic) acid	PFECA-D	MPFHxS	C7HF13O5	411.00	<b>317</b>	-19	-10	151772-59-7
	Perfluoro(3,6,9-trioxatridecanoic) acid	PFECA-E	MPFOA	C10HF19O5	561.00	<b>467</b>	-33	-18	330562-41-9
	Perfluoro-3-Methoxypropanoic Acid	PFECA-F	MPFOA	C4HF7O3	229.00	<b>85</b>	-20	-22	377-73-1
	Hexafluoropropylene oxide dimer acid	HFPO-DA	MHFPO-DA	C6HF11O3	329.00	<b>169/185</b>	-20	-17/-32	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	MPFOA	C7H2F12O4	377.00	<b>251/85</b>	-20	-14/-34	919005-14-4
	6:2 Chlorinated perfluoroether sulfonic acid	6:2 Cl-PFESA	MPFOS	C8HCIF16O4S	531.00	<b>351/83</b>	-40	-36/-36	73606-19-6
PFESAs	8:2 Chlorinated perfluoroethersulfonic acid	8:2 Cl-PFESA	MPFOS	C10HCIF20O4S	631.00	<b>451/83</b>	-60	-41/-91	83329-89-9
	Sodium Perfluoro[1,2- <sup>13</sup> C <sub>2</sub> ] dodecanate	MPFD <sub>o</sub> A		[13]C <sub>2</sub> C <sub>10</sub> HF <sub>23</sub> O <sub>2</sub>	615.00	<b>570</b>	-60	-21	960315-52-0
	Heptafluoro [1,2,3,4- <sup>13</sup> C <sub>4</sub> ] butyric acid	MPFBA		[13]C <sub>4</sub> HF <sub>7</sub> O <sub>2</sub>	217.00	<b>172</b>	-20	-14	1017281-29-6

	Perfluoro [1,2- <sup>13</sup> C <sub>2</sub> ] hexanoic acid	MPFH <sub>x</sub> A	[ <sup>13</sup> C] <sub>2</sub> C <sub>4</sub> HF <sub>11</sub> O <sub>2</sub>	315.00	<b>270</b>	-20	-13	960315-47-3
	Perfluoro [ <sup>18</sup> O <sub>2</sub> ] hexane sulfonic acid	MPFH <sub>x</sub> S	[ <sup>18</sup> O] <sub>2</sub> C <sub>6</sub> HF <sub>13</sub> O <sub>3</sub> Na	403.00	<b>84</b>	-50	-85	1585941-14-5
	Perfluoro [1,2,3,4- <sup>13</sup> C <sub>4</sub> ] octanoic acid	MPFOA	[ <sup>13</sup> C] <sub>4</sub> C <sub>4</sub> HF <sub>15</sub> O <sub>2</sub>	417.00	<b>372</b>	-20	-13	960315-48-4
	Perfluoro [1,2,3,4- <sup>13</sup> C <sub>4</sub> ] octanesulphonic acid	MPFOS	[ <sup>13</sup> C] <sub>4</sub> C <sub>4</sub> F <sub>17</sub> O <sub>3</sub> Na	503.00	<b>80</b>	-60	-108	960315-53-1
	Perfluoro [1,2,3,4,5- <sup>13</sup> C <sub>5</sub> ] nonanoic acid	MPFNA	[ <sup>13</sup> C] <sub>5</sub> C <sub>4</sub> HF <sub>17</sub> O <sub>2</sub>	468.00	<b>423</b>	-60	-16	960315-49-5
Internal standards	Perfluoro [1,2- <sup>13</sup> C <sub>2</sub> ] decanoic acid	MPFDA	[ <sup>13</sup> C] <sub>2</sub> C <sub>8</sub> HF <sub>19</sub> O <sub>2</sub>	515.00	<b>470</b>	-50	-18	960315-50-8
	Perfluoro [1,2- <sup>13</sup> C <sub>2</sub> ] undecanoic acid	MPFUA	[ <sup>13</sup> C] <sub>2</sub> C <sub>9</sub> HF <sub>21</sub> O <sub>2</sub>	565.00	<b>520</b>	-20	-18	960315-51-9
	Perfluoro [1,2,3,4,5- <sup>13</sup> C <sub>5</sub> ] valeric acid	MPFP <sub>e</sub> A	[ <sup>13</sup> C] <sub>5</sub> HF <sub>9</sub> O <sub>2</sub> Na	268.00	<b>229</b>	-20	-12	2283397-79-3
	Perfluoro [1,2,3- <sup>13</sup> C <sub>3</sub> ] butanesulfonic acid sodium salt	MPFBS	[ <sup>13</sup> C] <sub>3</sub> CF <sub>9</sub> NaO <sub>3</sub> S	302.00	<b>80</b>	-33	-68	2708218-84-0
	Perfluoro [1,2,3,4- <sup>13</sup> C <sub>4</sub> ] heptanoic acid (IS)	MPFH <sub>p</sub> A	[ <sup>13</sup> C] <sub>4</sub> C <sub>3</sub> HF <sub>13</sub> O <sub>2</sub>	367.00	<b>323</b>	-40	-14	2328024-55-9

Perfluoro [1,2- <sup>13</sup> C <sub>2</sub> ] tetradecanoic acid	MPFTeDA	[13]C2C12HF27 O2	715.00	<b>670</b>	-40	-20	2708218-82-8
1H,1H,2H,2H-perfluoro [1,2- <sup>13</sup> C <sub>2</sub> ] octane sulfonate sodium salt	M6:2FTS	[13]C2C6H4F13 NaO3S	429.00	<b>409</b>	-60	-34	27619-94-9
Sodium 1H,1H,2H,2H-perfluoro [1,2- <sup>13</sup> C <sub>2</sub> ] decane sulfonate	M8:2FTS	[13]C2C8H5F17 O3SNa	529.00	<b>509</b>	-116	-40	27619-96-1
Perfluoro [1,2,3,4,5,6,7,8- <sup>13</sup> C <sub>8</sub> ] octanesulfonamide	MPFOSA	[13]C8H2F17NO 2S	506.00	<b>78</b>	-115	-88	1365803-60-6
N-Methylperfluorooctanesulfonamidoacetic acid-d3	d3-N-MeFOSAA	C11D3H3F17NO 4S	573.00	<b>419</b>	-100	-31	1400690-70-1
Perfluoro[1,2,3- <sup>13</sup> C <sub>3</sub> ]-2-(propyloxy)propionic acid	MHFPO-DA	[13]C3C3HF11O 3	287.00	<b>169</b>	-62	-11	13252-13-6
Sodium bis(1H,1H,2H,2H-[1,2,3,4- <sup>13</sup> C <sub>4</sub> ] perfluorooctyl)-phosphate	M6:2diPA P	[13]C4C12H9F2 6O4P	791.00	<b>97</b>	-35	-95	/
Sodium bis(1H,1H,2H,2H-[1,2,3,4- <sup>13</sup> C <sub>4</sub> ] perfluorodecyl)-phosphate	M8:2diPA P	[13]C4C16H8F3 4O4P	993.00	<b>545</b>	-30	-35	/
6:2 Fluoro [1,2- <sup>13</sup> C <sub>2</sub> ] telomer unsaturatedcarboxylic acid	M6:2FTUCA	[13]C2C6H2F12 O2	359.00	<b>294</b>	-25	-18	/
8:2 Fluoro [1,2- <sup>13</sup> C <sub>2</sub> ] telomer unsaturatedcarboxylic acid	M8:2 FTUCA	[13]C2C8H2F16 O2	459.00	<b>394</b>	-50	-23	/

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10:2 Fluoro [1,2- <sup>13</sup> C <sub>2</sub> ] telomer unsaturated carboxylic acid	M10:2FTU CA	[ <sup>13</sup> C <sub>2</sub> C <sub>10</sub> H <sub>2</sub> F <sub>2</sub> 002	559.00	<b>494</b>	-60	-21	/
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*Note.* <sup>a</sup>Product ions in bold are quantitative ions.

**Supplementary Table S3.** The calibration curve parameters, LODs, LOQs, procedural recoveries and matrix effects of 53 target analytes in plasma

Analytes	Calibration range (ng/ml)	Number of points	R <sup>2</sup>	LOD <sup>a</sup> (ng/mL)	LOQ <sup>b</sup> (ng/mL)	10 (ng/mL)	
						Recovery (%)	matrix effect (%)
PFBA	0.05-100	8-10	>0.99	0.08	0.27	91	101
PFPeA	0.05-100	8-10	>0.99	0.02	0.06	92	111
PFHxA	0.05-100	8-10	>0.99	0.01	0.03	89	120
PFHpA	0.05-100	8-10	>0.99	0.00	0.01	93	112
PFOA	0.05-100	8-10	>0.99	0.03	0.10	98	134
PFNA	0.05-100	8-10	>0.99	0.01	0.03	88	118
PFDA	0.05-100	8-10	>0.99	0.01	0.02	95	102
PFUnDA	0.05-100	8-10	>0.99	0.01	0.02	96	111
PFDoDA	0.05-100	8-10	>0.99	0.00	0.01	80	86
PFTTrDA	0.05-100	8-10	>0.99	0.00	0.01	103	83
PFTeDA	0.05-100	8-10	>0.99	0.01	0.03	95	102
PFHxDA	0.05-100	8-10	>0.99	0.03	0.10	80	75
PFODA	0.05-100	8-10	>0.99	0.06	0.20	107	52
PFPrS	0.05-100	8-10	>0.99	0.00	0.01	84	35
PFBS	0.05-100	8-10	>0.99	0.01	0.02	92	99
PFPeS	0.05-100	8-10	>0.99	0.00	0.01	87	86
PFHxS	0.05-100	8-10	>0.99	0.01	0.03	90	90
PFHpS	0.05-100	8-10	>0.99	0.00	0.01	90	104
PFOS	0.05-100	8-10	>0.99	0.01	0.04	87	101
PFNS	0.05-100	8-10	>0.99	0.01	0.03	94	101
PFDS	0.05-100	8-10	>0.99	0.01	0.02	104	77
PFECHS	0.05-100	8-10	>0.99	0.01	0.03	92	75
6:2 diPAP	0.05-100	8-10	>0.99	0.01	0.03	100	108
8:2 diPAP	0.05-100	8-10	>0.99	0.03	0.10	96	111
6:6 PFPiA	0.05-100	8-10	>0.99	0.00	0.01	73	62

6:8 PFPiA	0.05-100	8-10	>0.99	0.00	0.01	90	27
8:8 PFPiA	0.05-100	8-10	>0.99	0.01	0.03	84	29
4:2 FTS	0.05-100	8-10	>0.99	0.01	0.03	70	95
6:2 FTS	0.05-100	8-10	>0.99	0.01	0.03	102	92
8:2 FTS	0.05-100	8-10	>0.99	0.01	0.03	98	122
10:2 FTS	0.05-100	8-10	>0.99	0.01	0.02	96	105
8:2 FTCA	0.05-100	8-10	>0.99	0.05	0.18	100	62
6:2 FTUCA	0.05-100	8-10	>0.99	0.01	0.02	86	85
8:2 FTUCA	0.05-100	8-10	>0.99	0.01	0.03	88	86
10:2 FTUCA	0.05-100	8-10	>0.99	0.01	0.02	97	80
PFOSA	0.05-100	8-10	>0.99	0.01	0.03	89	96
EtFOSA	0.05-100	8-10	>0.99	0.02	0.05	109	105
MeFOSAA	0.05-100	8-10	>0.99	0.02	0.08	90	97
EtFOSAA	0.05-100	8-10	>0.99	0.02	0.07	78	97
5H-PFPeA	0.05-100	8-10	>0.99	0.07	0.22	114	27
7H-PFHpA	0.05-100	8-10	>0.99	0.01	0.03	77	50
8H-PFOA	0.05-100	8-10	>0.99	0.01	0.02	93	84
9H-PFNA	0.05-100	8-10	>0.99	0.01	0.02	95	29
PFECA-A	0.05-100	8-10	>0.99	0.01	0.02	104	89
PFECA-B	0.05-100	8-10	>0.99	0.03	0.11	78	42
PFECA-C	0.05-100	8-10	>0.99	0.00	0.01	78	61
PFECA-D	0.05-100	8-10	>0.99	0.01	0.03	74	54
PFECA-E	0.05-100	8-10	>0.99	0.01	0.03	71	102
PFECA-F	0.05-100	8-10	>0.99	0.02	0.07	111	62
HFPO-DA	0.05-100	8-10	>0.99	0.01	0.03	76	108
ADONA	0.05-100	8-10	>0.99	0.01	0.03	93	76
6:2 Cl-PFESA	0.05-100	8-10	>0.99	0.00	0.01	100	96
8:2 Cl-PFESA	0.05-100	8-10	>0.99	0.00	0.01	114	92

*Note.* <sup>a</sup> LOD:Limit of detection; <sup>b</sup> LOQ:Limit of quantification.

**Supplementary Table S4.** HPLC and MS-MS parameters

<b>Instrument</b>	LC-40D x3 (Nexera, Japan) coupled to Triple Quad™ 5500+ System - QTRAP® Ready (AB SCIEX, USA)			
<b>Trap column</b>	XBridge BEH C18 Column (2.1 mm × 50 mm, 3.5 μm, Waters, USA)			
<b>Analytical column</b>	AQUITY UPLC BEH C18 (2.1 mm × 100 mm, 1.7 μm, Waters, USA)			
<b>HPLC conditions</b>		<b>Solvent Gradient</b>		
Column temperature	40 °C	Time (min)	A (%)	B (%)
Flow rate	0.3 mL/min	0	80	20
Injection volume	3 μL	0.5	80	20
Post run	5 min	4	50	50
Autosampler Temperature	15 °C	12.5	5	95
Gradient A	2 mM ammonium acetate in Milli-Q water	14	1	99
Gradient B	Acetonitrile	17	1	99
		17.1	80	20
		22	80	20
<b>Spectrometry conditions</b>				
Source/Gas	Turbo Spray	Scan Type	Multiple reaction monitoring	
Curtain Gas (CUR)	35 psi	Ion source	Electrospray Ionization	
Collision Gas (CAD)	9 psi	Ionization mode	Negative ion mode	
IonSpray Voltage (IS)	-4500 °C			
Temperature (TEM)	450 °C			
Ion Source Gas1 (GS1)	55 psi			
Ion Source Gas2 (GS2)	55 psi			

**Supplementary Table S5.** Distribution of AGD in newborns

Indicators (mm)	N	Mean±SD	Percentiles				
			Min	25th	50th	75th	Max
AGD <sub>AP</sub>	192	47.02±5.72	21.60	44.00	47.80	50.00	64.50
AGD <sub>AC</sub>	183	34.59±5.14	20.40	31.30	33.70	37.70	52.00
AGD <sub>AS</sub>	192	20.92±4.62	9.80	17.90	20.50	23.88	36.70
AGD <sub>AF</sub>	183	12.58±3.56	6.20	10.10	11.80	14.40	25.00

**Note.** Pregnant women were enrolled between September 2016 and April 2018; SD, standard deviation. AGD<sub>AP</sub>, anopenile distance; AGD<sub>AS</sub>, anoscrotal distance; AGD<sub>AC</sub>, anoclititoris distance; AGD<sub>AF</sub>, anofourchette distance.

**Supplementary Table S6.** The detection rate and concentration distribution of PFAS in maternal plasma during pregnancy

PFAS	LOQ (ng/mL)	Detection rates (%)	Geometric Mean	Percentiles					
				5th	25th	50th	75th	95th	
Emerging PFAS	6:2di PAP	0.03	14	0.02	<LOQ	<LOQ	<LOQ	<LOQ	0.08
	4:2FTS	0.03	34	0.03	<LOQ	<LOQ	<LOQ	0.04	0.08
	6:2FTS	0.03	98	0.93	0.11	0.37	0.85	2.88	6.59
	HFPO-DA	0.03	89	0.23	<LOQ	0.07	0.21	0.81	1.91
	6:2Cl-PFESA	0.01	100	5.86	0.47	2.34	7.25	16.89	38.65
	8:2Cl-PFESA	0.01	85	0.13	<LOQ	0.04	0.18	0.50	1.19
	PFBA	0.27	76	0.58	<LOQ	0.27	0.52	1.23	2.66
	PFPeA	0.06	50	0.07	<LOQ	<LOQ	0.60	0.11	0.21
	PFHxA	0.03	50	0.03	<LOQ	<LOQ	<LOQ	0.06	0.11
	PFHpA	0.01	95	0.07	<LOQ	0.04	0.08	0.16	0.33
Legacy PFAS	PFOA	0.10	100	10.75	1.42	6.20	13.58	22.18	46.18
	PFNA	0.03	100	1.74	0.17	0.77	1.90	4.49	10.07
	PFDA	0.02	100	2.29	0.16	0.82	2.51	7.30	17.00
	PFUnDA	0.02	100	1.80	0.13	0.63	1.97	6.25	14.55
	PFDoDA	0.01	93	0.17	<LOQ	0.06	0.20	0.64	1.48
	PFTTrDA	0.01	95	0.22	<LOQ	0.08	0.25	0.73	1.70
	PFTeDA	0.03	47	0.04	<LOQ	<LOQ	<LOQ	0.07	0.15
	PFBS	0.02	91	0.05	<LOQ	0.03	0.05	0.09	0.17
	PFHxS	0.03	100	3.74	0.43	2.55	4.65	7.25	14.32
	PFHpS	0.01	97	0.07	0.01	0.04	0.08	0.14	0.30
PFOS	0.04	100	4.47	0.42	1.83	5.40	11.85	26.94	

*Note.* LOQ: Limit of quantification

**Supplementary Table S7.** Comparison of median maternal serum concentrations of individual PFAS compounds stratified by infant sex

Analytes	Male	Female	p-value
	N = 192	N = 183	
6.2FTS	0.86 (0.39, 3.17)	0.83 (0.35, 2.81)	0.445
HFPO-DA	0.20 (0.07, 1.00)	0.21 (0.07, 0.71)	0.659
6.2Cl-PFESA	9 (3, 18)	5 (2, 14)	<b>0.015</b>
8.2Cl-PFESA	0.22 (0.05, 0.57)	0.15 (0.04, 0.45)	0.104
PFBA	0.50 (0.29, 1.19)	0.55 (0.19, 1.25)	0.765
PFHpA	0.08 (0.04, 0.17)	0.07 (0.04, 0.14)	0.224
PFOA	14 (8, 23)	12 (5, 20)	<b>0.028</b>
PFNA	2.32 (1.00, 5.36)	1.64 (0.65, 3.95)	<b>0.01</b>
PFDA	3.4 (1.1, 8.6)	1.8 (0.7, 6.6)	<b>0.008</b>
PFUnDA	2.3 (0.8, 7.0)	1.5 (0.5, 5.0)	<b>0.009</b>
PFDoDA	0.23 (0.09, 0.70)	0.18 (0.05, 0.50)	0.06
PFTTrDA	0.29 (0.11, 0.80)	0.21 (0.06, 0.67)	<b>0.038</b>
PFBS	0.05 (0.03, 0.09)	0.05 (0.03, 0.09)	0.386
PFHxS	4.9 (3.1, 8.2)	4.4 (1.7, 6.9)	<b>0.018</b>
PFHpS	0.09 (0.04, 0.15)	0.07 (0.03, 0.13)	<b>0.025</b>
PFOS	6 (2, 14)	4 (1, 10)	<b>0.006</b>
Median (Q1, Q3)			
Wilcoxon rank sum test			

*Note.* Data are presented as median. Differences between groups were assessed using the Mann-Whitney U test.

**Supplementary Table S8.** Mann-Whitney U test comparing high and low PFAS exposure groups

Analytes	Low-exposure group			High-exposure group		
	Male (N=86)	Female (N=103)	p-value	Male (N=106)	Female (N=80)	p-value
6:2 Cl-PFESA	0.96 (0.26, 1.54)	0.80 (0.03, 1.48)	0.267	2.89 (2.41, 3.24)	2.80 (2.45, 3.25)	0.741
PFOA	1.98 (1.34, 2.40)	1.72 (0.70, 2.21)	0.034	3.09 (2.81, 3.48)	3.11 (2.81, 3.48)	0.853
PFNA	-0.15 (-0.60, 0.36)	-0.40 (-1.29, 0.11)	0.006	1.59 (1.17, 2.11)	1.42 (1.09, 1.89)	0.246
PFDA	-0.04 (-0.78, 0.41)	-0.22 (-1.16, 0.32)	0.163	2.00 (1.61, 2.69)	1.95 (1.59, 2.65)	0.845
PFUnDA	-0.41 (-1.12, 0.27)	-0.55 (-1.43, 0.05)	0.106	1.85 (1.31, 2.42)	1.76 (1.27, 2.43)	0.752
PFTTrDA	-2.36 (-3.20, -1.89)	-2.77 (-3.75, -1.95)	0.06	-0.36 (-0.71, 0.41)	-0.26 (-0.71, 0.41)	0.67
PFHxS	1.08 (0.23, 1.32)	0.76 (-0.38, 1.28)	0.129	2.03 (1.73, 2.51)	1.96 (1.71, 2.29)	0.31
PFHpS	-3.33 (-3.75, -2.94)	-3.37 (-3.97, -2.97)	0.352	-1.94 (-2.26, -1.33)	-2.01 (-2.26, -1.38)	0.611
PFOS	0.78 (0.18, 1.22)	0.48 (-0.15, 1.08)	0.097	2.58 (2.10, 3.04)	2.39 (2.09, 2.98)	0.465

Median (Q1, Q3)  
Wilcoxon rank sum test

*Note.* Data are presented as median. Differences between groups were assessed using the Mann-Whitney U test.

**Supplementary Table S9.** Associations between ln-transformed PFAS in maternal plasma and AGD in male (N = 192) and female (N = 183) infants using multivariate linear regression model

Model 1	AGD <sub>AP</sub> (male)		AGD <sub>AC</sub> (female)		AGD <sub>AS</sub> (male)		AGD <sub>AF</sub> (female)	
	$\beta$ (95% CI)	<i>p</i>	$\beta$ (95% CI)	<i>p</i>	$\beta$ (95% CI)	<i>p</i>	$\beta$ (95% CI)	<i>p</i>
6:2FTS	-0.609(-0.017,0.575)	0.945	0.066(-0.494,0.626)	0.817	0.021(-0.459,0.502)	0.93	0.217(-0.187,0.621)	0.291
HFPO-DA	-0.022(-0.567,0.523)	0.937	0.16(-0.352,0.672)	0.538	-0.07(-0.513,0.372)	0.755	0.058(-0.312,0.429)	0.757
8:2CI-PFESA	0.259(-0.247,0.765)	0.314	0.112(-0.35,0.574)	0.632	0.119(-0.293,0.531)	0.568	0.211(-0.121,0.574)	0.212
PFBA	-0.80(-1.893,0.292)	0.150	-0.352(-1.176,0.471)	0.40	0.666(-0.221,1.554)	0.140	-0.505(-1.097,0.088)	0.195
PFHpA	0.236(-0.558,1.029)	0.559	<b>0.809(0.079,1.539)</b>	<b>0.03</b>	-0.292(-0.936,0.352)	0.372	0.315(-0.218,0.849)	0.245
PFDoDA	0.519(-0.045,1.084)	0.071	0.129(-0.355,0.613)	0.599	0.044(-0.418,0.507)	0.850	0.167(-0.195,0.53)	0.364
PFBS	0.829(-0.328,1.986)	0.159	-0.121(-1.125,0.883)	0.812	0.223(-0.722,1.167)	0.642	0.396(-0.328,1.12)	0.282
<b>Model 2</b>								
6:2CI-PFESA	0.3(-0.923,1.522)	0.629	0.451(-0.439,1.341)	0.319	-0.027(-1.023,0.969)	0.957	0.418(-0.233,1.06)	0.199
PFOA	-0.31(-1.545,0.925)	0.621	0.394(-0.602,1.39)	0.436	-0.739(-1.741,0.264)	0.148	0.619(-0.093,1.332)	0.088
PFNA	0.156(-1.105,1.417)	0.808	0.141(-0.835,1.116)	0.776	-0.299(-1.332,0.734)	0.568	0.112(-0.585,0.810)	0.752
PFDA	0.605(-0.503,1.713)	0.283	0.346(-0.552,1.243)	0.448	-0.200(-1.107,0.707)	0.664	0.212(-0.431,0.856)	0.516
PFUnDA	0.987(-0.115,2.09)	0.179	0.605(-0.205,1.016)	0.618	0.487(-0.417,1.39)	0.289	0.25(-0.331,0.832)	0.397
PFTTrDA	<b>1.084(0.112,2.057)</b>	<b>0.029</b>	-0.028(-0.831,0.774)	0.944	-0.066(-0.866,0.735)	0.872	0.519(-0.057,1.094)	0.177
PFHxS	0.996(-0.306,2.298)	0.133	<b>1.608(0.668,2.548)</b>	<b>&lt;0.001</b>	0.087(-0.977,1.151)	0.872	<b>1.265(0.589,1.941)</b>	<b>&lt;0.001</b>
PFHpS	-0.181(-1.754,1.392)	0.821	0.429(-0.825,1.682)	0.501	-0.696(-1.955,0.564)	0.277	0.571(-0.332,1.473)	0.214
PFOS	0.762(-0.541,2.065)	0.25	0.305(-0.629,1.24)	0.52	-0.074(-1.138,0.989)	0.891	0.358(-0.313,1.029)	0.294

*Note.* Model 1 was adjusted for maternal age, gestational age, parity, educational attainment, pre-pregnancy BMI, pre-pregnancy passive smoking and birth weight. Model 2 was further adjusted for exposure level. CI, confidence interval; AGD<sub>AP</sub>, anopenile distance; AGD<sub>AS</sub>, anoscrotal distance; AGD<sub>AC</sub>, anoclititoris distance; AGD<sub>AF</sub>, anofourchette distance. \*  $p < 0.05$ , #  $0.05 < p < 0.1$ .

**Supplementary Table S10.** Threshold effect analysis of 6:2 Cl-PFESA, PFUnDA and PFOS on AGD<sub>AF</sub>

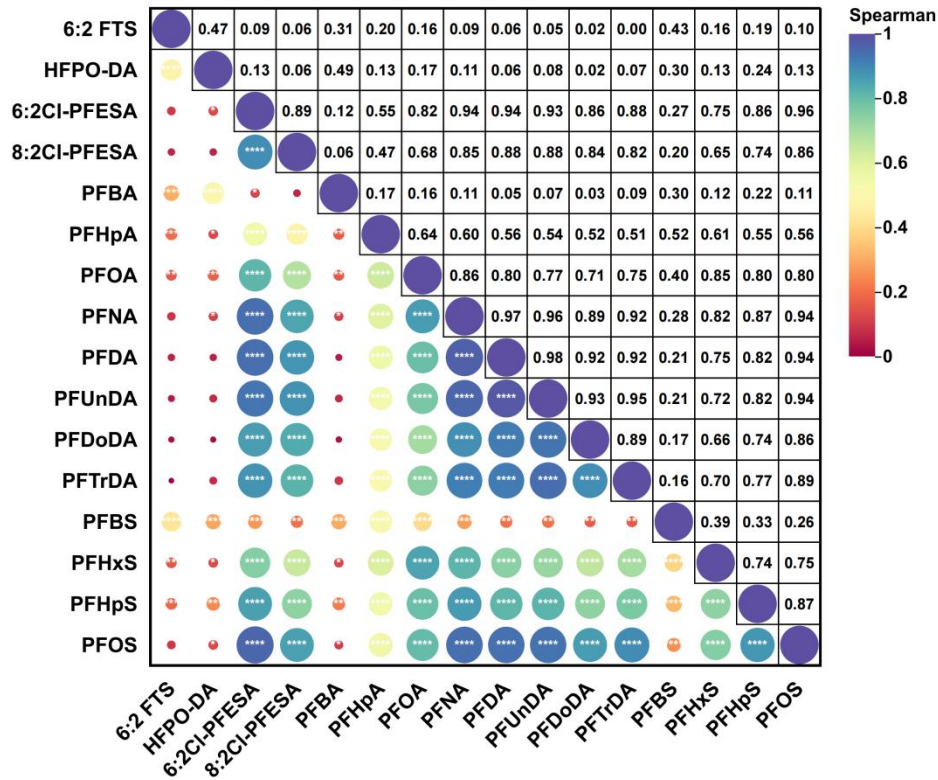
<b>6:2Cl-PFESA</b>	<b>β(95% CI)</b>	<b>p-value</b>
Fitting by standard Linear regression model	0.308(-0.096,0.712)	0.137
Fitting by Piecewise Linear regression model (break-point=1.649)		
6:2Cl-PFESA < 1.649	0.900(0.221,1.579)	<b>0.009</b>
6:2Cl-PFESA ≥ 1.649	-0.627(-1.580,0.327)	0.198
Log likelihood ratio		0.028
PFUnDA		
Fitting by standard Linear regression model	0.325(-0.037,0.687)	0.08
Fitting by Piecewise Linear regression model (break-point=0.415)		
PFUnDA < 0.415	0.850(0.215,1.484)	<b>0.009</b>
PFUnDA ≥ 0.415	-0.415(-1.236,0.406)	0.322
Log likelihood ratio		0.041
PFOS		
Fitting by standard Linear regression model	0.359(-0.060,0.779)	0.095
Fitting by Piecewise Linear regression model (break-point=1.429)		
PFOS < 1.429	1.036(0.326,1.745)	<b>0.004</b>
PFOS ≥ 1.429	-0.745(-1.772,0.283)	0.155
Log likelihood ratio		0.017

*Note.* Models were adjusted for maternal age, gestational age, parity, educational attainment, pre-pregnancy BMI, pre-pregnancy passive smoking and birth weight. PIP:posterior inclusion probability, AGD<sub>AP</sub>, anopenile distance; AGD<sub>AS</sub>, anoscrotal distance; AGD<sub>AC</sub>, anoclititoris distance; AGD<sub>AF</sub>, anofourchette distance.

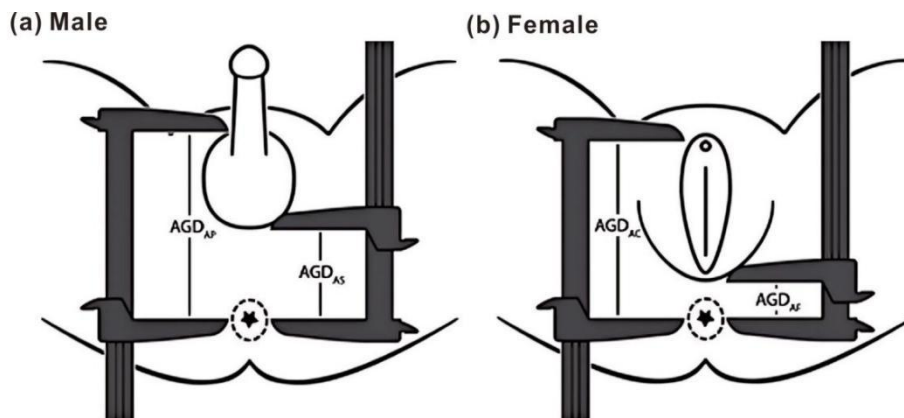
**Supplementary Table S11.** PIP in bayesian kernel machine regression models

<b>Chemicals</b>	<b>AGD<sub>AP</sub></b>	<b>AGD<sub>AC</sub></b>	<b>AGD<sub>AS</sub></b>	<b>AGD<sub>AF</sub></b>
PFOA	0.005	0.008	0	0.0462
PFHxS	0.0094	0.055	0.0046	0.122
PFHpS	0.0112	0.018	0.0818	0.0522
8:2Cl-PFESA	0	0.0382	0.0132	0.0354
6:2Cl-PFESA	0.0298	0.0748	0.0254	0.1536
PFOS	0.0164	0.0606	0.0444	0.209
PFNA	0	0.011	0.0752	0.1298
PFDA	0.038	0.0718	0.0510	0.0988
PFUnDA	0.0528	0.0268	0.0246	0.2686
PFDoDA	0.0004	0.0506	0.0068	0.0474
PFTTrDA	0.1418	0.0494	0.0220	0.1144
PFBA	0.0682	0.0004	0.0142	0.0716
PFHpA	0.0000	0.1916	0.0410	0.0158
PFBS	0.0022	0.0120	0.0290	0.0398
6:2 FTS	0.0100	0.0460	0.0128	0.0140
HFPO-DA	0.0000	0.0396	0.0356	0.0176

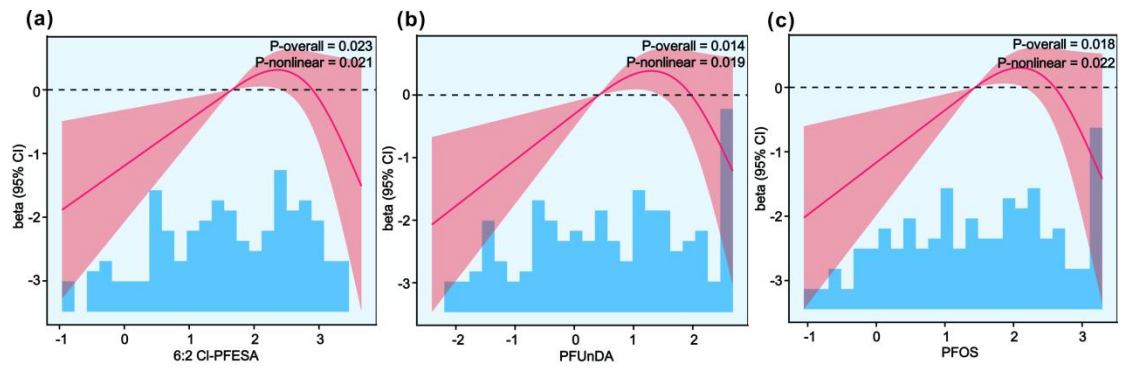
*Note.* Models were adjusted for maternal age, gestational age, parity, educational attainment, pre-pregnancy BMI, pre-pregnancy passive smoking and birth weight. PIP:posterior inclusion probability, AGD<sub>AP</sub>, anopenile distance; AGD<sub>AS</sub>, anoscrotal distance; AGD<sub>AC</sub>, anoclititoris distance; AGD<sub>AF</sub>, anofourchette distance



**Supplementary Figure S1.** Spearman’s correlations among the maternal plasma concentrations of 16 PFAS. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ , \*\*\*\*  $p < 0.0001$ .



**Supplementary Figure S2.** Schematic diagram of the AGD measurement methods for male and female infants. AGD<sub>AP</sub>, anopenile distance; AGD<sub>AS</sub>, anoscrotal distance; AGD<sub>AC</sub>, anoclitoris distance; AGD<sub>AF</sub>, anofourchette distance.



**Supplementary Figure S3.** Estimates of  $AGD_{AF}$  in females for ln-transformed PFHpA (a), PFOS (b) in restricted cubic spline (RCS) models. The RCS models were adjusted for maternal age, gestational age, parity, educational attainment, pre-pregnancy BMI, and pre-pregnancy passive smoking and birth weight.  $AGD_{AF}$ , anofourchette distance.