Supplementary Materials

Estimating drinking water PFAS exposures associated with serum clinical action levels using a probabilistic toxicokinetic model

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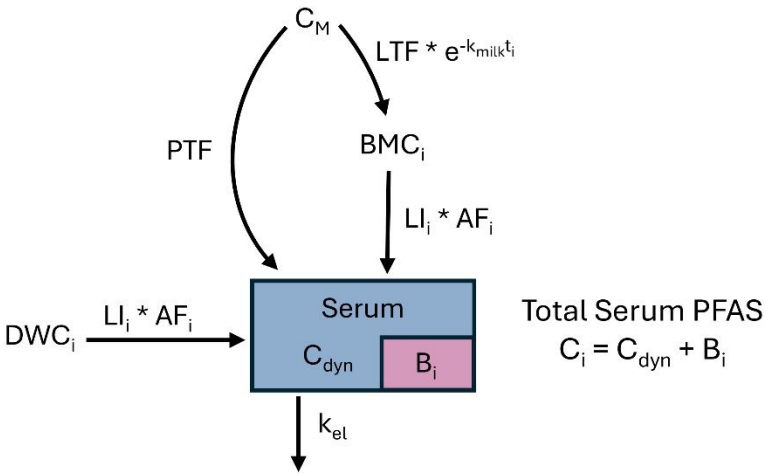
SUPPLEMENTARY METHODS



Supplementary Figure 1. Schematic of the one-compartment toxicokinetic model.Exposure parameters that change over time are denoted by the "i" subscript. DWC: drinking water PFAS concentration, LI: weight-adjusted mean daily liquid intake, AF: liquid intake adjustment factor, C_M: maternal serum PFAS concentration, PTF: placental transfer factor, LTF: lactational transfer factor, k_{milk}: breast milk elimination rate constant, BMC: breast milk PFAS concentration, C_{dyn}: serum PFAS concentration, B: background serum PFAS, k_{el}: elimination rate constant, C: total serum PFAS concentration.

Supplementary Table 1. List of parameters used in modeling

Parameter	Abbr.	Units	Distribution Shape	Value Sources
Chemical-Specific Parameters				
Half-life	$T_{1/2}$	Years	Lognormal	**Table 1**
Volume of distribution, weight-adjusted	V_d	L/kg	Lognormal	
Placental transfer factor	PTF	Unitless	Normal	
Lactational transfer factor	LTF	Unitless	Normal	
Breast milk elimination rate constant	k_{milk}	1/days	None; Linked to LTF in each iteration	
Age-Dependent Parameters				
Liquid intake, mean daily body weight-adjusted	LI	mL/(kg-day)	Mean value is constant at each age, distribution is created using the adjustment factor.	**Supplementary Table S4**
Adjustment Factor (AF), liquid intake variability	AF	Unitless	Normal or gamma	
"Background" serum PFAS concentration	B	µg/L	Lognormal	**Supplementary Table S5**
Scenario-Dependent Parameters				
Maternal serum PFAS concentration	C_M	µg/L	Specified by user	Selections supporting modeling in this manuscript are described in **Supplementary Tables S6, S7, and S8**.
Drinking water PFAS concentration	LC or DWC	ng/L	Specified by user	
Breast milk PFAS concentration	BMC or LC	ng/L	Determined by maternal serum PFAS concentration at birth.	

Supplementary Table 2. Model revisions to predict population-level distributions

	ATSDR Individual TK Model	MassDEP Population TK Model
Exposure Distributions for Populations		
Liquid intake distribution	Liquid intake in volume. Fixed normal distribution with 15% standard deviation around individual tap water fraction	Liquid intake volume is body weight-adjusted. Age-dependent population distributions for drinking water or breast milk intake (**Supplementary Table S4**)
Maternal serum [PFAS]	-Maternal serum PFAS concentrations only incorporated when modeling ages <6 years -Modeled using a steady-state approximation	-Maternal serum PFAS concentrations required for all modeling -Two options including 1) steady state approximation, or 2) entry of a known or modeled population distribution
Background	Set at adult or child level throughout modeling period	Can change with age and date over modeling period
Age	Models a single age based on user input	Enables variation in age of modeled population with multi-part distributions
Drinking water [PFAS] distribution	Normal or lognormal distribution with same fractional standard deviation for all time points	Allows normal, lognormal, gamma, Weibull, and uniform distribution shapes with entry of independent distributions at different time points.
Body weight	Body weight is an individual user input.	Eliminated from population modeling by using body weight-adjusted liquid intake.
Modeling for Young Children		
Breast milk [PFAS] decline over time	Literature-based decline data only available for PFOA. PFOS, PFHxS and PFNA are projected with percentage decline proportional to lactational transfer fraction.	Updated with new data for PFOA, PFOS and PFHxS. PFNA and PFDA are projected with decline rate proportional to lactational transfer fraction. PFHpA uses PFOA parameters.
Breast milk and formula mean intake	Absolute volume intake. Lower for formula than breast milk.	Liquid intake volume is adjusted for body weight. Equivalent for breast milk and formula.
Background for ages <6	Set at a constant level from birth, depending	Linear phase-in to child background level at age 3.

	on age at model end date.	
Volume of distribution adjustment	Adjusted for individuals under age 6 years	No adjustment (similar to [1])
Processing Efficiency for Reproducibility		
Serum calculation equation	Timestep-based approximation	Integrated rate law
Serum calculation dates	Dictated by timestep interval, without direct date selection options. Changing timestep interval can affect output.	Serum concentration is calculated whenever exposure changes for maximum accuracy with minimum computation. Option for additional dates, which will not affect output.
Default Monte Carlo iterations	1,000	35,000 (selected to reduce model variation at upper percentile values)
Runtime and storage space for 2,000 iterations[a]	8 minutes, storing 122 Mb.	37 seconds, storing 2.7 Mb.
Interface Revisions		
Exposure scenario entry	Entered directly in web site tool or R code	Excel spreadsheet manages all inputs for R code
Batch processing	None	Multiple exposure scenarios can be prepared at the same time

[a]Using PC with 16.0 GB RAM and an Intel Core i5 processor

Supplementary Section 1. Calculation of k_{milk}

Declining concentrations of PFAS in breast milk are approximated using an exponential decay rate constant k_{milk}, calculated from the milk decline ratio (MDR) over a defined time (t_{MDR}). The MDR is the fraction of PFAS lost in breast milk over a defined breastfeeding interval (**Supplementary Table 3**). If PFAS in breast milk (BMC) is in exponential decay, the concentration remaining t days later is given by:

$$BMC(t) = BMC_0 * e^{-k_{milk} * t} \quad \text{(S1)}$$

Where:

BMC(t) is the PFAS concentration in breast milk at t days after birth (µg/L),
BMC_0 is the PFAS concentration in breast milk at birth (µg/L),
k_{milk} is the the rate constant for breast milk decline (1/days), and
t is the time after birth, in days.

After t_{MDR} days, BMC(t) and BMC_0 are related by the MDR, allowing k_{milk} to be calculated:

$$-\ln(1-MDR)/t_{MDR} = k_{milk} \quad \text{(S2)}$$

Supplementary Table 3. Milk decline ratios and breast milk elimination rate constant for three PFAS

Chemical	Milk decline ratio (MDR) (unitless)[a]	Time (t_{MDR}) (days)	k_{milk} (1/day)[b]
PFOA	0.12	30	4.26E-03
PFOS	0.058	30	1.99E-03
PFHxS	0.025	30	8.44E-04

[a]Reported in Blomberg, et al., 2023 [2]
[b]Derived using **Supplementary Equation (2)**

Because PFNA and PFDA did not have literature-reported MDRs, we approximated k_{milk} values based on their known lactational transfer factors (LTFs), and an assumed proportional relationship between k_{milk} and the LTF. This proportionality exists because PFAS loss through

lactation is expected to outpace other PFAS elimination in the mother [3]. The geometric mean of the ratio between k_{milk} and LTF for PFOA, PFOS, and PFHxS is 0.091. This value was used to calculate k_{milk} for PFNA and PFDA by multiplying it by the corresponding LTF.

In the Monte Carlo model simulation, k_{milk} is adjusted relative to each iteration's LTF but does not have an independent distribution. Lactational transfer is treated as a normal distribution with 2% standard deviation [3]. For each iteration i, k_{milk_i} is calculated with the following formula:

$$k_{milk\_i} = k_{milk} * \frac{LTF_i}{LTF_{mean}} \quad \text{(S3)}$$

Where:

k_{milk_i} is k_{milk} for the iteration i,
k_{milk} is the constant chemical-specific k_{milk} value (1/day),
LTF_i is the lactational transfer factor for the iteration i, and
LTF_{mean} is the mean lactational transfer factor for the chemical.

Supplementary Section 2. Population Variability Distribution for Body Weight-Adjusted Liquid Intake Rates

Mean body weight-adjusted liquid intake rates (LI) and adjustment factor (AF) distributions were developed for this model. AF distributions were determined using the body weight-adjusted (mL/kg-day) consumer-only estimates of combined direct and indirect drinking water or breast milk intake data reported in the USEPA Exposure Factors Handbook (EFH) Tables 3-21, 3-63, and 15-17 [4, 5]. For all age groups, liquid intake at each reported percentile was divided by the corresponding mean liquid intake to generate the observed percentiles of mean-adjusted liquid intake. A weighting scheme was used to account for observations with lower statistical reliability as indicated in the EFH Tables 3-21 and 3-63 [4]. Observed percentiles with lower statistical reliability were weighted as follows: percentiles < 0.1 or > 0.9 were weighted 0.25, percentiles ≥ 0.1 and ≤ 0.9 were weighted 0.5. All other percentiles received a weighting of 1. The R package rriskDistributions was used to fit distributions to the observed percentiles for weighted, mean-adjusted liquid intake [6]. rriskDistributions uses an optimization function based on minimizing squared, weighted errors to select the best fit distribution shape(s) and parameters to observed percentile data [6].

Mean-adjusted percentile data for age groups <1 year were well-described by normally distributed AFs with a mean of 1 and similar standard deviations. The normal distribution fit to exclusively breastfed infants between ages 0 to 12 months was selected to represent all infants <1 year old as AF_{Infant}. The AF_{Infant} distribution estimated by this process matched previously published values [7].

Mean-adjusted percentile data for age groups >1 year showed distribution shapes that varied by age group. Gamma distributions provided the best distribution fit for most of these age groups.

These populations' variability was represented by two AFs; the $AF_{Child\&Adult}$ for ages 1 to <11, 21 to <60 years, and women of child-bearing age, and the AF_{Youth} to represent ages 11 to <21 years. These AF distributions were evaluated across age subgroups by minimizing the absolute error while ensuring the 90th percentile overall AF would not underestimate the 90th percentile for the subgroup.

Supplementary Table 4. Mean body weight-adjusted breast milk or drinking water intake and adjustment factor distributions by age

Age Group[a]	Mean daily body weight-adjusted liquid intake (LI) (mL/(kg-day))[a]	Adjustment Factor (AF) (unitless)[b]			
		Distribution Type	Mean or Shape[c]	SD or Rate[c]	Distribution Name
0 to <1 month	150	Normal	1	0.2	AF_{Infant}
1 to <3 months	140				
3 to <6 months	110				
6 months to <1 year	83				
1 to <2 years	22.1	Gamma	1.32	1.31	$AF_{Child\&Adult}$
2 to <3 years	23.9				
3 to <6 years	18.7				
6 to <11 years	15.2				
11 to <16 years	10.4	Gamma	0.88	0.87	AF_{Youth}
16 to <21 years	10.2				
21 to <30 years	15.9	Gamma	1.32	1.31	$AF_{Child\&Adult}$
30 to <40 years	15.8				
40 to <50 years	17.2				
50 to <60 years	17.6				
60 to <70 years	17.3				
70 to <80 years	16.3				
80+ years	15.6				
Women of child-bearing age (13 to <50 years)	15.6				

[a]Liquid intake includes drinking water and breastmilk. Mean and percentile data for consumer-only estimates of combined direct and indirect drinking water from the EFH Tables 3-21 for age groups >1 year old [4], and 3-63 for women of child-bearing age [4]. For infants <1 year old, means for exclusively breastfed infants from Table 15-1 [5] and percentile data from Table 15-17 [5].

[b]AF distributions were determined by fitting distributions to the reported percentiles of liquid intake data from the EFH tables using the rriskDistributions R package [6].

[c]Mean and standard deviation values for normal distributions. Shape and rate values for gamma distributions.

Supplementary Table 5. Distribution of age- and sex-specific background serum PFAS concentrations for children and adults.

PFAS	Sex[a]	Child (≥3-<12 years) Observed Serum PFAS (µg/L): Lognormal Distributions		Adult (≥12 years) Observed Serum PFAS (µg/L): Lognormal Distributions	
		GM	GSD	GM	GSD
PFOA[b]	Female	1.90	1.58	1.26	1.96
	Male	1.95	1.67	1.61	1.75
	Unknown	1.92	1.67	1.44	1.96
PFOS[b]	Female	3.70	1.64	3.42	1.78
	Male	4.07	1.91	5.36	1.63
	Unknown	3.88	1.91	4.39	1.78
PFHxS[b]	Female	0.757	1.94	0.810	1.81
	Male	0.933	2.17	1.48	2.15
	Unknown	0.845	2.17	1.15	2.15
PFNA[b]	Female	0.759	1.84	0.384	1.63
	Male	0.829	2.15	0.442	1.64
	Unknown	0.794	2.15	0.412	1.64
PFDA[c,d]	Female	0.100	2.38	0.196	2.05
	Male	0.072	3.00	0.190	1.86
	Unknown	0.086	3.00	0.193	2.05
PFHpA[e]	Female	0.034	3.16	0.071	1.67
	Male	0.035	2.91	0.071	1.67
	Unknown	0.035	3.16	0.071	1.67

[a]The "unknown" GM is the arithmetic mean of male and female values. The "unknown" GSD is the larger of the male or female GSDs.

[b]GM and GSD adopted from Lynch, et al., 2023 [3].

[c]The background distribution of PFDA for male and female children was calculated by fitting a lognormal distribution to observed concentrations at the 50th, 75th, 90th, and 95th percentiles from the 2013-2014 National Health and Nutrition Examination Survey (NHANES) data. The 50th percentile value for male children was below the detection limit, and the LOD/sqrt(2) was substituted for this single value.

[d]Adult background PFDA concentrations are GM and GSD values calculated using weighted data from the 2017-2018 NHANES cycle. For comparison, GM and GSD determined by fitting a lognormal distribution to the observed 50th, 75th, 90th, and 95th percentiles from the 2017-2018 NHANES cycle are 0.196 (2.01) for females and 0.2 (1.75) for males.

[e]PFHpA data are from the 2013-2014 NHANES cycle. Percentiles below the 90th percentile were below the detection limit for both sexes and age groups. The child background concentrations were selected by fitting a distribution to observed 90th and 95th percentiles with the 75th percentile set at the LOD/sqrt(2), and the median set at the LOD/sqrt(2)/2. For the adult population, the median was set at the LOD/sqrt(2) and GSD were fit until the 75th percentile was at 0.1.

GM: geometric mean, GSD: geometric standard deviation.

Supplementary Table 6. Inputs for modeled scenarios supporting manuscript tables and figures.

Modeled population	Population use	Sex	Drinking water conc. (ng/L)	Breastfeeding duration	Modeling duration	Maternal modeling method (C_M)	Maternal modeling scenario
Female lifetime trajectory	Maternal input for males	F	4-90	3 months	Birth-40 years	Steady-state	Steady-state serum concentration at each water concentration using body weight-adjusted liquid intake (LI) for women of child-bearing age of 15.6 mL/(kg-day) (Table 3-63, USEPA, 2019 [4]).
Male lifetime trajectory	**Figure 2**	M	20	6 months	Birth-70 years	Distribution	Modeled population of 40-year-old women with constant lifetime exposure to 20 ng/L
Male 6-month infants	**Figure 4**, **Table 2**	M	4-90	6 months	Birth-6 months	Distribution	Modeled population of 40-year-old women with constant lifetime exposure at each concentration
Male 6-month infants	Sensitivity analysis	M	20	6 months	Birth-6 months	Distribution	Modeled population of 40-year-old women with constant lifetime exposure at 20 ng/L
Model evaluation populations	**Figure 3**	Modeling scenarios are detailed in **Supplementary Tables S7 and S8**					

Supplementary Table 7. Datasets and inputs used to evaluate model performance for adults and older children (organized by data collection year).

Location, Year (Citation)	Number and ages of Participants [a]	PFAS data[b]	DW Conc. (ng/L)[c]	DW Data Type and Exposure Input[d]	Exposure Duration Selected	Maternal Modeling DW Conc. (ng/L)[c]	Modeling end date
Maine, USA, 2020 [8]	30 adults modeled with reported age distribution	PFOA	1749.0 (2.4)	Reported **GM** and reported or estimated[e] **(GSD)**. Pre- and post-contamination drinking water PFAS set at LOD/sqrt2.	High exposure concentration modeled as the mean duration of residence at sampled homes (23.7 years).	LOD/sqrt (2)	Serum data collected on average 252 days after DW data. Modeled as 252 days (~8 months) after DW sampling.
		PFOS	887.0 (19.7)				
		PFHxS	23.5 (6.77)				
		PFNA	269.4 (5.57)				
		PFDA	31.5 (13.1)				
		PFHpA	1124.8 (2.5)				
Pittsboro, North Carolina, USA, 2019 [9]	48 adults modeled with reported age distribution	PFOA	5 (1.54)	Input reported **median** drinking water concentrations for the first timepoint as the GM and estimated[f] (GSD) using reported data.	Lifetime exposure at the median DW concentration. 49% of participants lived at current home >=7 years.	5	Cross-sectional data for timepoint 1 collected in November 2019. Modeled as December 1, 2019.
		PFOS	2.4 (1.49)			2.4	
		PFHxS	1.7 (1.6)			1.7	
		PFNA	0.5 (1.3)			0.5	
		PFDA	0.3 (1.49)			0.3	
		PFHpA	12.6 (3.93)			12.6	
Gustavus, Alaska, USA, 2019 [10]	40 individuals ages 8-97 modeled	PFOA	0.636 (0.7)	Modeled lifetime exposure at reported **Mean** and **(SD)** calculated from the reported standard error and sample size. Authors report “residence time” for 73% of		0.636	Data collection dates not specified. Modeled as December 1, 2019.
		PFOS	14.9 (18.6)			14.9	
		PFHxS	4.38 (4.8)			4.38	

	with stated age distribution and percent of children	PFNA	0.0189 (0.01)	participants >= 10 years group.	0.0189	
Ronneby, SE, 2013/14 [11]	582 individuals modeled with reported age distribution	PFOA	1	The "Never High" adult population only was modeled. Drinking water concentration was set at 0 before 1980 and changes to the **reported concentration** beginning in the 1980s.	1	Biomonitoring completed December, 2015. Modeled as December 1, 2015.
		PFOS	27		27	
		PFHxS	4.6		4.6	
Ronneby, SE, 2013/14 [11]	17 children age 11 with lower exposure.	PFOA	1	Input lifetime exposure at **concentrations measured** in December 2013.	1	Data collected February 2014. Modeled as March 1, 2014.
		PFOS	27		27	
		PFHxS	4.6		4.6	
		PFHpA	1.4		1.4	
Ronneby, SE, 2013/14 [11]	20 children age 11 with high exposure	PFOA	100, 1	Input lifetime exposure at **high reported concentration** followed by a decrease to the **lower reported concentrations** beginning December 16, 2013.	100	Data collected February 2014. Modeled as March 1, 2014.
		PFOS	8000, 27		8000	
		PFHxS	1700, 4.6		1700	
		PFHpA	32, 1.4		32	
Arnsberg, DE, 2006 [12]	90 children ages 5-6 modeled with stated age range	PFOA	5, 5-519, 5, 71	Pre-contamination concentration imputed as LOD/2 (5 ng/L, method used by authors). Input linear increase between 5-519 ng/L between 2000-2006 during application of	5	Data collected September-November 2006. Modeled as December 1, 2006

	164 women ages 23-49 modeled with reported age range			contaminated soil amendment. Set post filtration installation DW concentration is LOD/2 (5). Field phase concentration reported in fall 2006 set at 71 ng/L.		
	101 men ages 18-69 modeled with reported age range					

[a]Populations including both males and females were modeled as "Unknown." Single-sex populations are noted.
[b]Within a cohort, PFAS with low detection frequencies were omitted from modeling.
[c]All modeling of maternal serum used the steady-state method. US populations were modeled with a 3-month breastfeeding duration. European cohorts were modeled with a 4-month breastfeeding duration.
[d]The drinking water concentration (DW Conc.) with the type of drinking water value(s) (GM and GSD, arithmetic mean, median, or other value) stated in **bold text** in the 'DW Data Type and Exposure Input' column.
[e]GSD not reported for PFHxS, PFNA, and PFDA. For these three chemicals, the GSD was estimated by fitting a lognormal distribution to reported 25th, 50th, 75th, 90th percentile drinking water concentrations using the R package 'rriskDistributions' [6]. PFNA modeling used a tolerance of 0.002 instead of the default 0.001. PFDA had below 100% detection frequency and values below detection limits were imputed. The reported 25th percentile value was weighted at 0.1 to account for this uncertainty when fitting the lognormal distribution.
[f]GSD estimated by fitting lognormal distributions to reported median and 90th percentile drinking water concentrations using the R package 'rriskDistributions' [6].
Abbreviations: Conc.: concentration, DW: drinking water, GM: geometric mean, GSD: geometric standard deviation, LOD: limit of detection, SD: standard deviation.

Supplementary Table 8. Datasets and input used to evaluate model performance for infants.

Location, Year (citation)	PFAS data[a]	Number of maternal samples (DF)	Maternal serum summary statistic	Maternal serum PFAS concentrations (summary statistic type in previous column) (ng/mL)[b]	Breastfeeding duration[c] (Source)	Number of infant samples (DF)	Timing of infant samples
Munich, DE, 2007-2009 [13]	PFOA	38 (100%)	median, 95th percentile	1.9, 5.2	6 months (37/50 infants were exclusively breastfed. Duration not reported)	40 (100%)	6 months
	PFOS	38 (100%)		3.2, 6.1		40 (100%)	
	PFHxS	38 (97%)		0.5, 1.5		40 (98%)	
	PFNA	38 (97%)		0.6, 3.0		40 (90%)	
Bergen, NO, 2007-2010[d] [14]	PFOA	114 (≥90%)	median (IQR)	0.96 (0.70, 1.24)	4 months (Reported mean duration of exclusive breastfeeding rounded to nearest month)	94 (≥90%)	6 months
	Σ PFOS			3.86 (2.96, 5.21)			
	Σ PFHxS			0.54 (0.38, 0.69)			
	PFNA			0.38 (0.31, 0.48)			
	PFDA			0.19 (0.15, 0.26)			

[a]PFAS with low detection frequencies were omitted from modeling.

[b]Maternal serum sample collected at delivery for the Munich, DE cohort [13] and at 36 weeks of pregnancy for the Bergen, NO cohort [14]. The R package rriskDistributions [6] was used to fit parameterized distributions to observed quantiles of maternal serum PFAS concentrations; the resulting distribution was used as the maternal serum concentration for modeling.

[c]Water concentration set to 4ng/L. Munich, DE cohort consumes no water over the modeling period while the Bergen, NO cohort consumes water for 2 months.

[d]Only reference to data collection time period is in the discussion of the paper.

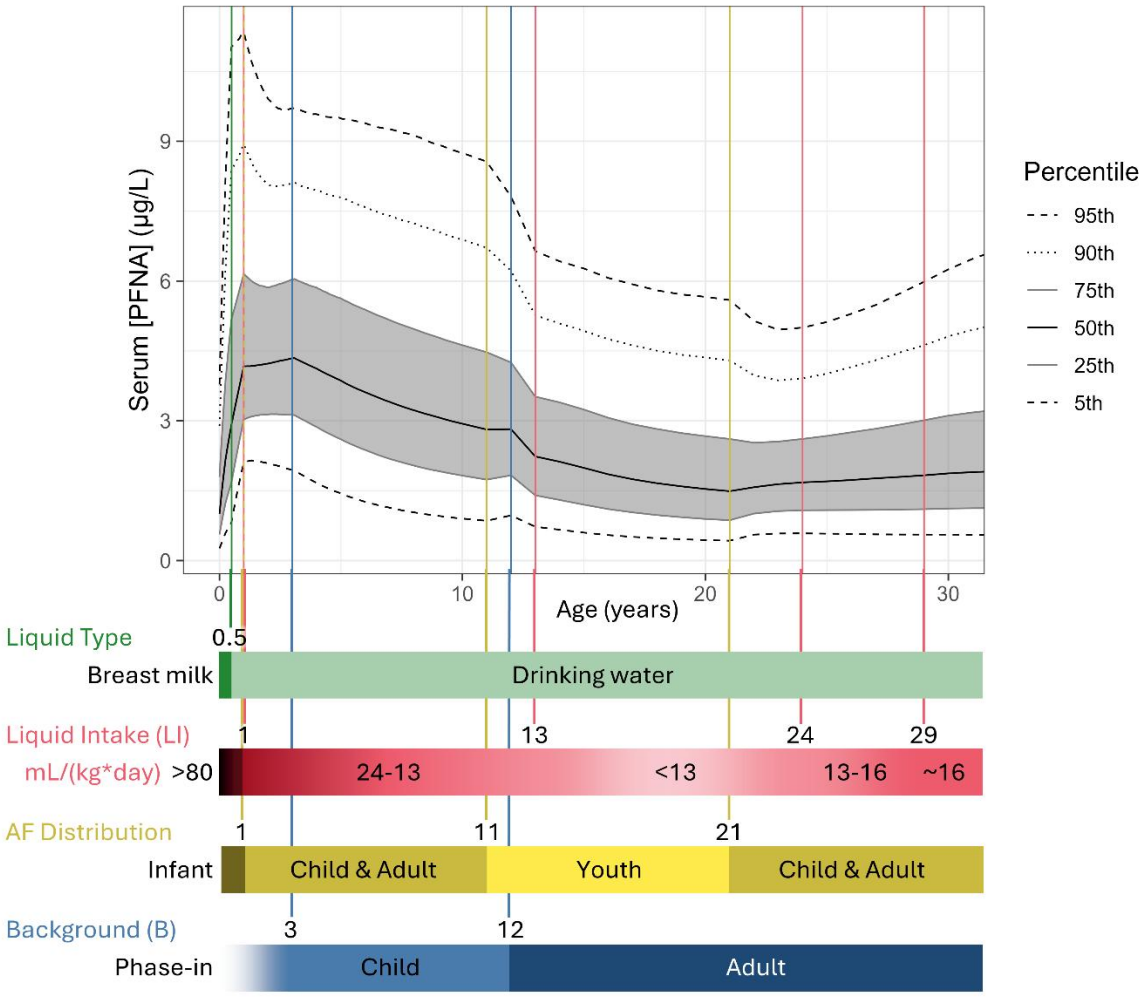
DF: detection frequency, IQR: interquartile range

SUPPLEMENTARY RESULTS

Supplementary Table 9. Comparison of maternal serum, breast milk, and infant serum PFAS at lifetime exposure to 20 ng/L PFAS in drinking water.

PFAS	Drinking Water PFAS (ng/L)	Modeled Maternal Serum PFAS at birth (µg/L)[a]	Modeled breast milk PFAS concentration at birth (ng/L)[b]	Modeled Infant Serum PFAS at birth (µg/L)[c]	Modeled Infant Serum PFAS at 6 months (µg/L)[d]
PFOA	20	2.2	115	1.9	6.3
PFOS		4.5	58	1.9	5.6
PFHxS		4.6	64	3.2	7.8
PFNA		1.9	19	1.0	2.9
PFDA		1.8	42	0.59	2.7
PFHpA		0.29	15	0.37	0.88

[a]Modeled 50th percentile maternal serum concentration with lifetime exposure to 20 ng/L in drinking water (rounded).
[b]Modeled 50th percentile breast milk concentrations at birth with unit conversion factor of 1000 between ng/mL and ng/L (rounded). Compare to drinking water PFAS concentration.
[c]Modeled 50th percentile infant serum PFAS concentration at birth.
[d]Modeled 50th percentile infant serum PFAS concentration with 6-month exclusive breastfeeding duration.

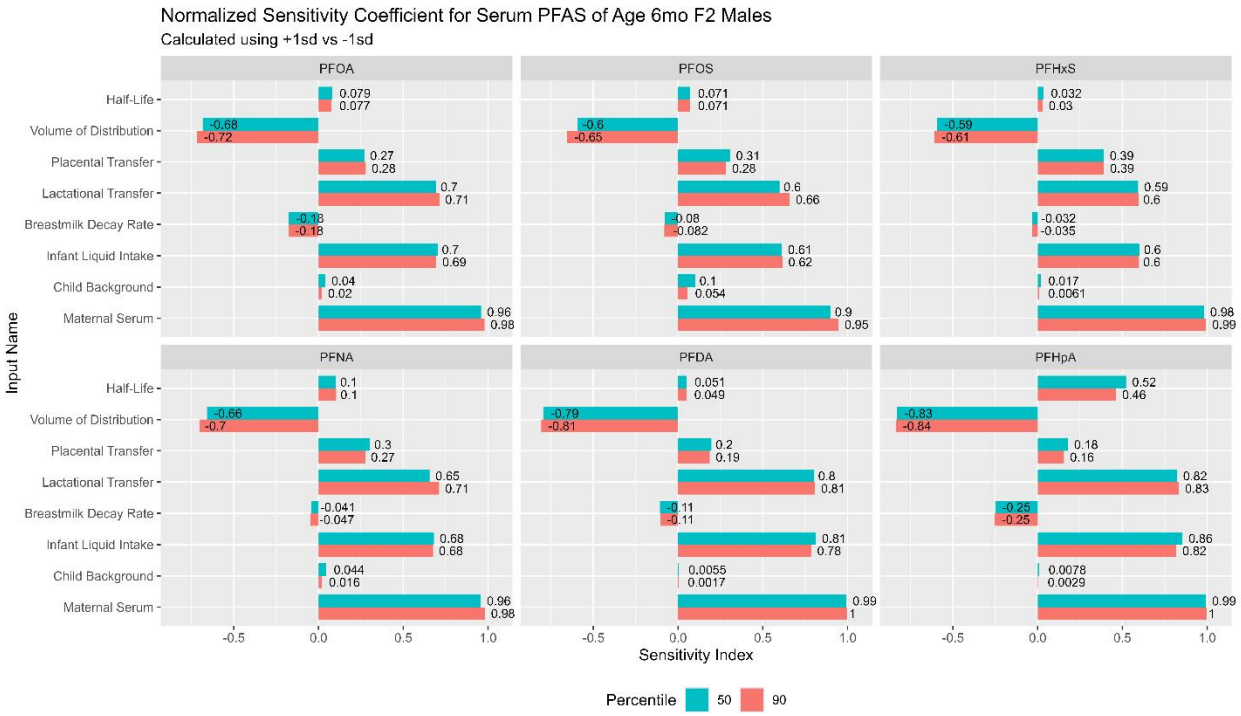


Supplementary Figure 2. Lifetime serum PFNA trajectory with exposure parameter overlay showing age-dependent changes in liquid type consumed, liquid intake rate, liquid intake AF distribution, and background level.

Supplementary Table 10. Model evaluation log10 root mean square error (RMSE) by PFAS

Central Tendency RMSE (Median or geometric mean)							
Age Group[a]	**All PFAS**	**PFOA**	**PFOS**	**PFHxS**	**PFNA**	**PFDA**	**PFHpA**
All	0.41	0.30	0.37	0.46	0.25	0.33	0.74
Infants	0.12	0.12	0.11	0.18	0.0047	0.14	
Non-Infants	0.46	0.33	0.42	0.52	0.33	0.39	0.74
Uppermost Percentile RMSE (90^{th}, 95^{th}, or maximum)							
Age Group	**All PFAS**	**PFOA**	**PFOS**	**PFHxS**	**PFNA**	**PFDA**	**PFHpA**
All	0.44	0.28	0.53	0.63	0.37	0.29	0.28
Infants	0.19	0.20	0.091	0.17	0.29	0.087	
Non-Infants	0.49	0.29	0.62	0.72	0.42	0.34	0.28

[a]Non-Infant populations used for modeling are described in **Supplementary Table S7**. Infant populations used for modeling are described in **Supplementary Table S8**.



Supplementary Figure 3. Normalized sensitivity coefficients for key toxicokinetic parameters and exposure factors at the 50th and 90th percentiles of the output serum [PFAS] distribution for a population of six-month-old exclusively breastfed infants (**Supplementary Table 6**). The maternal serum parameter is the output distribution from modeling a population of 40-year-old women with constant lifetime exposure to 20 ng/L PFAS in drinking water; maternal serum was fit to a lognormal distribution for this sensitivity analysis. Parameters are varied one at a time to plus or minus one normalized standard deviation value with the exception of k_{milk}, a constant, which was shifted by +/-2%. The normalized sensitivity coefficient values are shown at the end of each bar and are calculated as the change in serum concentration relative to the original serum concentration divided by the change in parameter relative to the original parameter.

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