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Supplemental Material

Associations of Maternal Serum Perfluoroalkyl Substances Concentrations with Early Adolescent Bone Mineral Content and Density: The Health Outcomes and Measures of the Environment (HOME) Study

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Figure S1. HOME Study eligibility and enrollment flowchart for study inclusion.

Figure S2. Directed acyclic graph for the relationship of maternal serum PFAS concentrations with child bone outcomes at age 12 years: The HOME Study.

Table S1. Maternal serum perfluoroalkyl substances concentrations (ng/mL) (*n* = 206): The HOME Study, 2003-2006

PFAS	Limit of detection (LOD)	% Detected	Minimum	25th Percentile	Median	75th Percentile	Maximum
PFOA	0.1	100	0.5	3.7	5.2	7.2	17.4
PFNA	0.082	100	0.1	0.7	0.9	1.2	2.9
PFHxS	0.1	99	< LOD	0.8	1.3	2.3	32.5
PFOS	0.2	100	0.4	8.8	12.9	18	57.2

Note. PFAS, per- and polyfluoroalkyl substances; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

Table S2. Spearman's rank order correlation coefficients of maternal serum perfluoroalkyl substance concentrations (*n* = 206): The HOME Study

	PFOA	PFNA	PFHxS	PFOS
PFOA	1			
PFNA	0.48	1		
PFHxS	0.48	0.32	1	
PFOS	0.60	0.53	0.61	1

PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

Table S3. Adjusted associations of maternal serum perfluoroalkyl substances concentrations with bone outcome Z-scores at 12 years of age (*n* = 206): The HOME Study

Outcome	PFOA	PFNA	PFHxS	PFOS
BMC Z-score				
Whole-body less head	-0.06 (-0.19, 0.08)	-0.07 (-0.23, 0.08)	0.01 (-0.09, 0.11)	-0.02 (-0.14, 0.10)
Total hip	-0.16 (-0.32, 0.00)	-0.18 (-0.36, -0.01)	-0.04 (-0.15, 0.08)	-0.07 (-0.20, 0.06)
Femoral neck	-0.05 (-0.22, 0.12)	-0.05 (-0.24, 0.14)	0.02 (-0.10, 0.15)	0.01 (-0.14, 0.15)
Forearm	-0.17 (-0.35, 0.01)	-0.24 (-0.44, -0.05)	-0.02 (-0.13, 0.10)	-0.07 (-0.22, 0.08)
Spine	-0.09 (-0.24, 0.05)	-0.11 (-0.29, 0.07)	-0.02 (-0.12, 0.08)	-0.04 (-0.17, 0.09)
BMD Z-score				
Whole-body less head aBMD	-0.08 (-0.24, 0.07)	-0.12 (-0.30, 0.07)	0.00 (-0.11, 0.10)	-0.01 (-0.14, 0.12)
Total hip aBMD	-0.12 (-0.29, 0.06)	-0.06 (-0.29, 0.17)	-0.03 (-0.17, 0.11)	-0.01 (-0.17, 0.15)
Femoral neck aBMD	-0.01 (-0.19, 0.18)	0.13 (-0.10, 0.36)	0.04 (-0.09, 0.18)	0.05 (-0.13, 0.22)
Forearm aBMD	-0.16 (-0.33, 0.00)	-0.13 (-0.33, 0.08)	-0.09 (-0.20, 0.02)	-0.08 (-0.22, 0.05)
Ultradistal forearm aBMD	-0.02 (-0.24, 0.20)	0.04 (-0.22, 0.30)	-0.01 (-0.16, 0.15)	-0.09 (-0.29, 0.12)
Spine BMAD	-0.08 (-0.25, 0.09)	-0.05 (-0.25, 0.15)	-0.11 (-0.25, 0.02)	-0.01 (-0.16, 0.13)

Note: Difference (95% confidence interval) in bone outcome Z-score per $\log_2$ unit increase in perfluoroalkyl substance concentrations estimated in separate linear regression models adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, child sex, child age at follow-up, child sex * child age at follow-up. Missing covariate information accounted for using full-information maximum likelihood. BMC, bone mineral content; aBMD, areal bone mineral density; BMAD, bone mineral apparent density; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

Table S4. Adjusted associations of maternal serum perfluoroalkyl substances concentrations with bone outcome Z-scores at age 12 years among males (*n* = 93) and females (*n* = 113): The HOME Study

Outcome	PFOA	PFNA	PFHxS	PFOS
Whole-body less head BMC				
Males	-0.13 (-0.34, 0.09)	-0.05 (-0.34, 0.24)	0.11 (-0.03, 0.24)	0.06 (-0.11, 0.24)
Females	0.04 (-0.13, 0.21)	-0.05 (-0.23, 0.14)	-0.04 (-0.16, 0.08)	-0.05 (-0.22, 0.12)
EMM p-value[a]	0.23	0.98	0.11	0.37
Total hip BMC				
Males	-0.24 (-0.49, 0.01)	-0.20 (-0.56, 0.17)	0.08 (-0.09, 0.25)	-0.03 (-0.24, 0.19)
Females	-0.11 (-0.31, 0.09)	-0.16 (-0.35, 0.04)	-0.12 (-0.25, 0.01)	-0.14 (-0.29, 0.02)
EMM p-value[a]	0.44	0.85	0.07	0.41
Femoral neck BMC				
Males	-0.14 (-0.41, 0.14)	-0.01 (-0.37, 0.36)	0.08 (-0.11, 0.26)	0.03 (-0.20, 0.27)
Females	0.02 (-0.20, 0.24)	-0.04 (-0.27, 0.18)	-0.02 (-0.16, 0.12)	-0.02 (-0.20, 0.16)
EMM p-value[a]	0.37	0.86	0.4	0.71
Forearm BMC				
Males	-0.25 (-0.54, 0.03)	-0.17 (-0.52, 0.19)	0.08 (-0.12, 0.27)	0.11 (-0.15, 0.36)
Females	-0.05 (-0.26, 0.17)	-0.26 (-0.50, -0.02)	-0.09 (-0.23, 0.06)	-0.18 (-0.39, 0.02)
EMM p-value[a]	0.25	0.66	0.19	0.08
Spine BMC				
Males	-0.21 (-0.45, 0.04)	-0.05 (-0.42, 0.32)	0.01 (-0.16, 0.19)	-0.03 (-0.25, 0.20)
Females	0.01 (-0.20, 0.22)	-0.12 (-0.32, 0.08)	-0.04 (-0.16, 0.09)	-0.06 (-0.23, 0.12)
EMM p-value[a]	0.19	0.73	0.64	0.83
Whole-body less head aBMD				
Males	-0.12 (-0.37, 0.14)	-0.11 (-0.46, 0.24)	0.05 (-0.11, 0.21)	0.03 (-0.18, 0.24)
Females	0.00 (-0.21, 0.21)	-0.06 (-0.29, 0.16)	-0.01 (-0.14, 0.12)	0.01 (-0.17, 0.18)
EMM p-value[a]	0.48	0.83	0.54	0.88
Total hip aBMD				
Males	-0.17 (-0.47, 0.13)	0.00 (-0.49, 0.49)	0.08 (-0.12, 0.28)	0.07 (-0.22, 0.35)
Females	-0.09 (-0.32, 0.13)	-0.07 (-0.33, 0.19)	-0.10 (-0.27, 0.07)	-0.07 (-0.27, 0.13)
EMM p-value[a]	0.67	0.8	0.18	0.44
Femoral neck aBMD				

Males	-0.17 (-0.49, 0.14)	0.08 (-0.42, 0.58)	0.05 (-0.15, 0.26)	0.07 (-0.23, 0.38)
Females	0.11 (-0.14, 0.36)	0.17 (-0.08, 0.42)	0.02 (-0.15, 0.19)	0.01 (-0.21, 0.23)
EMM p-value[a]	0.17	0.74	0.81	0.72
Forearm aBMD				
Males	-0.20 (-0.43, 0.03)	0.02 (-0.32, 0.37)	-0.09 (-0.28, 0.10)	0.01 (-0.22, 0.25)
Females	-0.08 (-0.31, 0.15)	-0.17 (-0.42, 0.09)	-0.10 (-0.21, 0.01)	-0.12 (-0.31, 0.07)
EMM p-value[a]	0.47	0.39	0.94	0.38
Ultradistal forearm aBMD				
Males	-0.14 (-0.41, 0.14)	0.22 (-0.26, 0.70)	0.04 (-0.15, 0.23)	0.08 (-0.20, 0.37)
Females	0.17 (-0.15, 0.49)	0.02 (-0.30, 0.33)	-0.04 (-0.25, 0.17)	-0.12 (-0.42, 0.17)
EMM p-value[a]	0.16	0.48	0.58	0.32
Spine BMAD				
Males	-0.31 (-0.58, -0.03)	0.02 (-0.34, 0.37)	-0.09 (-0.29, 0.12)	-0.05 (-0.30, 0.20)
Females	0.07 (-0.16, 0.30)	-0.06 (-0.31, 0.19)	-0.14 (-0.31, 0.02)	-0.02 (-0.22, 0.18)
EMM p-value[a]	0.04	0.72	0.68	0.86

Note: Difference (95% confidence interval) in bone outcome Z-score per $\log_2$ unit increase in perfluoroalkyl substance concentration estimated in separate linear regression models adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, and child age at follow-up. Missing covariate information accounted for using full-information maximum likelihood. BMC, bone mineral content; aBMD, areal bone mineral density; BMAD, bone mineral apparent density; EMM, effect measure modification; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

[a] p-value for EMM by child sex calculated with a two-sample z-test.

Table S5. Unadjusted associations of maternal serum perfluoroalkyl substances concentrations with bone outcome Z-scores at age 12 years, overall and by child sex (*n* = 206): The HOME Study

Outcome	PFOA	PFNA	PFHxS	PFOS
Whole-body less head BMC)				
Overall	-0.08 (-0.23, 0.07)	-0.11 (-0.29, 0.06)	-0.04 (-0.15, 0.06)	-0.05 (-0.19, 0.08)
Males	-0.18 (-0.39, 0.03)	-0.05 (-0.32, 0.23)	0.02 (-0.10, 0.15)	0.01 (-0.17, 0.19)
Females	0.00 (-0.21, 0.22)	-0.14 (-0.36, 0.08)	-0.08 (-0.21, 0.06)	-0.09 (-0.26, 0.08)
EMM p-value[a]	0.23	0.6	0.31	0.42
Total hip BMC				
Overall	-0.16 (-0.30, -0.02)	-0.20 (-0.38, -0.02)	-0.07 (-0.17, 0.04)	-0.09 (-0.22, 0.03)
Males	-0.30 (-0.53, -0.07)	-0.20 (-0.54, 0.14)	-0.02 (-0.20, 0.16)	-0.07 (-0.29, 0.15)
Females	-0.05 (-0.24, 0.13)	-0.20 (-0.42, 0.01)	-0.09 (-0.22, 0.04)	-0.10 (-0.25, 0.05)
EMM p-value[a]	0.1	0.97	0.53	0.82
Femoral neck BMC				
Overall	-0.09 (-0.26, 0.08)	-0.10 (-0.31, 0.11)	-0.04 (-0.16, 0.08)	-0.05 (-0.21, 0.11)
Males	-0.21 (-0.49, 0.05)	-0.02 (-0.37, 0.33)	-0.01 (-0.20, 0.17)	-0.01 (-0.25, 0.23)
Females	0.01 (-0.23, 0.24)	-0.14 (-0.39, 0.11)	-0.06 (-0.21, 0.10)	-0.07 (-0.27, 0.12)
EMM p-value[a]	0.23	0.58	0.73	0.69
Forearm BMC				
Overall	-0.17 (-0.34, 0.01)	-0.24 (-0.45, -0.04)	-0.03 (-0.14, 0.07)	-0.07 (-0.22, 0.08)
Males	-0.31 (-0.58, -0.04)	-0.12 (-0.44, 0.20)	0.03 (-0.16, 0.21)	0.07 (-0.18, 0.33)
Females	-0.05 (-0.29, 0.19)	-0.30 (-0.56, -0.05)	-0.07 (-0.19, 0.06)	-0.15 (-0.33, 0.03)
EMM p-value[a]	0.15	0.39	0.41	0.16
Spine BMC				
Overall	-0.10 (-0.26, 0.05)	-0.12 (-0.30, 0.07)	-0.05 (-0.15, 0.05)	-0.06 (-0.19, 0.07)
Males	-0.23 (-0.47, 0.01)	-0.02 (-0.36, 0.31)	-0.04 (-0.20, 0.12)	-0.05 (-0.26, 0.17)
Females	0.00 (-0.23, 0.23)	-0.16 (-0.37, 0.05)	-0.06 (-0.19, 0.06)	-0.07 (-0.23, 0.10)
EMM p-value[a]	0.17	0.48	0.81	0.89
Whole-body less head aBMD				
Overall	-0.07 (-0.24, 0.09)	-0.08 (-0.28, 0.12)	0.00 (-0.11, 0.11)	0.00 (-0.14, 0.14)
Males	-0.17 (-0.42, 0.07)	-0.02 (-0.34, 0.30)	0.01 (-0.15, 0.17)	0.00 (-0.22, 0.22)
Females	0.01 (-0.22, 0.23)	-0.11 (-0.36, 0.14)	-0.01 (-0.15, 0.14)	0.00 (-0.18, 0.18)

EMM p-value[a]	0.29	0.66	0.85	0.99
Total hip aBMD				
Overall	-0.14 (-0.32, 0.03)	-0.06 (-0.30, 0.17)	-0.06 (-0.19, 0.07)	-0.04 (-0.21, 0.13)
Males	-0.24 (-0.53, 0.05)	0.05 (-0.40, 0.49)	-0.01 (-0.22, 0.19)	0.03 (-0.26, 0.31)
Females	-0.07 (-0.29, 0.16)	-0.12 (-0.39, 0.15)	-0.09 (-0.25, 0.08)	-0.07 (-0.27, 0.13)
EMM p-value[a]	0.35	0.52	0.57	0.57
Femoral neck aBMD				
Overall	-0.06 (-0.26, 0.13)	0.08 (-0.17, 0.33)	-0.03 (-0.17, 0.11)	-0.02 (-0.20, 0.17)
Males	-0.23 (-0.53, 0.08)	0.12 (-0.34, 0.58)	-0.03 (-0.23, 0.18)	0.04 (-0.25, 0.34)
Females	0.07 (-0.22, 0.35)	0.06 (-0.21, 0.34)	-0.03 (-0.21, 0.15)	-0.05 (-0.27, 0.18)
EMM p-value[a]	0.16	0.83	1	0.64
Forearm aBMD				
Overall	-0.16 (-0.36, 0.00)	-0.14 (-0.34, 0.06)	-0.09 (-0.19, 0.01)	-0.09 (-0.22, 0.05)
Males	-0.23 (-0.44, -0.01)	0.04 (-0.27, 0.36)	-0.05 (-0.22, 0.11)	0.01 (-0.21, 0.24)
Females	-0.11 (-0.36, 0.13)	-0.24 (-0.50, 0.02)	-0.12 (-0.24, 0.01)	-0.14 (-0.32, 0.04)
EMM p-value[a]	0.49	0.16	0.55	0.29
Ultradistal forearm aBMD				
Overall	-0.07 (-0.34, 0.19)	-0.01 (-0.29, 0.26)	-0.05 (-0.22, 0.13)	-0.12 (-0.35, 0.11)
Males	-0.17 (-0.45, 0.11)	0.27 (-0.12, 0.66)	0.06 (-0.10, 0.22)	0.07 (-0.21, 0.34)
Females	0.00 (-0.42, 0.43)	-0.16 (-0.52, 0.20)	-0.10 (-0.34, 0.13)	-0.22 (-0.53, 0.10)
EMM p-value[a]	0.5	0.11	0.25	0.18
Spine BMAD				
Overall	-0.11 (-0.29, 0.06)	-0.07 (-0.27, 0.14)	-0.12 (-0.24, -0.01)	-0.05 (-0.20, 0.10)
Males	-0.33 (-0.62, -0.04)	0.00 (-0.37, 0.38)	-0.11 (-0.29, 0.07)	-0.07 (-0.33, 0.20)
Females	0.06 (-0.18, 0.31)	-0.10 (-0.34, 0.13)	-0.13 (-0.28, 0.02)	-0.04 (-0.23, 0.14)
EMM p-value[a]	0.04	0.63	0.87	0.88

Note: Difference (95% confidence interval) in outcome Z-score per $\log_2$ unit increase in perfluoroalkyl substance concentration estimated in separate linear regression models. Sample size: overall, n=206; males, n=93; females, n=113. Missing covariate information accounted for using full-information maximum likelihood. aBMD, areal bone mineral density; BMAD, bone mineral apparent density; EMM, effect measure modification; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.
[a] p-value for EMM by child sex calculated with a two-sample z-test.

Table S6. Adjusted associations of the maternal serum perfluoroalkyl substances mixture with bone outcome Z-scores at age 12 years estimated using quantile g-computation, overall and by child sex (*n* = 206): The HOME Study

Outcome	Overall (*n* = 206)		Males (*n* = 93)		Females (*n* = 113)	
Whole-body less head BMC						
Ψ[a]	-0.04 (-0.18, 0.10)		0.01 (-0.21, 0.22)		-0.04 (-0.23, 0.15)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.08	-0.11	0.23	-0.22	0.11	-0.15
PFOA weight[d]		47.5		96.4	80.1	
PFNA weight[d]		9.7	17.5			28.9
PFHxS weight[d]	100		82.5		19.9	
PFOS weight[d]		42.8		3.6		71.1
Total hip BMC						
Ψ[a]	-0.14 (-0.31, 0.02)		-0.10 (-0.36, 0.16)		-0.17 (-0.38, 0.05)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.01	-0.15	0.18	-0.28	0.03	-0.20
PFOA weight[d]	63.4		93.5		100	
PFNA weight[d]	26.8		0.7			20.1
PFHxS weight[d]		100		100		34.3
PFOS weight[d]	9.8		5.8			45.5
Femoral neck BMC						
Ψ[a]	-0.02 (-0.19, 0.15)		0.03 (-0.24, 0.29)		-0.02 (-0.25, 0.22)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.07	-0.09	0.37	-0.34	0.05	-0.07
PFOA weight[d]	76.6			68.4	100	
PFNA weight[d]		16.1	36.3			44.6
PFHxS weight[d]	19.9		63.7			1.6
PFOS weight[d]		71.1		31.6		53.4
Forearm BMC						
Ψ[a]	-0.18 (-0.34, -0.02)		-0.20 (-0.46, 0.07)		-0.21 (-0.44, 0.02)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.05	-0.23	0.23	-0.43	0.16	-0.37
PFOA weight[d]		23.4		51.8	87.4	
PFNA weight[d]		55.4		48.2		38.6
PFHxS weight[d]	100		12.1		12.6	
PFOS weight[d]		21.2	87.9			61.4
Spine BMC						
Ψ[a]	-0.07 (-0.23, 0.08)		-0.11 (-0.38, 0.16)		-0.01 (-0.24, 0.21)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0	-0.07	0.11	-0.22	0.12	-0.14
PFOA weight[d]		44.9		100	100	
PFNA weight[d]		13.6	45.2			33.9

PFHxS weight[d]		17.6	52.0			16.9
PFOS weight[d]		23.9	2.8			49.1
Whole-body less head aBMD						
Ψ[a]	-0.06 (-0.21, 0.10)		-0.03 (-0.28, 0.22)		-0.02 (-0.25, 0.21)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.05	-0.11	0.13	-0.16	0.04	-0.06
PFOA weight[d]		59.3		98.4	61.1	
PFNA weight[d]		25.4		0.8		55.6
PFHxS weight[d]	100		100		38.9	
PFOS weight[d]		15.4		0.8		44.4
Total hip aBMD						
Ψ[a]	-0.05 (-0.24, 0.14)		0.04 (-0.28, 0.36)		-0.08 (-0.35, 0.20)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.06	-0.12	0.36	-0.32	0.03	-0.11
PFOA weight[d]		100		82.3		11.4
PFNA weight[d]	75.2		39.9		100	
PFHxS weight[d]	20.0		60.1			62.5
PFOS weight[d]	4.8			17.7		26.1
Femoral neck aBMD						
Ψ[a]	0.11 (-0.09, 0.30)		0.05 (-0.28, 0.38)		0.17 (-0.09, 0.42)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.19	-0.08	0.33	-0.28	0.24	-0.07
PFOA weight[d]		64.1		83.3	34.4	
PFNA weight[d]	57.5		42.1		47.4	
PFHxS weight[d]	42.5		57.9		18.1	
PFOS weight[d]		35.9		16.7		100
Forearm aBMD						
Ψ[a]	-0.15 (-0.31, 0.00)		-0.09 (-0.36, 0.18)		-0.22 (-0.44, -0.01)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.00	-0.15	0.05	-0.14	0	-0.22
PFOA weight[d]		44.6		47.3		14.7
PFNA weight[d]	100			15.2		7.3
PFHxS weight[d]		5.9		37.6		8.3
PFOS weight[d]		49.4	100			69.7
Ultradistal forearm aBMD						
Ψ[a]	0.05 (-0.15, 0.24)		0.09 (-0.20, 0.38)		0.01 (-0.29, 0.31)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.3	-0.25	0.4	-0.31	0.37	-0.36
PFOA weight[d]		6.3		71.9	48.9	
PFNA weight[d]	44.6		48.0		14.8	
PFHxS weight[d]	55.4		52.0		36.4	
PFOS weight[d]		93.7		28.1		100
Spine BMAD						

Ψ[a]	-0.10 (-0.29, 0.08)		-0.16 (-0.47, 0.15)		-0.05 (-0.31, 0.22)	
Direction	Positive[b]	Negative[c]	Positive[b]	Negative[c]	Positive[b]	Negative[c]
Scaled effect	0.04	-0.14	0.12	-0.27	0.12	-0.17
PFOA weight[d]		21.1		82.9	100	
PFNA weight[d]	5.8		82.2			24.0
PFHxS weight[d]		78.9		17.1		63.4
PFOS weight[d]	94.2		17.8			12.6

Note: Difference (95% confidence interval) in bone outcome Z-score per quartile increase in all perfluoroalkyl substances, directional scaled effects, and weights estimated using quantile g-computation. Adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, and child age at follow-up. Models for the overall population are additionally adjusted for child sex and child sex * child age at follow-up. Missing covariate information accounted for using single stochastic imputation by chained equations. BMC, bone mineral content; aBMD, areal bone mineral density; BMAD, bone mineral apparent density; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

[a] Difference (95% confidence interval) in outcome Z-score per quartile increase in all perfluoroalkyl substances

[b] Difference in bone outcome Z-score per quartile increase in perfluoroalkyl substances with estimated effects in the positive direction

[c] Difference in bone outcome Z-score per quartile increase in perfluoroalkyl substances with estimated effects in the negative direction

d Weight for the percent contribution of each PFAS to the overall mixture effect (Ψ)

Table S7. Adjusted differences (95% credible intervals) in bone outcome Z-scores at age 12 years for percentiles of the maternal serum perfluoroalkyl substances mixture compared to the 50th percentile estimated using Bayesian kernel machine regression, overall and by child sex (*n* = 206): The HOME Study

Outcome	Overall (*n* = 206)	Males (*n* = 93)	Females (*n* = 113)
Whole-body less head BMC			
10th	0.05 (-0.12, 0.22)	-0.07 (-0.33, 0.20)	0.16 (-0.13, 0.45)
25th	0.03 (-0.06, 0.12)	0.01 (-0.14, 0.16)	0.05 (-0.09, 0.19)
50th	Ref	Ref	Ref
75th	-0.02 (-0.13, 0.08)	0.01 (-0.18, 0.20)	-0.02 (-0.17, 0.16)
90th	-0.05 (-0.27, 0.17)	-0.14 (-0.52, 0.24)	0.03 (-0.28, 0.34)
Total hip BMC			
10th	0.19 (-0.12, 0.51)	0.09 (-0.26, 0.44)	0.24 (-0.09, 0.57)
25th	0.10 (-0.07, 0.27)	0.10 (-0.09, 0.30)	0.10 (-0.06, 0.27)
50th	Ref	Ref	Ref
75th	-0.07 (-0.24, 0.10)	-0.04 (-0.27, 0.20)	-0.09 (-0.27, 0.10)
90th	-0.16 (-0.51, 0.18)	-0.22 (-0.69, 0.26)	-0.13 (-0.47, 0.22)
Femoral neck BMC			
10th	0.01 (-0.24, 0.25)	-0.24 (-0.62, 0.14)	0.13 (-0.22, 0.48)
25th	0.00 (-0.13, 0.14)	-0.02 (-0.23, 0.18)	0.02 (-0.15, 0.20)
50th	Ref	Ref	Ref
75th	-0.01 (-0.14, 0.13)	-0.09 (-0.34, 0.16)	0.03 (-0.16, 0.23)
90th	-0.03 (-0.33, 0.26)	-0.44 (-0.97, 0.08)	0.12 (-0.26, 0.50)
Forearm BMC			
10th	0.29 (0.01, 0.56)	0.10 (-0.25, 0.46)	0.42 (0.03, 0.82)
25th	0.16 (0.01, 0.30)	0.10 (-0.10, 0.31)	0.14 (-0.04, 0.33)
50th	Ref	Ref	Ref
75th	-0.12 (-0.27, 0.02)	-0.07 (-0.31, 0.16)	-0.15 (-0.36, 0.05)
90th	-0.18 (-0.49, 0.13)	-0.26 (-0.74, 0.22)	-0.19 (-0.59, 0.20)
Spine BMC			
10th	0.14 (-0.18, 0.45)	0.11 (-0.30, 0.52)	0.26 (-0.16, 0.68)
25th	0.07 (-0.10, 0.24)	0.11 (-0.14, 0.36)	0.04 (-0.16, 0.23)
50th	Ref	Ref	Ref
75th	-0.01 (-0.18, 0.16)	-0.07 (-0.31, 0.16)	0.09 (-0.13, 0.30)
90th	0.06 (-0.28, 0.41)	-0.26 (-0.75, 0.24)	0.26 (-0.14, 0.66)
Whole-body less head aBMD			
10th	0.10 (-0.14, 0.33)	-0.09 (-0.41, 0.24)	0.28 (-0.12, 0.68)
25th	0.05 (-0.08, 0.18)	0.01 (-0.18, 0.19)	0.06 (-0.12, 0.25)
50th	Ref	Ref	Ref
75th	-0.04 (-0.17, 0.10)	-0.07 (-0.29, 0.15)	0.01 (-0.20, 0.22)
90th	-0.05 (-0.34, 0.23)	-0.31 (-0.77, 0.15)	0.16 (-0.23, 0.56)
Total hip aBMD			
10th	0.05 (-0.20, 0.31)	-0.11 (-0.57, 0.35)	0.32 (-0.13, 0.77)
25th	0.03 (-0.11, 0.18)	0.00 (-0.27, 0.26)	0.11 (-0.10, 0.32)

50th	Ref	Ref	Ref
75th	-0.03 (-0.18, 0.12)	-0.03 (-0.31, 0.26)	0.02 (-0.22, 0.26)
90th	-0.05 (-0.37, 0.27)	-0.25 (-0.85, 0.35)	0.16 (-0.30, 0.61)
Femoral neck aBMD			
10th	-0.07 (-0.37, 0.24)	-0.19 (-0.67, 0.28)	0.11 (-0.33, 0.54)
25th	-0.05 (-0.22, 0.11)	-0.04 (-0.31, 0.23)	0.00 (-0.21, 0.20)
50th	Ref	Ref	Ref
75th	0.11 (-0.05, 0.27)	-0.03 (-0.33, 0.26)	0.25 (0.02, 0.48)
90th	0.22 (-0.13, 0.57)	-0.32 (-0.93, 0.30)	0.56 (0.13, 0.99)
Forearm aBMD			
10th	0.20 (-0.03, 0.43)	0.07 (-0.23, 0.38)	0.34 (-0.06, 0.74)
25th	0.12 (-0.01, 0.25)	0.04 (-0.14, 0.22)	0.14 (-0.05, 0.33)
50th	Ref	Ref	Ref
75th	-0.10 (-0.23, 0.03)	-0.05 (-0.25, 0.16)	-0.10 (-0.31, 0.11)
90th	-0.16 (-0.44, 0.12)	-0.16 (-0.58, 0.26)	-0.11 (-0.51, 0.29)
Ultradistal forearm aBMD			
10th	0.07 (-0.29, 0.43)	-0.23 (-0.61, 0.14)	0.54 (-0.08, 1.16)
25th	0.01 (-0.18, 0.20)	-0.07 (-0.29, 0.14)	0.15 (-0.13, 0.44)
50th	Ref	Ref	Ref
75th	0.07 (-0.12, 0.26)	-0.03 (-0.28, 0.22)	0.19 (-0.12, 0.50)
90th	0.15 (-0.25, 0.54)	-0.32 (-0.83, 0.19)	0.47 (-0.10, 1.04)
Spine BMAD			
10th	0.02 (-0.27, 0.32)	-0.01 (-0.39, 0.37)	0.11 (-0.26, 0.47)
25th	0.03 (-0.13, 0.19)	0.05 (-0.16, 0.27)	0.04 (-0.15, 0.22)
50th	Ref	Ref	Ref
75th	-0.09 (-0.24, 0.07)	-0.15 (-0.40, 0.10)	-0.01 (-0.23, 0.20)
90th	-0.18 (-0.52, 0.16)	-0.57 (-1.10, -0.04)	-0.02 (-0.42, 0.38)

Note: Differences (95% credible intervals) in bone outcome Z-scores estimated using Bayesian kernel machine regression. Adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, and child age at follow-up. Models for the overall population are additionally adjusted for child sex and child sex * child age at follow-up. Missing covariate information accounted for using single stochastic imputation by chained equations. BMC, bone mineral content; aBMD, areal bone mineral density; BMAD, bone mineral apparent density.

Table S8. Posterior inclusion probabilities estimated in Bayesian kernel machine regression models of adjusted associations of maternal serum perfluoroalkyl substances concentrations with bone outcome Z-scores at age 12 years, overall and by child sex (*n* = 206): The HOME Study

	Overall				Males				Females			
Outcome	PFOA	PFNA	PFHxS	PFOS	PFOA	PFNA	PFHxS	PFOS	PFOA	PFNA	PFHxS	PFOS
BMC Z-score												
Whole-body less head	0.29	0.29	0.28	0.27	0.57	0.39	0.51	0.44	0.39	0.37	0.36	0.39
Total hip	0.57	0.45	0.40	0.37	0.64	0.46	0.50	0.42	0.37	0.40	0.45	0.43
Femoral neck	0.36	0.34	0.38	0.34	0.60	0.46	0.61	0.47	0.33	0.34	0.34	0.32
Forearm	0.54	0.66	0.37	0.41	0.78	0.49	0.51	0.62	0.41	0.60	0.40	0.55
Spine	0.45	0.44	0.41	0.43	0.62	0.42	0.44	0.41	0.52	0.47	0.41	0.44
BMD Z-score												
Whole-body less head aBMD	0.38	0.40	0.34	0.34	0.43	0.38	0.43	0.39	0.45	0.45	0.42	0.44
Total hip aBMD	0.38	0.29	0.34	0.29	0.52	0.43	0.48	0.46	0.45	0.46	0.45	0.43
Femoral neck aBMD	0.38	0.47	0.41	0.40	0.54	0.46	0.53	0.48	0.54	0.64	0.49	0.50
Forearm aBMD	0.54	0.37	0.37	0.36	0.54	0.41	0.43	0.42	0.45	0.46	0.45	0.46
Ultradistal forearm aBMD	0.41	0.42	0.41	0.45	0.59	0.55	0.47	0.49	0.69	0.58	0.48	0.66
Spine BMAD	0.33	0.30	0.50	0.33	0.82	0.45	0.47	0.44	0.42	0.33	0.51	0.36

Note: Posterior inclusion probabilities estimated using Bayesian kernel machine regression. Adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, and child age at follow-up. Models for the overall population are additionally adjusted for child sex and child sex * child age at follow-up. Missing covariate information accounted for using single stochastic imputation by chained equations. Sample size: overall, n=206; males, n=93; females, n=113. BMC, bone mineral content; aBMD, areal bone mineral density; BMAD, bone mineral apparent density; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

Table S9. Adjusted estimates of natural indirect (lean body mass index mediated) and natural direct effects of maternal serum perfluoroalkyl substances concentrations on BMD Z-scores at age 12 years, overall (*n* = 206): The HOME Study

Outcome	PFOA	PFNA	PFHxS	PFOS
Whole-body less head aBMD				
NIE	-0.03 (-0.12, 0.04)	-0.05 (-0.16, 0.03)	0.01 (-0.04, 0.07)	-0.03 (-0.09, 0.03)
NDE	-0.05 (-0.22, 0.10)	-0.06 (-0.27, 0.13)	-0.01 (-0.12, 0.09)	0.02 (-0.12, 0.14)
Total hip aBMD				
NIE	-0.04 (-0.14, 0.05)	-0.07 (-0.19, 0.04)	0.02 (-0.04, 0.08)	-0.03 (-0.11, 0.04)
NDE	-0.08 (-0.26, 0.08)	0.00 (-0.24, 0.26)	-0.05 (-0.18, 0.09)	0.02 (-0.15, 0.19)
Femoral neck aBMD				
NIE	-0.04 (-0.14, 0.05)	-0.07 (-0.20, 0.04)	0.02 (-0.05, 0.09)	-0.03 (-0.11, 0.04)
NDE	0.03 (-0.16, 0.20)	0.20 (-0.03, 0.44)	0.03 (-0.11, 0.16)	0.08 (-0.10, 0.26)
Forearm aBMD				
NIE	-0.03 (-0.10, 0.03)	-0.05 (-0.13, 0.02)	0.01 (-0.03, 0.05)	-0.02 (-0.08, 0.02)
NDE	-0.14 (-0.31, 0.03)	-0.08 (-0.31, 0.12)	-0.10 (-0.03, 0.05)	-0.06 (-0.21, 0.07)
Ultradistal forearm aBMD				
NIE	-0.04 (-0.14, 0.06)	-0.07 (-0.21, 0.04)	0.02 (-0.05, 0.09)	-0.03 (-0.12, 0.04)
NDE	0.02 (-0.22, 0.23)	0.11 (-0.16, 0.36)	-0.03 (-0.20, 0.13)	-0.06 (-0.29, 0.14)
Spine BMAD				
NIE	-0.03 (-0.11, 0.04)	-0.06 (-0.16, 0.03)	0.01 (-0.04, 0.07)	-0.03 (-0.09, 0.03)
NDE	-0.05 (-0.25, 0.12)	0.00 (-0.21, 0.20)	-0.12 (-0.26, 0.00)	0.01 (-0.15, 0.15)

Note: Difference (95% confidence interval) in outcome Z-score per $\log_2$ unit increase in perfluoroalkyl substance concentration estimated in separate linear regression models adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, child sex, child age at follow-up, child sex * child age at follow-up. Indirect and direct effects were estimated using structural equation models, maximum likelihood estimation, and bias-corrected and accelerated bootstrap confidence intervals. Missing covariate information accounted for using full-information maximum likelihood. aBMD, areal bone mineral density; BMAD, bone mineral apparent density; NIE, natural indirect effect; NDE, natural direct effect; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

Table S10. Adjusted estimates of natural indirect (lean body mass index mediated) and natural direct effects of maternal serum perfluoroalkyl substances concentrations on BMD Z-scores at age 12 years, males (*n* = 93): The HOME Study

Outcome	PFOA	PFNA	PFHxS	PFOS
Whole-body less head aBMD				
NIE	-0.08 (-0.27, 0.05)	0.01 (-0.23, 0.21)	0.07 (-0.03, 0.21)	0.00 (-0.13, 0.14)
NDE	-0.03 (-0.26, 0.19)	-0.12 (-0.45, 0.22)	-0.02 (-0.20, 0.14)	0.03 (-0.20, 0.22)
Total hip aBMD				
NIE	-0.10 (-0.32, 0.05)	0.01 (-0.28, 0.25)	0.09 (-0.03, 0.27)	0.00 (-0.15, 0.17)
NDE	-0.07 (-0.36, 0.20)	-0.01 (-0.50, 0.54)	-0.01 (-0.23, 0.21)	0.06 (-0.27, 0.34)
Femoral neck aBMD				
NIE	-0.11 (-0.34, 0.06)	0.01 (-0.30, 0.26)	0.10 (-0.03, 0.28)	0.00 (-0.17, 0.18)
NDE	-0.07 (-0.35, 0.18)	0.07 (-0.38, 0.58)	-0.04 (-0.28, 0.18)	0.07 (-0.27, 0.36)
Forearm aBMD				
NIE	-0.07 (-0.24, 0.03)	0.01 (-0.21, 0.18)	0.07 (-0.02, 0.19)	0.00 (-0.11, 0.12)
NDE	-0.12 (-0.35, 0.09)	0.02 (-0.34, 0.37)	-0.16 (-0.36, 0.02)	0.01 (-0.23, 0.25)
Ultradistal forearm aBMD				
NIE	-0.09 (-0.27, 0.05)	0.01 (-0.23, 0.22)	0.08 (-0.03, 0.23)	-0.09 (-0.27, 0.05)
NDE	-0.05 (-0.30, 0.21)	0.21 (-0.21, 0.22)	-0.04 (-0.25, 0.16)	-0.05 (-0.30, 0.21)
Spine BMAD				
NIE	-0.07 (-0.23, 0.03)	0.01 (-0.19, 0.17)	0.06 (-0.02, 0.20)	0.00 (-0.11, 0.12)
NDE	-0.24 (-0.54, 0.05)	0.01 (-0.35, 0.37)	-0.15 (-0.36, 0.06)	-0.05 (-0.31, 0.22)

Note: Difference (95% confidence interval) in outcome Z-score per $\log_2$ unit increase in perfluoroalkyl substance concentration estimated in separate linear regression models adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, and child age at follow-up. Indirect and direct effects were estimated using structural equation models, maximum likelihood estimation, and bias-corrected and accelerated bootstrap confidence intervals. Missing covariate information accounted for using full-information maximum likelihood. aBMD, areal bone mineral density; BMAD, bone mineral apparent density; NIE, natural indirect effect; NDE, natural direct effect; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

Table S11. Adjusted estimates of natural indirect (lean body mass index mediated) and natural direct effects of maternal serum perfluoroalkyl substances concentrations on BMD Z-scores at age 12 years, females (*n* = 113): The HOME Study

Outcome	PFOA	PFNA	PFHxS	PFOS
Whole-body less head aBMD				
NIE	-0.01 (-0.12, 0.08)	-0.07 (-0.22, 0.00)	-0.02 (-0.08, 0.02)	-0.05 (-0.15, 0.01)
NDE	0.01 (-0.26, 0.23)	0.00 (-0.27, 0.27)	0.00 (-0.15, 0.15)	0.05 (-0.17, 0.23)
Total hip aBMD				
NIE	-0.01 (-0.13, 0.11)	-0.10 (-0.25, 0.00)	-0.02 (-0.10, 0.03)	-0.06 (-0.18, 0.01)
NDE	-0.09 (-0.37, 0.16)	-0.02 (-0.27, 0.33)	-0.08 (-0.27, 0.10)	-0.02 (-0.26, 0.19)
Femoral neck aBMD				
NIE	-0.01 (-0.13, 0.11)	-0.10 (-0.26, 0.00)	-0.02 (-0.09, 0.04)	-0.06 (-0.17, 0.02)
NDE	0.11 (-0.17, 0.37)	0.27 (0.00, 0.56)	0.04 (-0.15, 0.23)	0.06 (-0.19, 0.30)
Forearm aBMD				
NIE	0.00 (-0.08, 0.05)	-0.04 (-0.16, 0.01)	-0.01 (-0.08, 0.01)	-0.03 (-0.13, 0.00)
NDE	-0.08 (-0.35, 0.18)	-0.13 (-0.42, 0.16)	-0.10 (-0.22, 0.03)	-0.10 (-0.34, 0.09)
Ultradistal forearm aBMD				
NIE	-0.01 (-0.15, 0.14)	-0.12 (-0.31, 0.00)	-0.02 (-0.12, 0.05)	-0.06 (-0.20, 0.02)
NDE	0.17 (-0.23, 0.50)	0.12 (-0.26, 0.46)	-0.02 (-0.25, 0.20)	-0.07 (-0.43, 0.21)
Spine BMAD				
NIE	-0.01 (-0.13, 0.10)	-0.09 (-0.24, 0.00)	-0.02 (-0.09, 0.03)	-0.06 (-0.17, 0.02)
NDE	0.08 (-0.19, 0.33)	0.03 (-0.26, 0.31)	-0.12 (-0.30, 0.06)	0.03 (-0.21, 0.22)

Note: Difference (95% confidence interval) in outcome Z-score per $\log_2$ unit increase in perfluoroalkyl substance concentration estimated in separate linear regression models adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, and child age at follow-up. Indirect and direct effects were estimated using structural equation models, maximum likelihood estimation, and bias-corrected and accelerated bootstrap confidence intervals. Missing covariate information accounted for using full-information maximum likelihood. aBMD, areal bone mineral density; BMAD, bone mineral apparent density; NIE, natural indirect effect; NDE, natural direct effect; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

Table S12. Adjusted estimates of empirical mean (95% credible interval) natural indirect effects and natural direct effects from Bayesian kernel machine regression causal mediation analysis models of the maternal serum perfluoroalkyl substances mixture with bone outcome Z-scores at age 12 years, overall and by child sex (*n* = 206): The HOME Study

Outcome	Overall (*n* = 206)	Males (*n* = 93)	Females (*n* = 113)
Whole-body less head BMC			
NIE	0.01 (-0.20, 0.21)	0.01 (-0.30, 0.33)	0.01 (-0.27, 0.28)
NDE	-0.03 (-0.23, 0.18)	-0.02 (-0.35, 0.30)	-0.02 (-0.30, 0.25)
Total hip BMC			
NIE	-0.02 (-0.27, 0.23)	0.00 (-0.39, 0.39)	-0.04 (-0.36, 0.26)
NDE	-0.07 (-0.33, 0.18)	-0.10 (-0.50, 0.28)	-0.07 (-0.39, 0.23)
Femoral neck BMC			
NIE	0.00 (-0.24, 0.23)	0.01 (-0.38, 0.40)	-0.01 (-0.34, 0.31)
NDE	0.00 (-0.23, 0.23)	-0.05 (-0.45, 0.35)	0.02 (-0.29, 0.34)
Forearm BMC			
NIE	0.01 (-0.29, 0.30)	0.03 (-0.36, 0.45)	-0.03 (-0.41, 0.35)
NDE	-0.15 (-0.44, 0.13)	-0.14 (-0.58, 0.25)	-0.15 (-0.53, 0.21)
Spine BMC			
NIE	-0.01 (-0.22, 0.20)	-0.02 (-0.36, 0.32)	-0.02 (-0.33, 0.30)
NDE	-0.01 (-0.22, 0.20)	-0.07 (-0.43, 0.28)	0.04 (-0.27, 0.36)
Whole-body less head aBMD			
NIE	-0.02 (-0.24, 0.21)	0.00 (-0.36, 0.35)	-0.02 (-0.33, 0.29)
NDE	-0.01 (-0.23, 0.21)	-0.04 (-0.41, 0.31)	0.01 (-0.29, 0.31)
Total hip aBMD			
NIE	-0.02 (-0.31, 0.25)	-0.01 (-0.45, 0.43)	-0.02 (-0.38, 0.34)
NDE	-0.01 (-0.29, 0.27)	0.00 (-0.45, 0.44)	-0.02 (-0.38, 0.34)
Femoral neck aBMD			
NIE	-0.05 (-0.34, 0.24)	-0.02 (-0.49, 0.44)	-0.06 (-0.45, 0.34)
NDE	0.09 (-0.19, 0.39)	0.02 (-0.45, 0.48)	0.18 (-0.19, 0.59)
Forearm aBMD			
NIE	0.03 (-0.23, 0.29)	0.02 (-0.33, 0.37)	0.02 (-0.32, 0.37)
NDE	-0.13 (-0.40, 0.12)	-0.08 (-0.44, 0.27)	-0.12 (-0.48, 0.20)
Ultradistal forearm aBMD			
NIE	0.00 (-0.28, 0.29)	0.01 (-0.38, 0.41)	-0.01 (-0.48, 0.46)
NDE	0.00 (-0.28, 0.28)	0.00 (-0.40, 0.40)	0.06 (-0.40, 0.52)
Spine BMAD			
NIE	0.00 (-0.26, 0.27)	0.04 (-0.40, 0.58)	-0.01 (-0.39, 0.36)
NDE	-0.05 (-0.34, 0.21)	-0.21 (-0.77, 0.24)	-0.02 (-0.40, 0.35)

Note: Empirical mean (95% credible interval) natural indirect effects and natural direct effects estimated using Bayesian kernel machine regression causal mediation analysis. Adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, and child age at follow-up. Models for the overall population are additionally adjusted for child sex and child sex * child age at follow-up. NDEs estimate the average difference (95% credible interval) in the counterfactual outcomes for a change in exposures from the 75th percentile to the 25th percentile, fixing the mediator to the level it would have taken if the exposures were at the 25th

percentile. NIEs estimate the average difference (95% credible interval) in counterfactual outcomes when the exposures are fixed to the 75th percentile, but the mediator varies from the value it would have taken if the exposures were set to the 75th compared to the 25th percentile. Missing covariate information accounted for using single stochastic imputation by chained equations. BMC, bone mineral content; aBMD, areal bone mineral density; BMAD, bone mineral apparent density; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid; TE, total effect; NDE, natural direct effect; NIE, natural indirect effect.

Table S13. Adjusted associations of maternal serum perfluoroalkyl substances concentrations with bone outcome Z-scores at 12 years of age (*n* = 206): The HOME Study. Sensitivity analysis with additional adjustment for Tanner stage at age 12 years

Outcome	PFOA	PFNA	PFHxS	PFOS
BMC Z-score				
Whole-body less head	-0.08 (-0.23, 0.07)	-0.07 (-0.23, 0.10)	0.00 (-0.10, 0.11)	-0.04 (-0.17, 0.10)
Total hip	-0.19 (-0.35, -0.03)	-0.18 (-0.36, 0.01)	-0.05 (-0.16, 0.07)	-0.09 (-0.23, 0.05)
Femoral neck	-0.07 (-0.25, 0.11)	-0.05 (-0.25, 0.15)	0.02 (-0.11, 0.14)	-0.01 (-0.17, 0.15)
Forearm	-0.19 (-0.38, 0.00)	-0.24 (-0.44, -0.05)	-0.02 (-0.14, 0.09)	-0.08 (-0.23, 0.07)
Spine	-0.12 (-0.27, 0.04)	-0.10 (-0.29, 0.09)	-0.03 (-0.14, 0.08)	-0.06 (-0.21, 0.08)
BMD Z-score				
Whole-body less head aBMD	-0.11 (-0.28, 0.06)	-0.11 (-0.31, 0.09)	-0.01 (-0.12, 0.10)	-0.03 (-0.17, 0.12)
Total hip aBMD	-0.14 (-0.32, 0.05)	-0.06 (-0.30, 0.18)	-0.03 (-0.17, 0.11)	-0.02 (-0.19, 0.15)
Femoral neck aBMD	-0.02 (-0.22, 0.17)	0.14 (-0.10, 0.37)	0.04 (-0.10, 0.18)	0.03 (-0.15, 0.22)
Forearm aBMD	-0.17 (-0.35, 0.00)	-0.12 (-0.34, 0.09)	-0.09 (-0.20, 0.01)	-0.09 (-0.23, 0.05)
Ultradistal forearm aBMD	-0.02 (-0.24, 0.20)	0.04 (-0.22, 0.30)	-0.01 (-0.16, 0.15)	-0.09 (-0.29, 0.12)
Spine BMAD	-0.11 (-0.30, 0.08)	-0.04 (-0.25, 0.17)	-0.12 (-0.26, 0.02)	-0.03 (-0.20, 0.13)

Note: Difference (95% confidence interval) in bone outcome Z-score per $\log_2$ unit increase in perfluoroalkyl substance concentrations estimated in separate linear regression models adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, child sex, child age at follow-up, child sex * child age at follow-up, and Tanner stage at follow-up. Missing covariate information accounted for using full-information maximum likelihood. BMC, bone mineral content; aBMD, areal bone mineral density; BMAD, bone mineral apparent density; PFOA, perfluorooctanoic acid; PFNA, perfluorononanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

Table S14. Adjusted associations of maternal serum perfluoroalkyl substance concentrations with bone outcome Z-scores at 12 years of age among males (*n* = 93) and females (*n* = 113): The HOME Study. Sensitivity analysis with additional adjustment for Tanner stage at age 12 years

Outcome	PFOA	PFNA	PFHxS	PFOS
Whole-body less head BMC				
Males	-0.13 (-0.34, 0.09)	-0.02 (-0.32, 0.27)	0.08 (-0.06, 0.22)	0.06 (-0.13, 0.24)
Females	0.01 (-0.19, 0.21)	-0.04 (-0.25, 0.17)	-0.04 (-0.17, 0.09)	-0.07 (-0.27, 0.13)
EMM p-value[a]	0.36	0.91	0.23	0.37
Total hip BMC				
Males	-0.24 (-0.49, 0.01)	-0.15 (-0.52, 0.21)	0.04 (-0.14, 0.22)	-0.03 (-0.27, 0.21)
Females	-0.15 (-0.35, 0.05)	-0.15 (-0.35, 0.05)	-0.12 (-0.25, 0.01)	-0.16 (-0.32, 0.00)
EMM p-value[a]	0.58	1.00	0.15	0.39
Femoral neck BMC				
Males	-0.14 (-0.41, 0.14)	0.02 (-0.35, 0.39)	0.06 (-0.14, 0.25)	0.03 (-0.21, 0.27)
Females	-0.01 (-0.25, 0.23)	-0.04 (-0.28, 0.20)	-0.02 (-0.17, 0.13)	-0.04 (-0.25, 0.17)
EMM p-value[a]	0.49	0.80	0.55	0.67
Forearm BMC				
Males	-0.25 (-0.53, 0.04)	-0.14 (-0.49, 0.20)	0.05 (-0.14, 0.25)	0.10 (-0.15, 0.36)
Females	-0.07 (-0.29, 0.15)	-0.26 (-0.50, -0.01)	-0.08 (-0.23, 0.06)	-0.20 (-0.42, 0.01)
EMM p-value[a]	0.34	0.60	0.26	0.07
Spine BMC				
Males	-0.21 (-0.44, 0.03)	-0.01 (-0.38, 0.36)	-0.02 (-0.20, 0.16)	-0.03 (-0.27, 0.21)
Females	-0.03 (-0.27, 0.20)	-0.11 (-0.35, 0.12)	-0.03 (-0.17, 0.10)	-0.08 (-0.27, 0.11)
EMM p-value[a]	0.30	0.65	0.89	0.77
Whole-body less head aBMD				
Males	-0.12 (-0.36, 0.12)	-0.07 (-0.42, 0.28)	0.01 (-0.16, 0.19)	0.02 (-0.20, 0.24)
Females	-0.02 (-0.25, 0.21)	-0.06 (-0.31, 0.19)	-0.01 (-0.15, 0.13)	0.00 (-0.20, 0.19)
EMM p-value[a]	0.57	0.97	0.83	0.87
Total hip aBMD				
Males	-0.17 (-0.47, 0.13)	0.03 (-0.47, 0.53)	0.05 (-0.15, 0.26)	0.06 (-0.24, 0.36)
Females	-0.12 (-0.36, 0.13)	-0.07 (-0.34, 0.20)	-0.10 (-0.28, 0.08)	-0.09 (-0.30, 0.13)
EMM p-value[a]	0.78	0.74	0.27	0.43

Femoral neck aBMD				
Males	-0.17 (-0.49, 0.14)	0.11 (-0.39, 0.60)	0.03 (-0.19, 0.25)	0.07 (-0.24, 0.38)
Females	0.09 (-0.17, 0.34)	0.18 (-0.08, 0.44)	0.02 (-0.16, 0.21)	-0.01 (-0.24, 0.23)
EMM p-value[a]	0.20	0.80	0.96	0.70
Forearm aBMD				
Males	-0.19 (-0.42, 0.03)	0.05 (-0.30, 0.39)	-0.12 (-0.31, 0.08)	0.01 (-0.23, 0.25)
Females	-0.10 (-0.34, 0.15)	-0.16 (-0.43, 0.10)	-0.10 (-0.22, 0.01)	-0.13 (-0.33, 0.07)
EMM p-value[a]	0.57	0.34	0.89	0.37
Ultradistal forearm aBMD				
Males	-0.14 (-0.41, 0.14)	0.23 (-0.24, 0.70)	0.03 (-0.17, 0.23)	0.08 (-0.21, 0.38)
Females	0.18 (-0.14, 0.49)	0.02 (-0.30, 0.33)	-0.04 (-0.24, 0.17)	-0.12 (-0.42, 0.17)
EMM p-value[a]	0.14	0.46	0.65	0.34
Spine BMAD				
Males	-0.31 (-0.58, -0.04)	0.04 (-0.32, 0.39)	-0.11 (-0.31, 0.10)	-0.05 (-0.31, 0.20)
Females	0.02 (-0.26, 0.29)	-0.05 (-0.33, 0.23)	-0.14 (-0.33, 0.04)	-0.05 (-0.29, 0.19)
EMM p-value[a]	0.10	0.69	0.81	0.99

Note: Difference (95% confidence interval) in bone outcome Z-score per $\log_2$ unit increase in perfluoroalkyl substance concentration estimated in separate linear regression models adjusted for maternal age at delivery, mid-pregnancy BMI, race/ethnicity, household income, parity, prenatal vitamin use, average blood lead concentration, and child age and Tanner stage at follow-up. Missing covariate information accounted for using full-information maximum likelihood. BMC, bone mineral content; aBMD, areal bone mineral density; BMAD, bone mineral apparent density; EMM, effect measure modification; PFOA, perfluorooctanoic acid; PFNA, perfluoronoanoic acid; PFHxS, perfluorohexane sulfonic acid; PFOS, perfluorooctane sulfonic acid.

[a] p-value for EMM by child sex calculated with a two-sample z-test.

Figure S1. HOME Study eligibility and enrollment flowchart for study inclusion

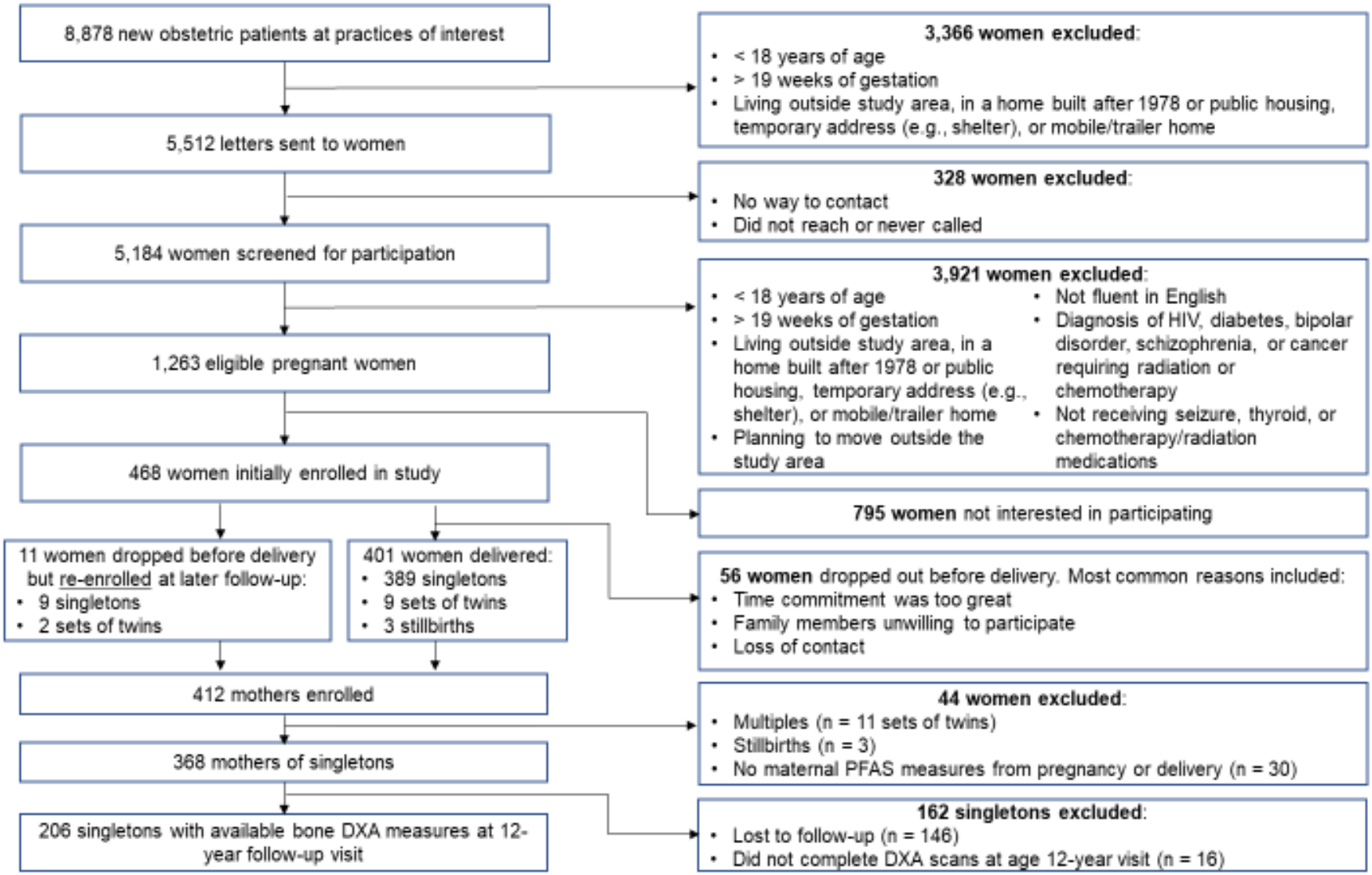

Figure S2. Directed acyclic graph for the relationship of maternal serum PFAS concentrations with child bone outcomes at age 12 years: The HOME Study.