

Overview of Perfluorochemical (**PFC**) Results in Biomonitoring CA Studies

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12 PFCs measured by Biomonitoring CA

2-(N-Ethylperfluorooctane sulfonamido) acetic acid	Et-PFOSA-AcOH
2-(N-Methylperfluorooctane sulfonamido) acetic acid	Me-PFOSA-AcOH
Perfluorobutane sulfonic acid	PFBS
Perfluorodecanoic acid	PFDeA
Perfluorododecanoic acid	PFDoA
Perfluoroheptanoic acid	PFHpA
Perfluorohexane sulfonic acid	PFHxS
Perfluorononanoic acid	PFNA
Perfluorooctane sulfonamide	PFOSA
Perfluorooctane sulfonic acid	PFOS
Perfluorooctanoic acid	PFOA
Perfluoroundecanoic acid	PFUA

Biomonitoring CA Studies

- ✧ California Teachers Study (**CTS**), lab collaboration
 - 2011-14; n=1337
 - Majority white, females, median age in 60's
 - All of CA

- ◆ Expanded Biomonitoring Exposures Study (**EBEST**)
 - 2013; n=337
 - Oversampled for Hispanics & Asian/Pacific Islanders, median age in 40's
 - Kaiser Permanente Northern CA collaboration, Central Valley

- ✚ Pilot BEST (**PBEST**)
 - 2011-12; n=110
 - Evenly distributed race/ethnicity, median age in 50's
 - Kaiser Permanente Northern CA collaboration, Central Valley

** The n presented is the number of study participants with PFCs measured.*

Biomonitoring CA Studies (*continued*)

- Firefighter Occupational Exposures (**FOX**) Project
 - 2010-11; n=101
 - Majority white, mostly male, mean age in 40's
 - Southern CA

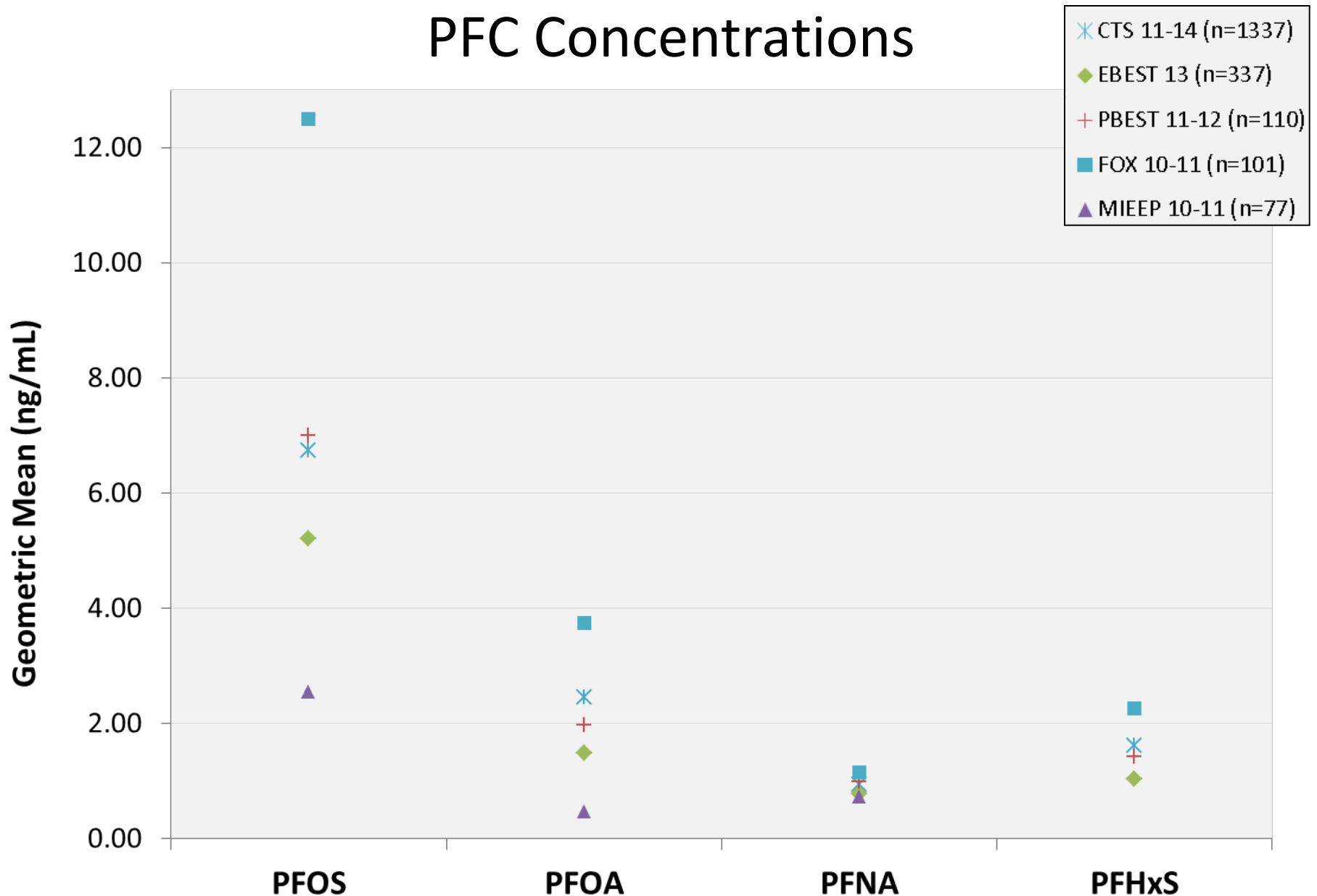
- ▲ Maternal and Infant Environmental Exposure Project (**MIEEP**)
 - 2010-11; n=77
 - Majority Latina, pregnant females
 - San Francisco General Hospital

** The n presented is the number of study participants with PFCs measured.*

Detection Frequencies

- PFOS, PFOA, PFNA, PFHxS
 - Most studies $\geq 98\%$
- PFBS
 - Most studies $< 12\%$
- Detection frequencies varied for other PFCs

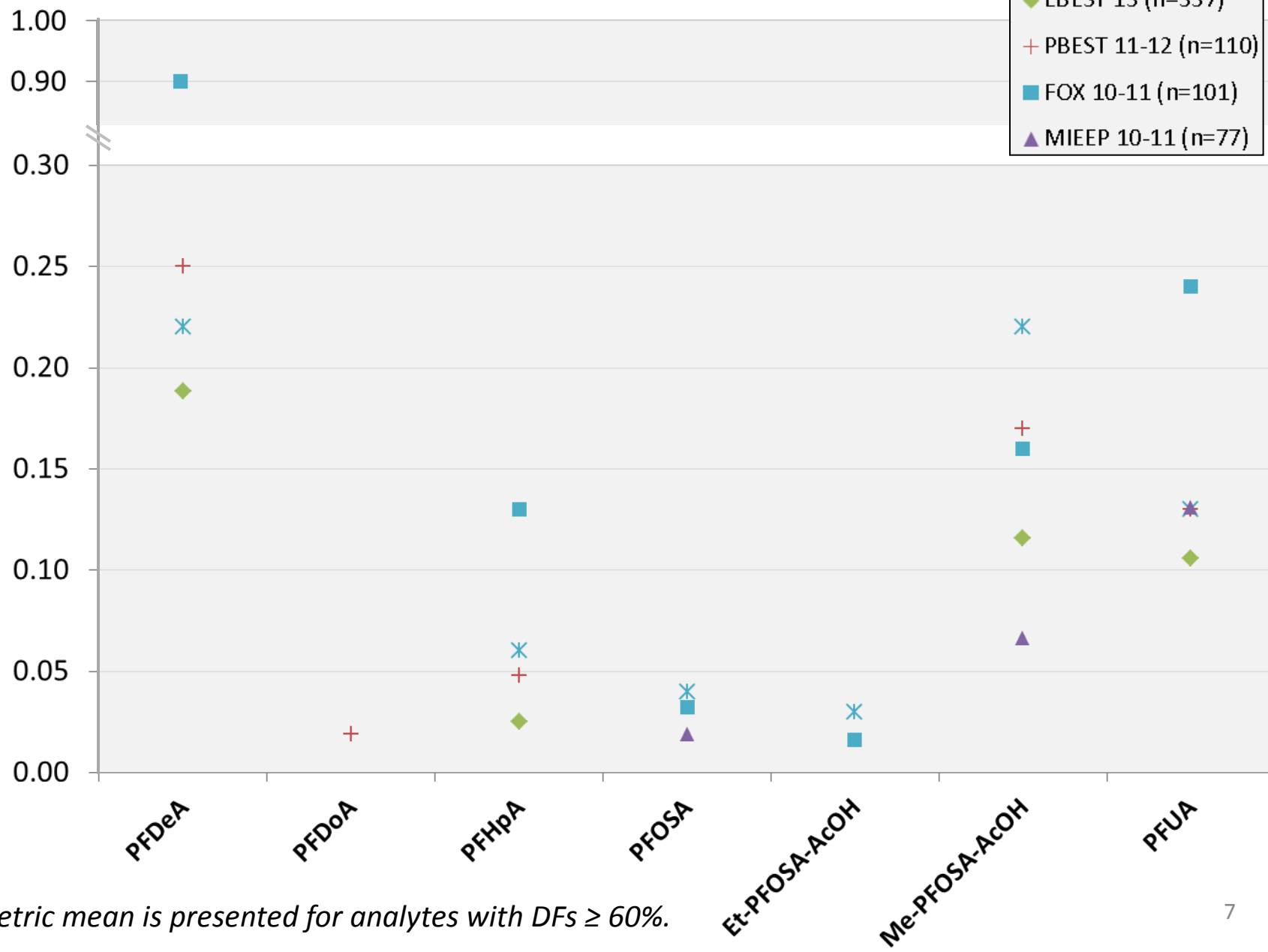
PFC Concentrations



* Geometric mean is presented for analytes with detection frequencies (DF) $\geq 60\%$.
PFHxS not measured in MIEEP.

PFC Concentrations (*continued*)

Geometric Mean (ng/mL)



* Geometric mean is presented for analytes with DFs $\geq 60\%$.

ORIGINAL ARTICLE

Biomonitoring in California Firefighters

Metals and Perfluorinated Chemicals

Dina Dobraca, MPH, Leslie Israel, DO, MPH, Sandra McNeel, DVM, Robert Voss, MS, Miaomiao Wang, PhD, Ryszard Gajek, PhD, June-Soo Park, PhD, Suhash Harwani, PhD, Frank Barley, PhD, Jianwen She, PhD, and Rupali Das, MD, MPH

TABLE 4. Serum PFC Concentrations ($\mu\text{g/L}$) in FOX Firefighters, 2010 to 2011, Compared with NHANES*

Serum PFCs	Population	n	LOD	DF (%)	25th	50th	75th	95th	Maximum	Geometric Mean [‡] (95% CI)
PFOS	FOX	101	0.083	100	10.10	12.70	16.80	24.70	46.60	12.50 (11.34, 13.78)
Perfluorooctane sulfonic acid	NHANES	876	0.2	99.8	8.30	12.30	17.60	40.40	281.0	12.13 (10.43, 14.10)
PFOA	FOX	101	0.301	100	2.96	3.86	4.89	9.54	18.10	3.75 (3.37, 4.17)
Perfluorooctanoic acid	NHANES	876	0.1	99.7	2.70	3.70	5.10	8.20	24.00	3.61 (3.28, 3.98)
PFHxS	FOX	101	0.012	100	1.61	2.27	3.13	4.64	13.20	2.26 (2.00, 2.54)
Perfluorohexane sulfonic acid	NHANES	876	0.1	99.6	1.40	2.20	3.40	6.90	44.80	2.15 (1.93, 2.40)
PFNA	FOX	101	0.075	100	0.89	1.13	1.49	2.21	4.23	1.15 (1.06, 1.25)
Perfluorononanoic acid	NHANES	876	0.082	99.8	0.98	1.31	1.89	4.18	17.95	1.40 (1.20, 1.63)
PFDeA	FOX	101	0.032	100	0.51	0.72	1.72	2.63	4.60	0.90 (0.78, 1.03)
Perfluorodecanoic acid	NHANES	876	0.1	96.4	0.20	0.30	0.40	0.90	20.70	0.30 (0.28, 0.34)
PFHpA	FOX	101	0.059	75.2	0.06	0.12	0.22	0.63	0.98	0.13 (0.11, 0.15)
Perfluoroheptanoic acid	NHANES	876	0.1	16.3	<LOD	<LOD	<LOD	0.20	1.00	—
PFOSA	FOX	101	0.009	95.0	0.019	0.029	0.050	0.151	0.396	0.032 (0.027, 0.037)
Perfluorooctane sulfonamide	NHANES	876	0.1	0.1	<LOD	<LOD	<LOD	<LOD	0.10	—
N-MeFOSAA	FOX	101	0.013	100	0.09	0.14	0.24	0.61	1.86	0.16 (0.13, 0.18)
2-(N-methyl-PFOSA) acetic acid	NHANES	876	0.1	75.9	0.10	0.20	0.30	1.00	3.80	0.19 (0.18, 0.21)
N-EtFOSAA	FOX	101	0.011	65.3	<LOD	0.016	0.023	0.060	0.464	0.016 (0.014, 0.018)
2-(N-ethyl-PFOSA) acetic acid	NHANES	876	0.1	6.0	<LOD	<LOD	<LOD	0.10	1.00	—
PFUA	FOX	101	0.010	100	0.17	0.26	0.37	0.53	0.73	0.24 (0.21, 0.27)
Perfluoroundecanoic acid	NHANES	876	0.1	75.4	0.10	0.20	0.30	0.90	28.50	0.18 (0.16, 0.21)
PFDaA	FOX	101	0.040	0.0	<LOD	<LOD	<LOD	<LOD	<LOD	—
Perfluorododecanoic acid	NHANES	876	0.1	4.6	<LOD	<LOD	<LOD	<LOD	2.80	—
PFBuS	FOX	101	0.020	6.9	<LOD	<LOD	<LOD	0.02	0.04	—
Perfluorobutane sulfonic acid	NHANES	876	0.1	0.7	<LOD	<LOD	<LOD	<LOD	0.40	—

[‡]Geometric means were calculated for analytes detected in more than 60% of samples.

*2009 to 2010 NHANES males aged 20 years or older.

CI, confidence intervals; DF, detection frequency; LOD, limit of detection; NHANES, National Health and Nutrition Examination Survey.

Next Steps for EBEST and PBEST

- Compare to NHANES using appropriate gender, age, race/ethnicity groups
- Examine gender, age, race/ethnicity differences within each study
- Analyze exposure questionnaire data