BIOMONITORING CALIFORNIA

Serum PFAS levels and their predictors in San Francisco Bay Area Asian and Pacific Islander Communities

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Biomonitoring California
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Asian/Pacific Islander Community Exposures (ACE) Study

- In EBEST, Asian/Pacific Islanders had elevated levels of
  - Metals: arsenic and mercury
  - PFASs
- Community-based study to biomonitor Asian populations in San Francisco and San Jose
  - Metals and PFASs
- Project to address data-gap related to specific Asian sub-populations

Two phases of ACE

- ACE 1 – Chinese Americans primarily in San Francisco
  - Collaborated with APA Family Support Services
  - Samples collected in 2016

- ACE 2 – Vietnamese Americans primarily in San Jose
  - Collaborated with Vietnamese Voluntary Foundation (VIVO)
  - Samples collected in 2017

Analyses

- Distributions of PFAS levels
  - Five most frequently detected compounds
- Associations with demographic characteristics

Demographics

		ACE 1 N=96	ACE 2 N=99	Comparison P-value
Age	Mean	44	47	0.15
Sex	% Male	48%	45%	0.73
Income	<$25K	27%	45%	0.02
	$25-$75K	41%	26%	
	>$75K	13%	10%	
	Declined	20%	18%	
Education	% Greater than high school	58%	42%	0.03
Birth country	% outside the US	81%	96%	<0.01
Portion of life in US	Mean %	51%	36%	<0.01
Interview language	% Non-English	57%	63%	0.45
Home language	% Non-English	79%	97%	<0.01

Chi-square or t-test

PFAS serum levels

Geometric means (µg/L)

All >98% detected

	ACE 1 2016	ACE 2 2017	Comparison P-value
PFOA	1.36	1.69	0.04
PFOS	6.58	7.47	0.24
PFHxS	0.77	1.29	<0.01
PFUdA	0.39	0.45	0.20
PFNA	0.96	1.1	0.20

T-test

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T-test

PFAS serum levels

Geometric means (µg/L)

	Combined	ACE 1 2016	ACE 2 2017	NHANES Asian 2013-2014
PFOA	1.5	1.4	1.7	2.0
PFOS	7.0	6.6	7.5	6.4
PFHxS	1.0	0.8	1.3	1.2
PFUdA	0.4	0.4	0.5	0.3
PFNA	1.0	1.0	1.1	0.9

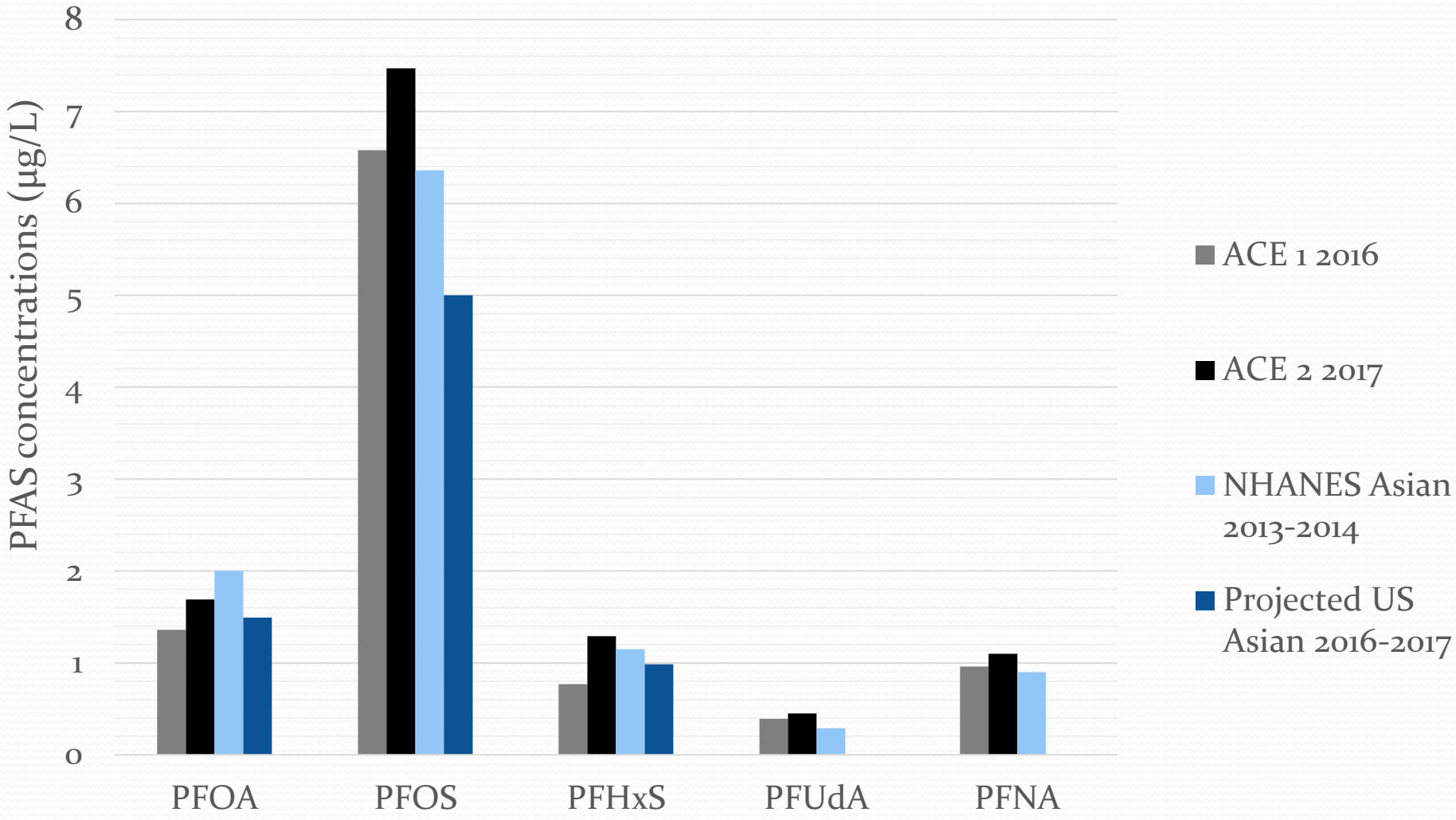
PFAS serum levels

Geometric means (µg/L)

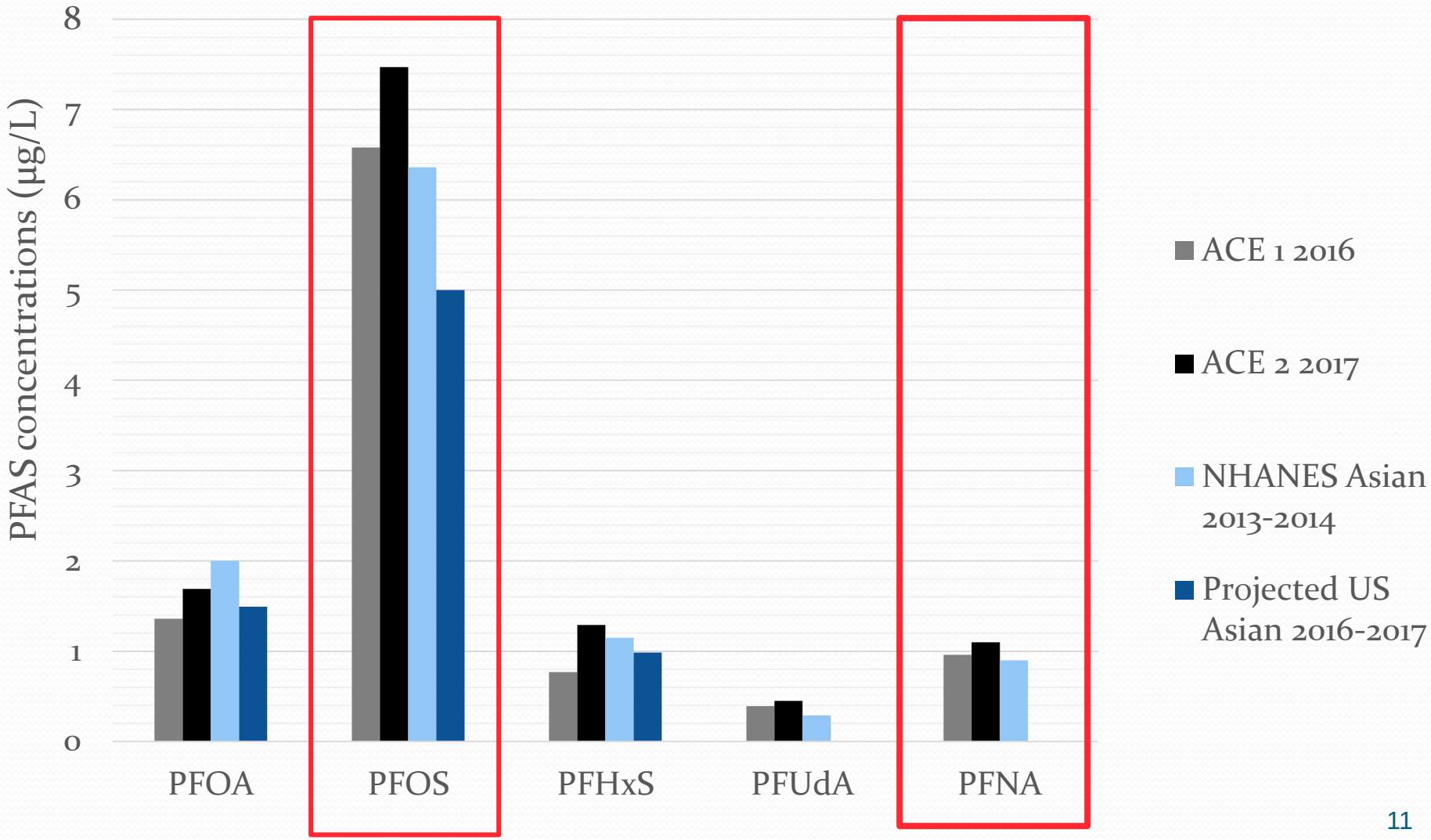
	Combined	ACE 1 2016	ACE 2 2017	NHANES Asian 2013-2014	Percent yearly change in CA Teachers Study*	Projected US Asian 2016-2017
PFOA	1.5	1.4	1.7	2.0	-9.3	1.5
PFOS	7.0	6.6	7.5	6.4	-7.7	5.0
PFHxS	1.0	0.8	1.3	1.2	-5.0	1.0
PFUdA	0.4	0.4	0.5	0.3	-	-
PFNA	1.0	1.0	1.1	0.9	NA	-

*Hurley et al. 2017

Comparison to NHANES



Comparison to NHANES



Significant associations with demographic factors

- ACE 1 or 2
- Sex
- Age
- US residency: years in the U.S. and portion of life in U.S.
- Birth country
- Household income
- Language preference: at interview and in home
- Education level

Demographic models for combined ACE 1 and 2

Percent (%) adjusted change

	Male	Age - Female	Age - Male	Non-English Interview language	Birth Country	Portion of Life in US	R-squared
PFOA							
PFOS							
PFHxS							
PFUdA							
PFNA							

Variables significant at $p < 0.05$

Demographic models

Percent (%) adjusted change

	Male	Age - Female	Age - Male	Non-English Interview language	Birth Country	Portion of Life in US	R-squared
PFOA	**125**	**1.0**	**-0.1**				**0.13**
PFOS							
PFHxS							
PFUdA							
PFNA							

Variables significant at $p < 0.05$

Demographic models

Percent (%) adjusted change

	Male	Age - Female	Age - Male	Non-English Interview language	Birth Country	Portion of Life in US	R-squared
PFOA	125	1.0	-0.1				0.13
PFOS	**0.4**	**1.6**	**1.6**	**20.0**	**China 94.0** **Hong Kong 8.7*** **Taiwan 40.9*** **Vietnam 50.1**		**0.36**
PFHxS							
PFUdA							
PFNA							

All variables significant at p <0.05, except variables with *

Demographic models

Percent (%) adjusted change

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PFOS	0.4	1.6	1.6	20.0	China 94.0 Hong Kong 8.7* Taiwan 40.9* Vietnam 50.1		0.36
PFHxS	**368**	**1.9**	**-0.1**		**China -10.6** **Hong Kong -14.5** **Taiwan 32.6*** **Vietnam 40.9**	**-31.2**	**0.49**
PFUdA							
PFNA							

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PFUdA				**25.0**		**-40.7**	**0.13**
PFNA							

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PFUdA				25.0		-40.7	0.13
PFNA	**82**	**1.3**	**0.5**			**-35**	**0.22**

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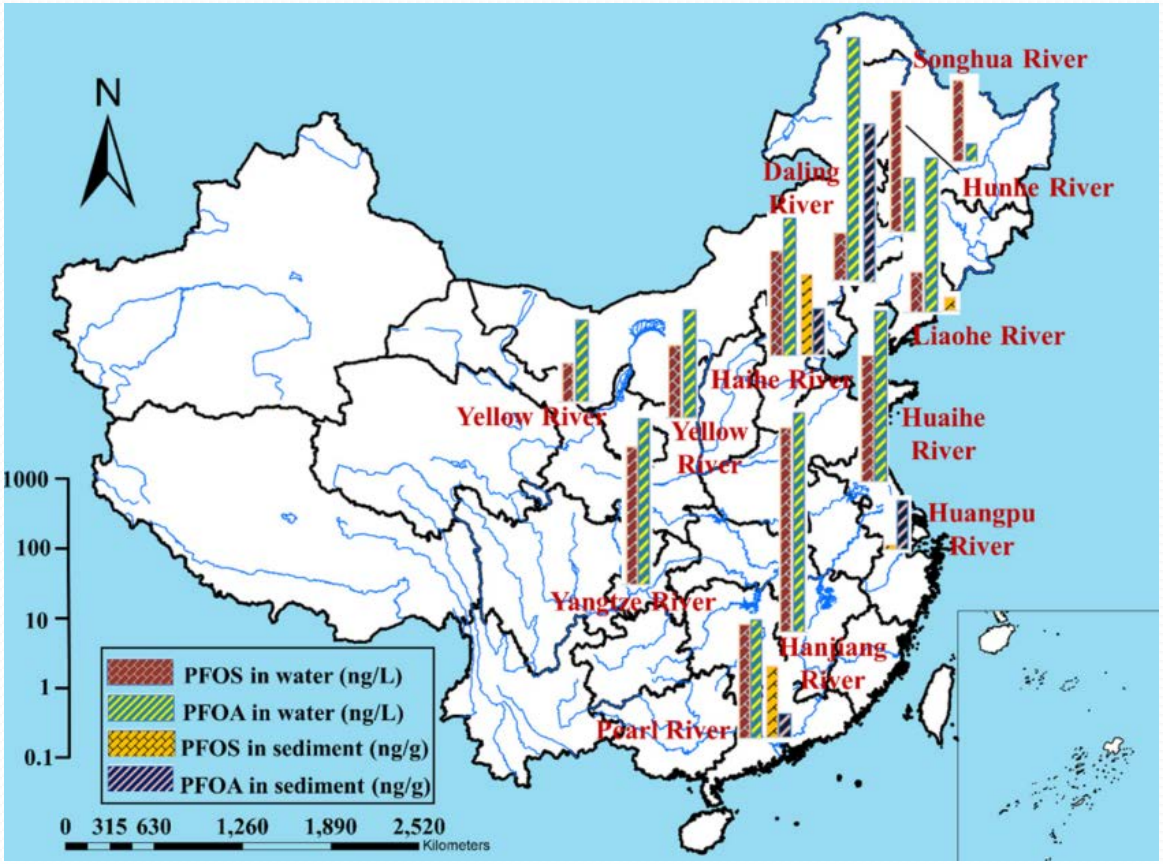
Comparisons to other studies

- Similarities
  - Males higher than females except PFUdA
  - Age-sex interaction for PFOA, PFHxS, PFNA
    - Seen in NHANES 1999-2008 (Kato et al. 2011)
    - Also evident in Red Cross study (2000-2015 samples) for PFHXS and PFOA (Olsen et al. 2017)
- Differences
  - Education and income not as significant
  - Birth country and time spent in U.S. not previously investigated

Comparisons to Asian studies

- China
  - Continued production of PFOS and PFOA
  - Areas of sizable contamination



Wang et al. 2015

Comparisons to Asian studies

- China
  - Biomonitoring has a range of results – comparable to US and much larger
    - Employees of a contaminated fishery – PFOS median 10,400 ug/L (Zhou et al. 2014)
    - Residents near a fluorochemical industrial park – PFOA median 9.4 ug/L (Bao et al. 2017)
- No PFAS biomonitoring studies in Vietnam

Next steps

- Further explore exposure questionnaire items
  - Limitation: Does not address drinking water sources or consumption
- Exposures from home country versus in the U.S.

Take aways

- Community studies can reveal more about sub-groups within California

- California's regional immigration and racial/ethnicity patterns may contribute to differences in PFAS and other contaminants across the state

Thanks to:

- ACE 1 and 2 participants
- APA Family Support Services
  - Farmmary Saephan
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- Project VIVO
  - Hang Ho
- All Biomonitoring California staff who have contributed to ACE 1 and ACE2

Upcoming presentation

August 27, 2018

International Society of Exposure Science/International Society of Environmental Epidemiology

Serum PFAS levels and their predictors in a San Francisco Bay Area Chinese Community

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References

- Bao J, Liu L, Wang X, Jin YH, Dong GH. Human exposure to perfluoroalkyl substances near a fluorochemical industrial park in China.Environ Sci Pollut Res Int. 2017 Apr;24(10):9194-9201.
- Hurley S, Goldberg D, Wang M, Park JS, Petreas M, Bernstein L, Anton-Culver H, Nelson DO, Reynolds P. Time Trends in Per- and Polyfluoroalkyl Substances (PFASs) in California Women: Declining Serum Levels, 2011-2015. Environ Sci Technol. 2018 Jan 2;52(1):277-287.
- Kato K, Wong LY, Jia LT, Kuklenyik Z, Calafat AM. Trends in exposure to polyfluoroalkyl chemicals in the U.S. Population: 1999-2008. Environ Sci Technol. 2011 Oct 1;45(19):8037-45.
- Olsen GW, Mair DC, Lange CC, Harrington LM, Church TR, Goldberg CL, Herron RM, Hanna H, Nobiletti JB, Rios JA, Reagen WK, Ley CA. Per- and polyfluoroalkyl substances (PFAS) in American Red Cross adult blood donors, 2000-2015. Environ Res. 2017 Aug;157:87-95.
- Wang T, Wang P, Meng J, Liu S, Lu Y, Khim JS, Giesy JP. A review of sources, multimedia distribution and health risks of perfluoroalkyl acids (PFAAs) in China. Chemosphere. 2015 Jun;129:87-99.
- Zhou Z, Shi Y, Vestergren R, Wang T, Liang Y, Cai Y. Highly elevated serum concentrations of perfluoroalkyl substances in fishery employees from Tangxun Lake, China. Environ Sci Technol. 2014 Apr 1;48(7):3864-74.

Questions?