

Introduction to Biomonitoring California's PFAS Studies

Kathleen Attfield, ScD

Toki Fillman, MS

California Department of Public Health



Biomonitoring California mandates

- Determine biological levels of environmental chemicals in Californians
- Establish trends in the levels of these chemicals in Californians' bodies over time
- Help to assess the effectiveness of public health efforts and regulatory programs to decrease exposures to specific chemicals



Surveillance biomonitoring and targeted studies

Biomonitoring California's approach:

- Investigate overall population trends with surveillance activities
- Characterize populations of concern using community-based studies
 - Geographic areas
 - Specific racial/ethnic community or occupational group
 - Sensitive sub-populations, such as pregnant individuals

Studies of PFASs in California



General population
BEST, Kaiser members
2011-2013



Asian Americans
ACE 1 & 2
2016-2017



Pregnant women
MIEEP
2010-2011
MAMAS
2012, 2015-16
STEPS
2015, 2018, 2024



General population
2018



Firefighters
2010-2011



General population
2019

FINDINGS:

Evaluate presence and trends of toxic chemicals

- Regional sampling in 2018-2020 showed

PFAS

- Near universal detections
- Lower levels of PFAS in Californians versus national levels
- Higher levels in Asians, males, older age groups, and higher income/education groups



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Evaluate presence and trends of toxic chemicals

- Regional sampling in 2018-2020 showed

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- Sampling of pregnant individuals 2012, 2015-2016 showed

PFAS

- Near universal detections, decreasing levels of most legacy PFAS
- Unique look into Asian subgroups: Vietnamese showed higher levels than Chinese and Filipina, masked by being grouped together
- Emerging issue: Higher levels of a 4-carbon PFAS than seen elsewhere

PCBs +
PBDEs

- Banned chemicals now at lowering detection frequency but not gone

OCPs

- Possible increase in levels in banned HCB



FINDINGS:

Linking to sources of exposure to support regulatory efforts

- Associations between serum PFASs and drinking water

PFAS

- **32% higher levels of PFHxS** in participants whose water systems had at least one PFHxS detection
 - **64% higher** for those whose water systems had over 50% of sampling points test positive



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- Associations between serum PFASs and drinking water

PFAS

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- Associations between serum PFASs and fish consumption

PFAS

- Up to **60% higher** in those eating 3 or more fish meals per week
- Up to **124% higher** in those eating fish parts (organs, head, skin, eyes)



Opportunities for collaboration

- Contribute to future surveillance planning – PFAS and beyond!
 - Inform and enrich study design, add complementary components beyond BiomCA requirements (possible)
 - Establish early data sharing plans
- Perform epi analysis with our data
 - Links to health records
 - Maternal samples and birth outcomes (Northeastern/Emory)
 - Links to early markers of effect (if measured...)
- Perform analysis for sources of exposure
 - Questionnaire data
 - Diet, occupation, hobbies, home characteristics, water source
 - External environmental, geocoded datasets
 - Maternal samples and drinking water, PFAS sources, pesticide/biosolid applications sites (UCB Morello-Frosch/UCLA)



Biomonitoring California studies - overview

	Sample Collection Year	Participant Description	Approximate n	Analytical Panels
Maternal and Infant Environmental Exposures Project (MIEEP)	2010-11	Pregnant women in San Francisco	92	Metals PFASs Phenols/Phthalates Pesticides, POPs, PAHs
Firefighter Occupational Exposures(FOX) Project	2010-11	Southern California firefighters	101	Metals PFASs Phenols/Phthalates Pesticides POPs, PAHs, OPFRs
Biomonitoring Exposures Study (BEST)	2011-12 2013	General adult population, Central Valley	112 341	Metals PFASs Phenols/Phthalates Pesticides Perchlorates, POPs, PAHs
Measuring Analytes in Maternal Archived Samples (MAMAS)	2012 2015 2016	Pregnant women in the California Genetic Disease Screening Program (GDSP)	460 540 300	PFASs POPs
Asian/Pacific Islanders Community Exposures (ACE) Project	2016, 2017	Adults of Chinese descent, San Francisco/Bay area Adults of Vietnamese descent, San Jose	100 100	Metals PFASs
Foam Replacement Environmental Exposure Study (FREES)	2016-17	Adults/households in the San Francisco/Bay area	28	PBDEs OPFRs
California Regional Exposure (CARE) Study	2018 2019 2020	General adult population, Region 1 Los Angeles County Region 2 (San Bernardino, Riverside, Imperial Mono, and Inyo counties) Region 3 (San Diego/Orange counties)	430 359 90	Metals PFASs Phenols 1-Nitropyrene
Studying Trends in Exposure in Prenatal Samples (STEPS)	2015 2018 2021 (+ future)	Pregnant women in the California Genetic Disease Screening Program (GDSP), population sampled for two counties	166, 166 166, 166 166, 166	PFASs (to be ready by June 2024)

PFAS results available on Biomonitoring CA website

<http://biomonitoring.ca.gov/>

The screenshot shows the Biomonitoring California website interface. At the top, there is a navigation menu with icons for About, Projects, Chemicals, Results, Resources, Meetings, and En español. The main content area displays the project name: "California Regional Exposure Study, Los Angeles County (CARE-LA)". Below this, there are two key details: "Study Group: 430 adults (age 18 and up) living in Los Angeles County" and "Sample Collection Date: 2018". A section titled "Study Group Subset: Adults" is also present. The "Unweighted Results" section contains a table with the following data:

Chemical measured	Indicates Exposure to	Adjusted for	Units	Number of people tested	Geometric mean	95% Confidence Interval		Selected Percentiles				Detection Frequency	Limit of Detection (LOD), wet-weight
						Lower	Upper	25th	50th	75th	95th		
Et-PFOSA-AcOH	Et-PFOSA-AcOH	NA	ng/mL	425	*	*	*	<LOD	<LOD	0.0132	0.0457	31.3%	0.0115
Me-PFOSA-AcOH	Me-PFOSA-AcOH	NA	ng/mL	425	0.0681	0.0630	0.0736	0.0405	0.0562	0.0942	0.341	100%	0.0114
PFBuS	PFBS	NA	ng/mL	425	*	*	*	<LOD	<LOD	<LOD	<LOD	4.94%	0.0303

Associations Between PFASs in Drinking Water and Serum Among Southern California Adults

Toki Fillman

Biomonitoring California

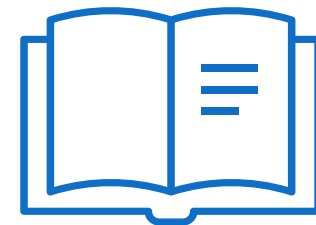
Environmental Health Investigations Branch

California Department of Public Health



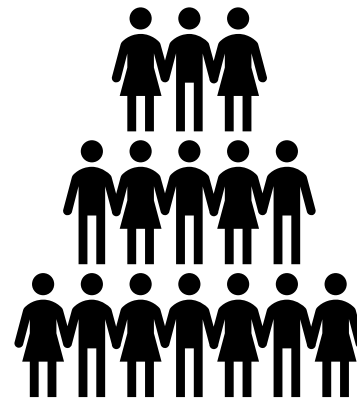
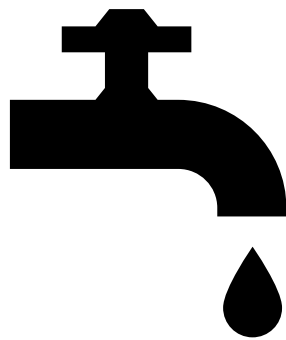
PFASs and drinking water in the literature

- Studies from areas with high PFAS contamination have reported significant contributions of drinking water to overall PFAS exposure
- Few studies have focused on the general population



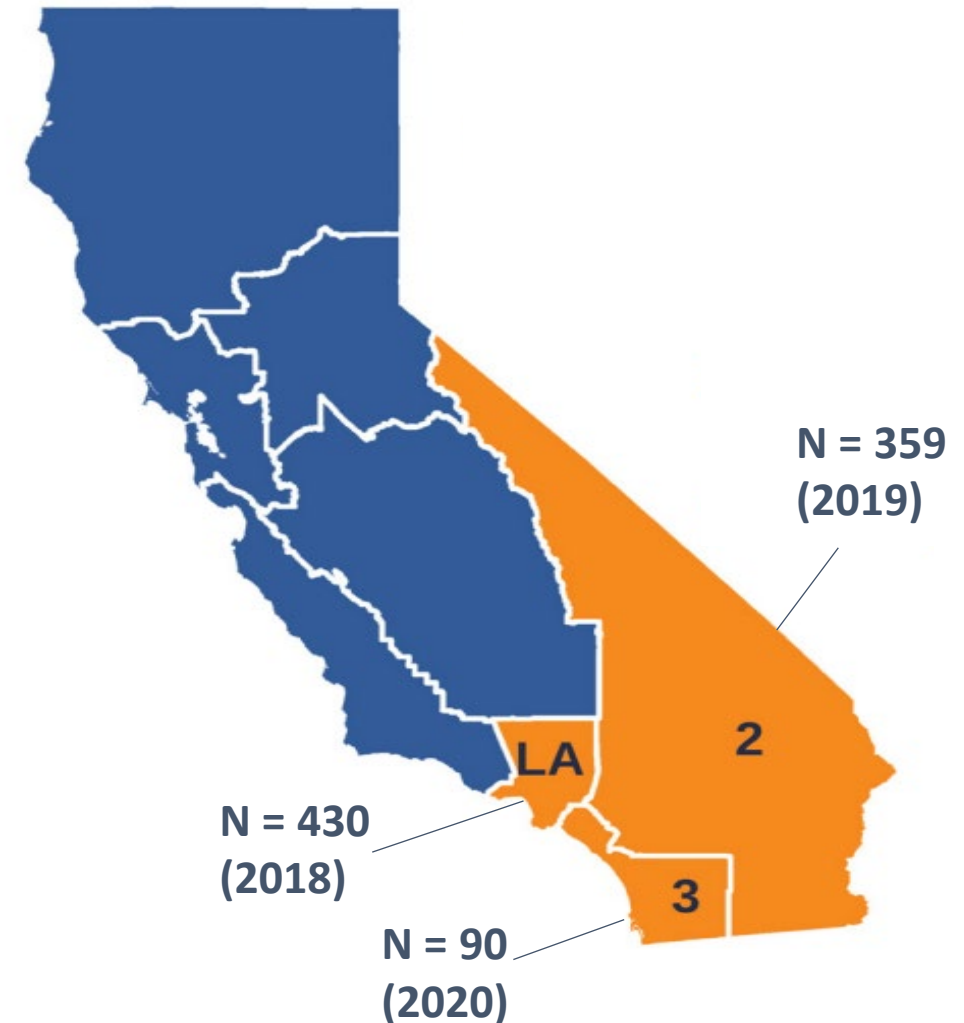
Study Objective

- To assess the association between PFAS detections in drinking water and PFAS concentrations in serum among a general population of adults in California



California Regional Exposure (CARE) Study

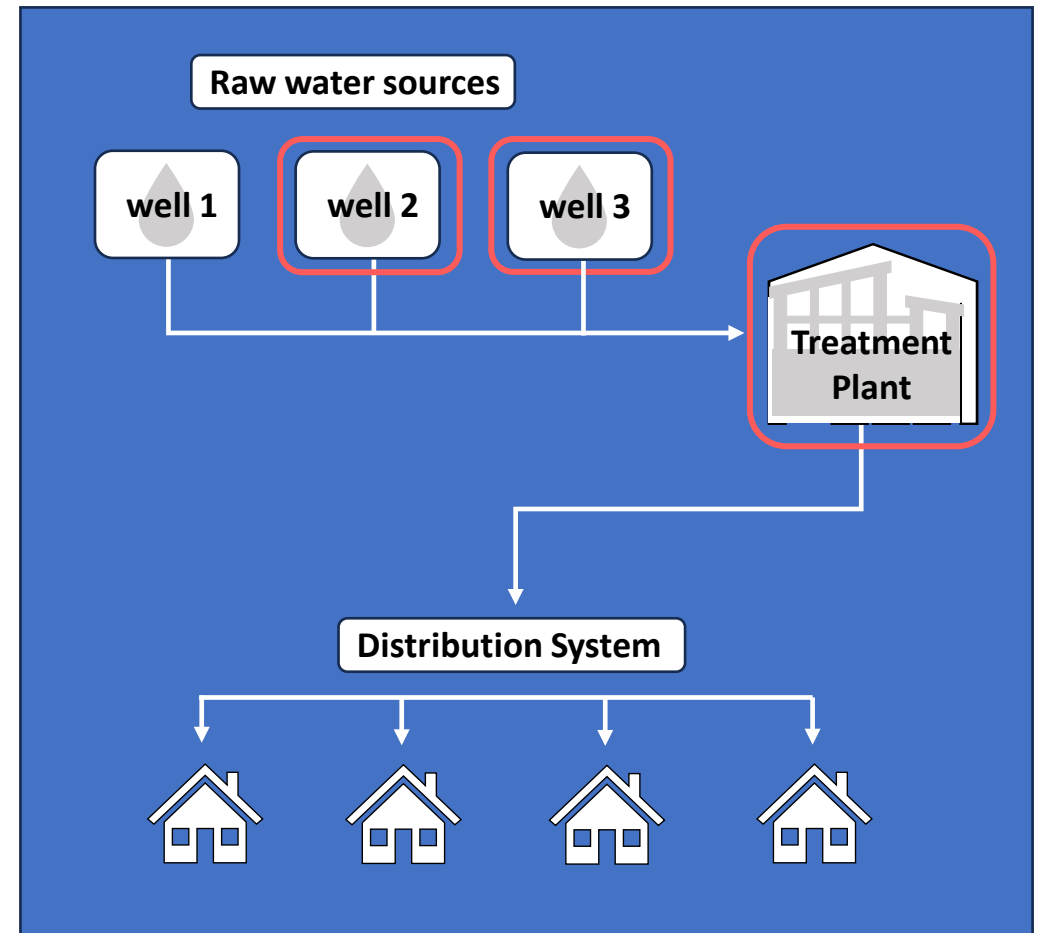
- Measured 12 PFASs in serum
- Exposure questionnaire
 - Demographics
 - Reproductive history
 - Diet
 - Home characteristics
 - Occupation
 - Hobbies



Public water system PFAS monitoring in California

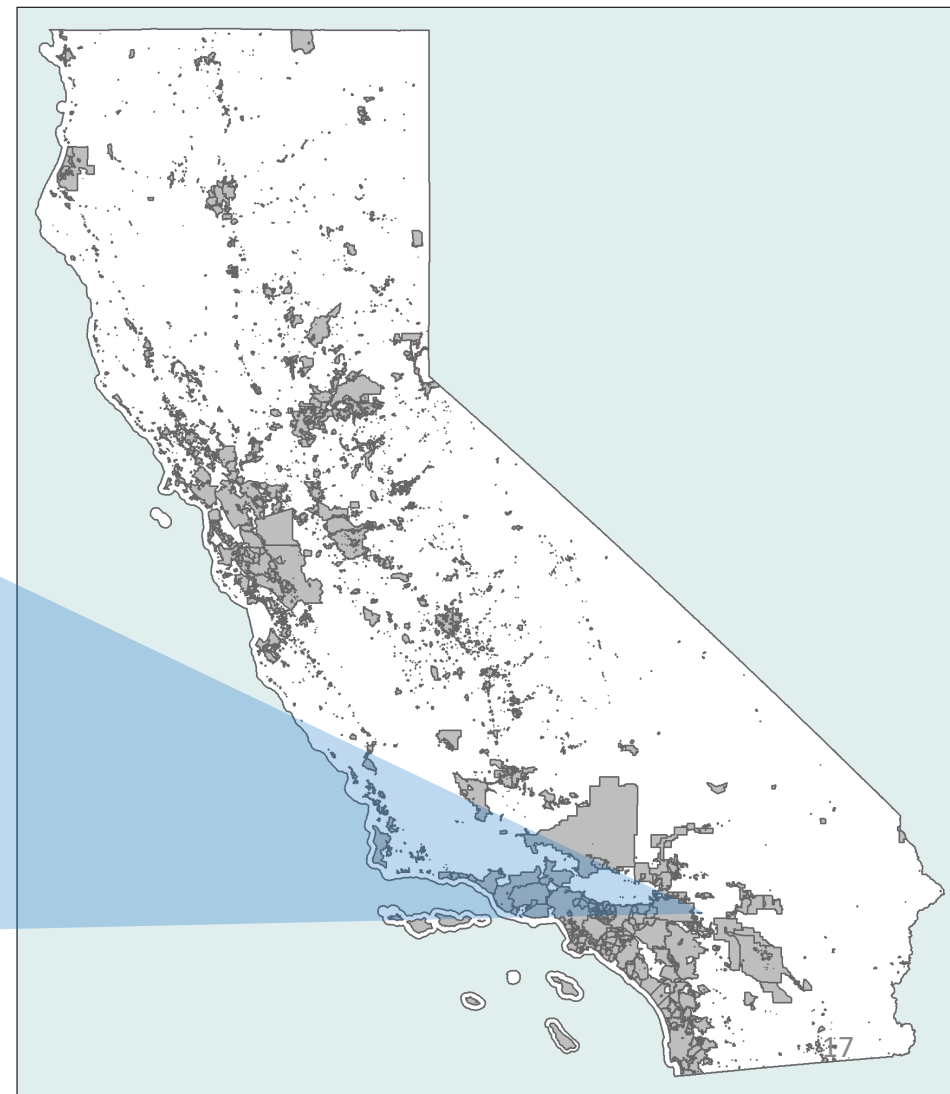
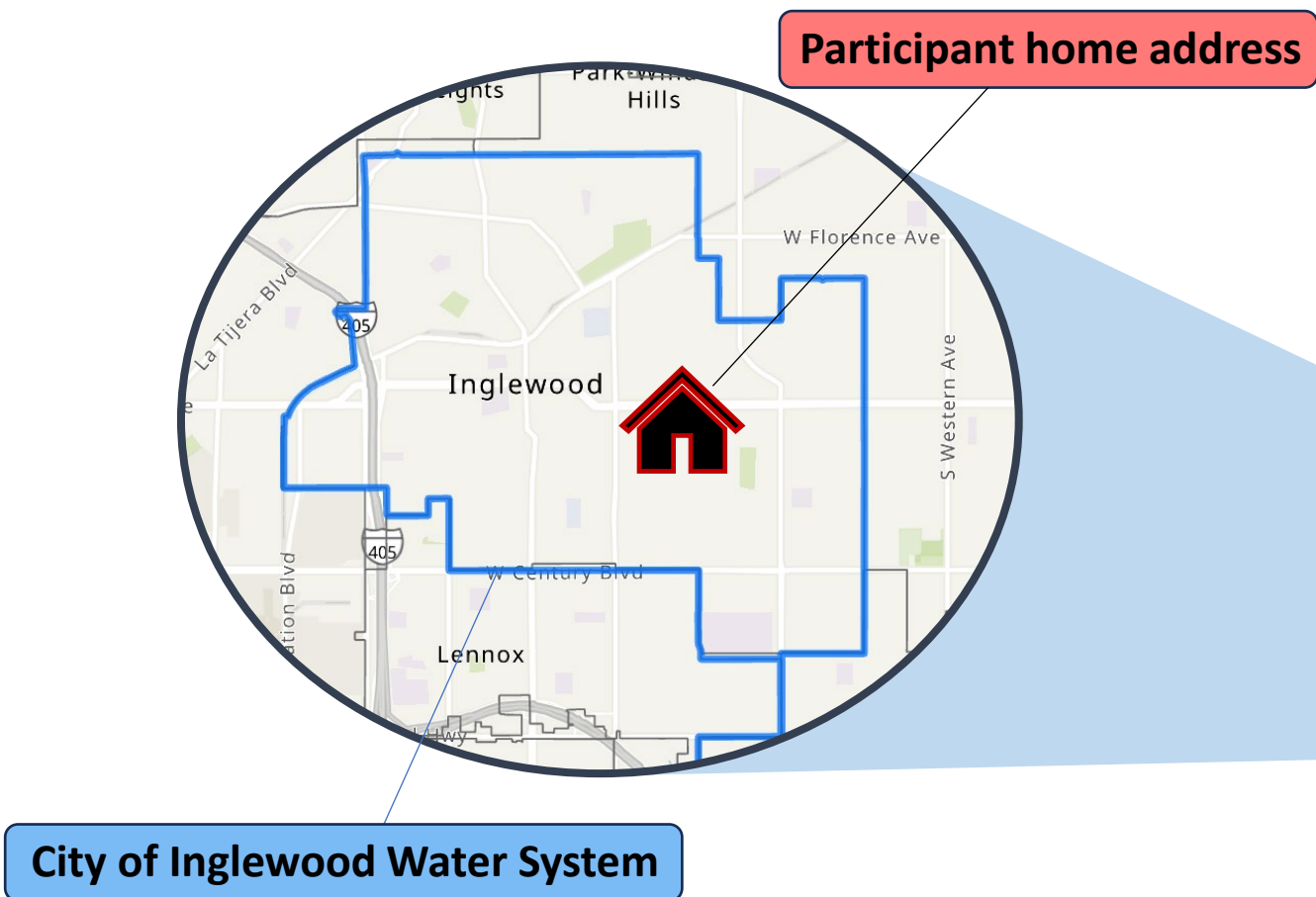
- Public water systems included in the 2019-2022 California Water Boards PFAS investigative orders
- Most sampling from source wells from areas with suspected PFAS contamination
 - Some treated water sampled
- 18 PFASs: statewide required reporting limits (2-4 ng/L)

Water Supply Distribution System



Matched CARE participants to public water systems

- Water systems included in 2019–2022 PFAS monitoring



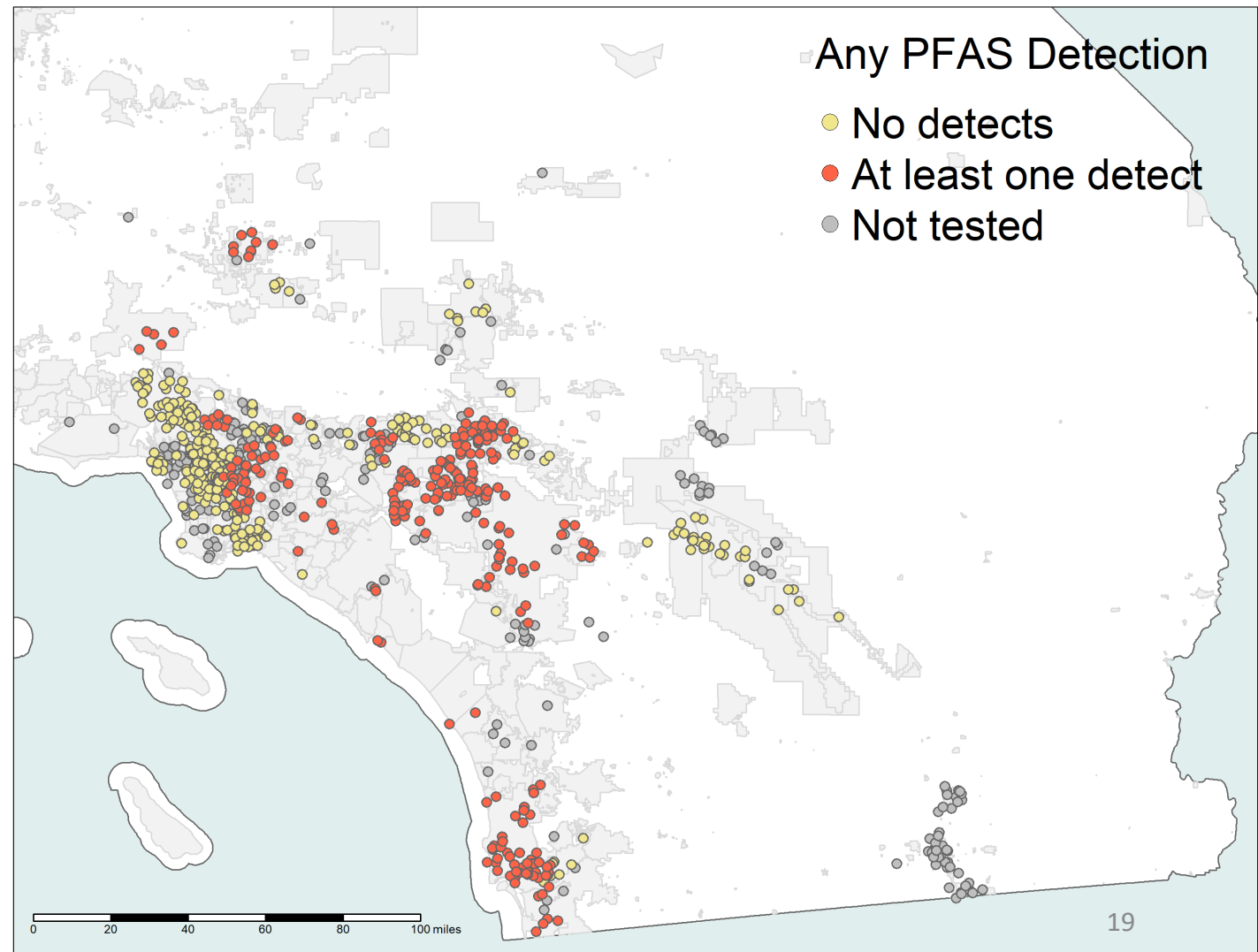
Study population

n = 563

Sociodemographic Characteristics	Mean (SD) or N (%)
Age	
Mean (SD)	48.5 (16)
Gender	
Female	341 (61%)
Male	222 (39%)
Race/ethnicity	
Asian alone	51 (9%)
Black alone	54 (10%)
Hispanic any	228 (40%)
Multi-racial and other	30 (5%)
White alone	200 (36%)
Education	
Some high school or less	40 (7%)
High diploma or GED	63 (11%)
College/some college/trade/tech	338 (60%)
Graduate degree	122 (22%)
Income	
\$25K or less	160 (28%)
\$25,001 to \$75,000	229 (41%)
\$75,001 to \$150,000	124 (22%)
More than \$150K	50 (9%)

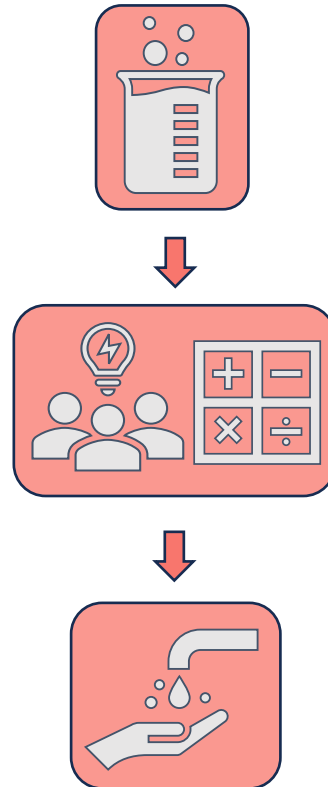
Nearly half of participants live in water systems with detections of PFASs

- 47% of participants (265 of 563) lived in a water system service area with at least one PFAS detection

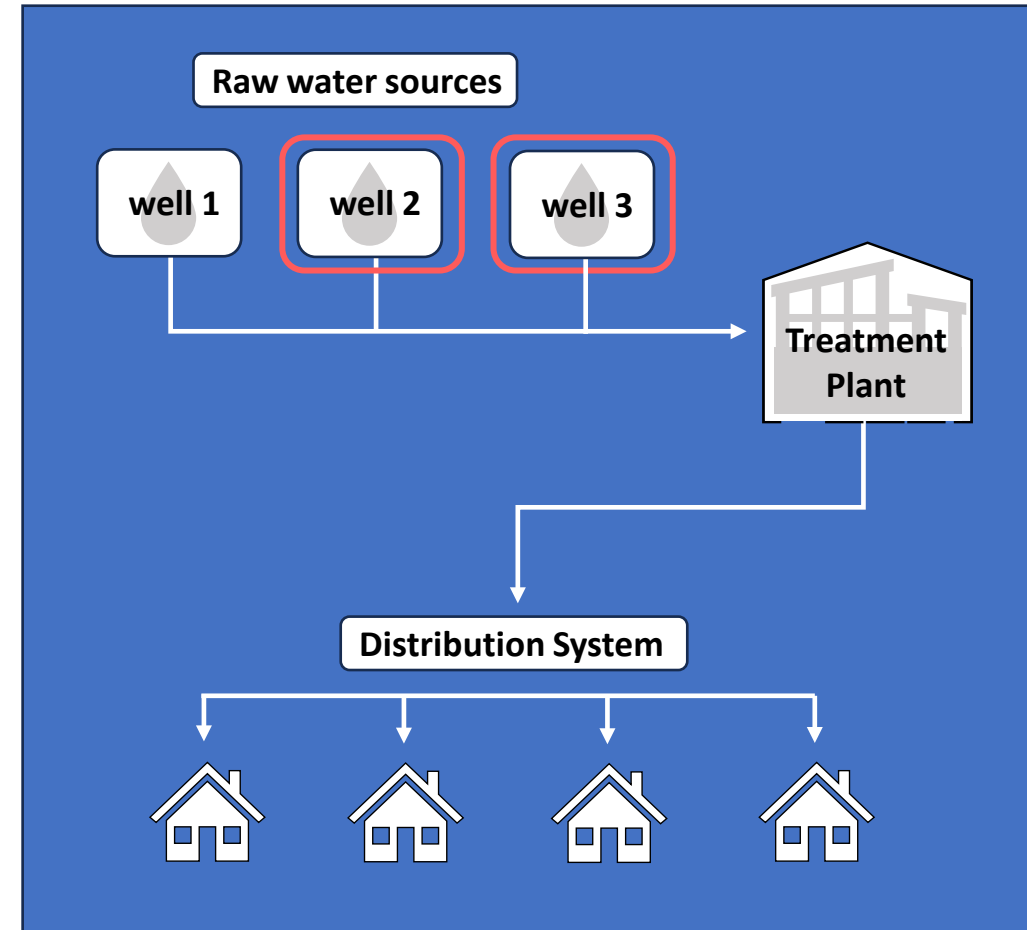


Assignment of drinking water exposure indicator: ideal goal

- Ideal goal: estimate finished water levels

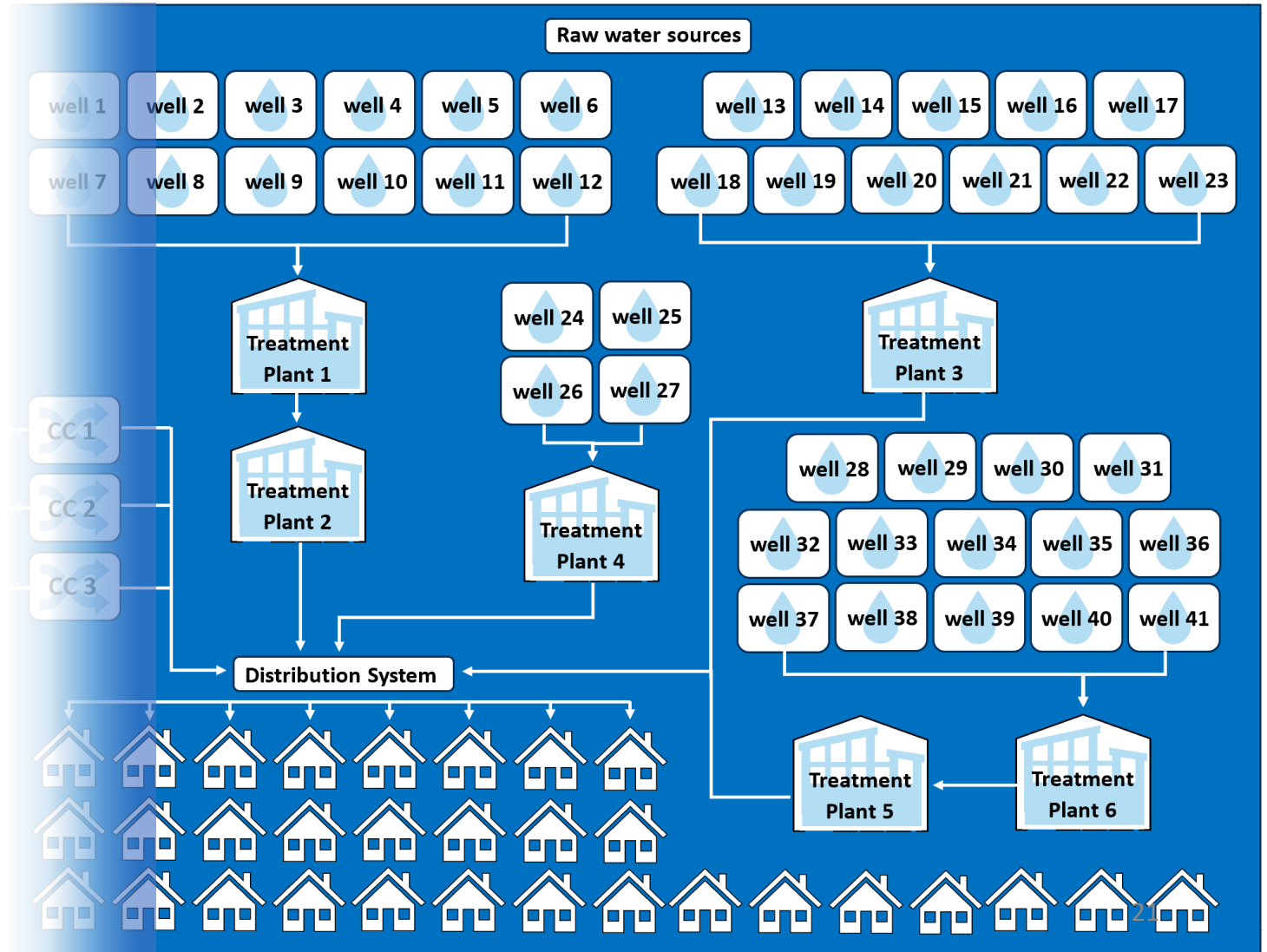


Water Supply Distribution System



Estimating PFAS concentrations in finished water is challenging

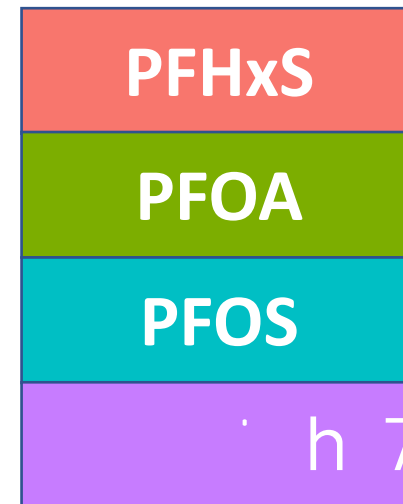
- Challenges:
 - Sampling is primarily from raw untreated sources
 - No water blending / mixing / volume data
 - Data coverage differs by water system



Assignment of drinking water exposure indicator: binary category

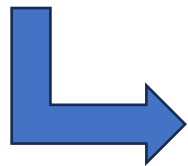
- Binary category based on statewide required reporting limits (4 ng/L)
 - No PFAS detections
 - At least one PFAS detection

- For analytes:



Assignment of drinking water exposure indicator: post-treatment drinking water only

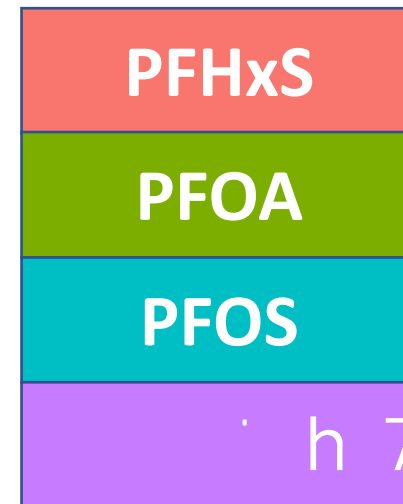
- Binary category based on statewide required reporting limits (4 ng/L)
 - No PFAS detections
 - At least one PFAS detection



**Subgroup of 235 participants
matched to water systems
with treated water samples**

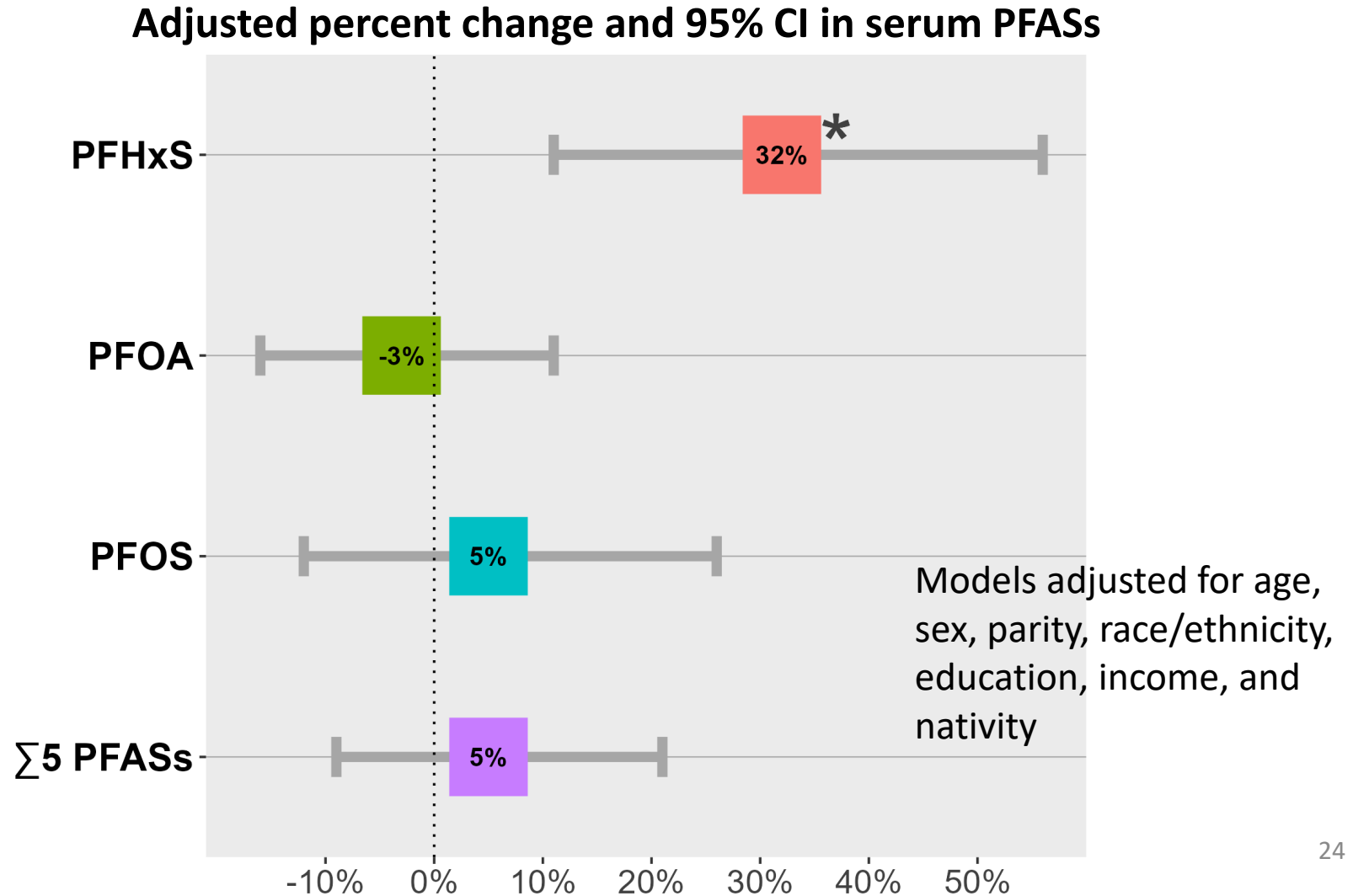


- For analytes:



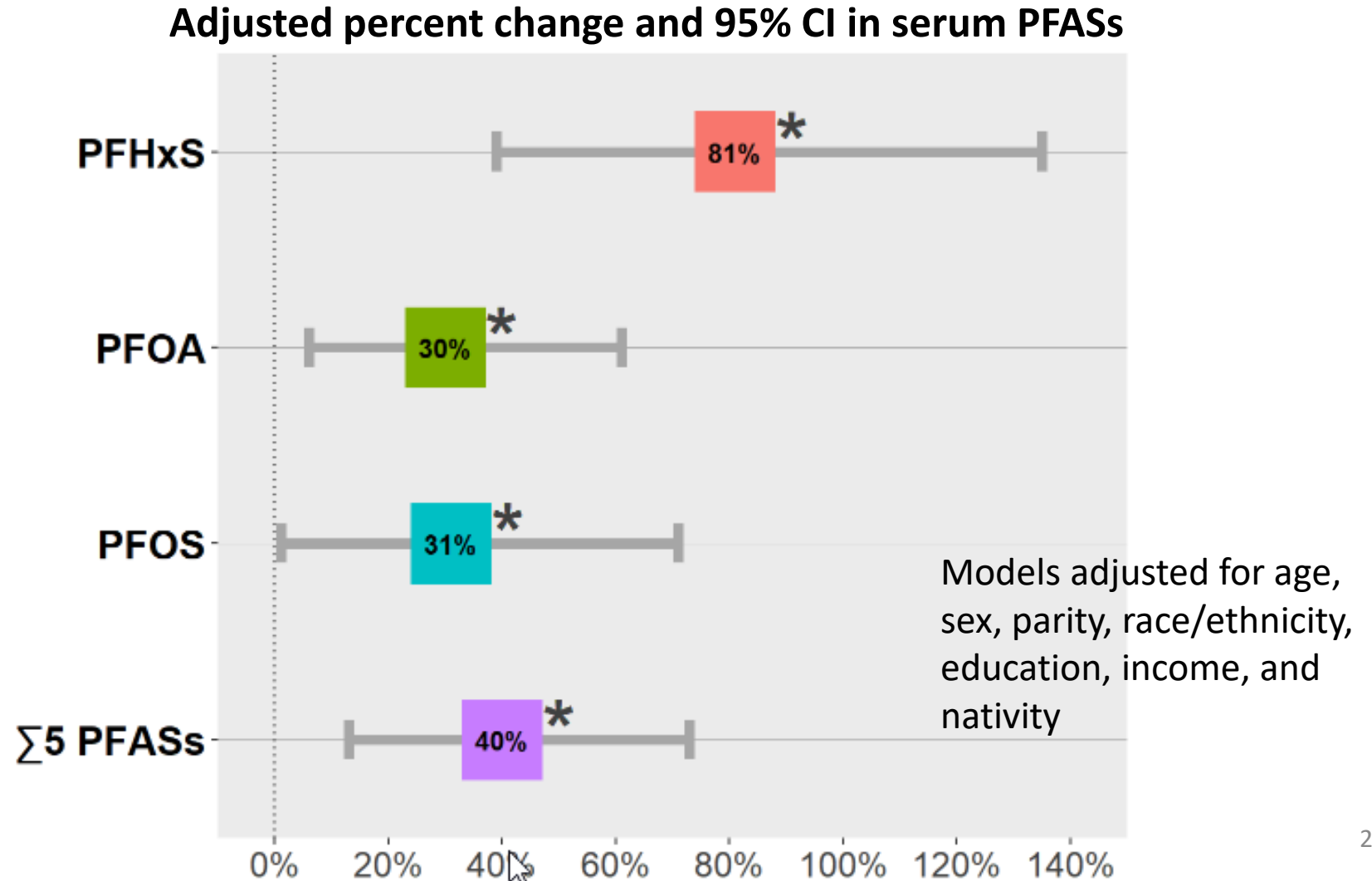
Participants living in water system service areas with PFHxS detections had higher serum levels

Source wells and post-treatment water:
n = 563

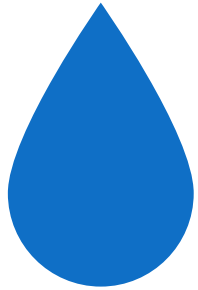


Participants living in water systems with **post-treatment drinking water detections** had higher serum PFAS levels

Post-treatment
subgroup: n = 235



Conclusions



In this general population of adults in southern California, PFAS contamination in drinking water may be a significant contributor to serum PFAS levels.

Even among communities without high level contamination from industrial manufacturing



Results from this study align with literature demonstrating drinking water can contribute to PFAS exposure.

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- DTSC



Questions?

Contact:

Kathleen.Attfield@cdph.ca.gov

Toki.Fillman@cdph.ca.gov

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