

WEBS Speciated Arsenic and Pesticide Results

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Advisory Committee Meeting – October 2013

Analytes by Study

Analyte	General Population*	High As Area	Pyrethroid Exposure Survey & Testing (PEST)	Low Income Survey & Testing (LIST)*
1. Total arsenic + 12 metals	X	X		
2. Speciated arsenic	X	X		
3. Creatinine	X	X	X	X
4. Pesticides				
pyrethroid metabolites (3-PBA, DCCA, 4F-3PBA, DBCA)	X		X	X
OP metabolite (TCPy)	X			X
bifenthrin metabolites	X		X	
5. BPA and Phthalates	X			X

* Indicates 5 year storage of samples

Green indicates non-CDC funding for lab analysis

Methods: General population sample (2010-2011)

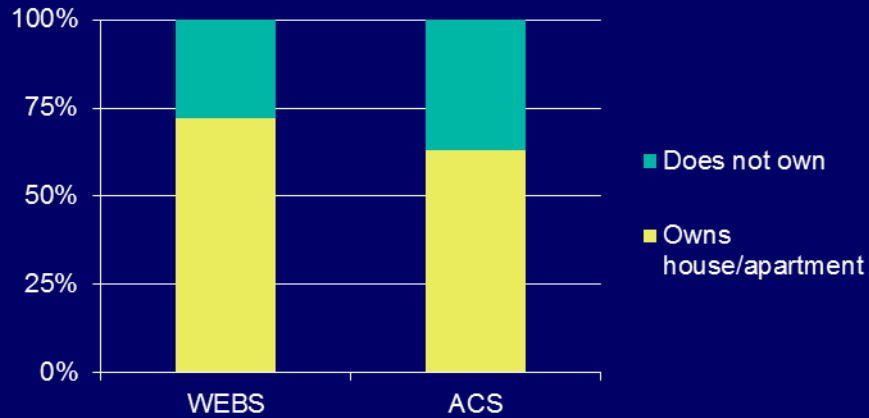
Final sample

- **666 households (response rate \approx 37%)**
 - 498 tap water samples
- **1,419 participants**
 - 1,077 with corresponding water samples

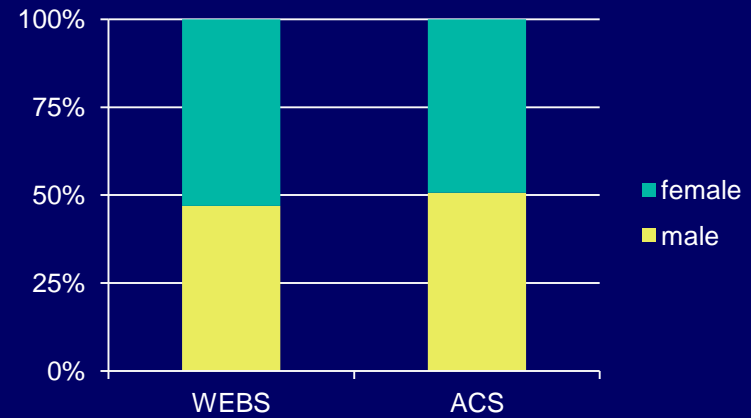
Methods: General population sample (2010-2011)

Checking representativeness with the American Communities Survey (ACS)

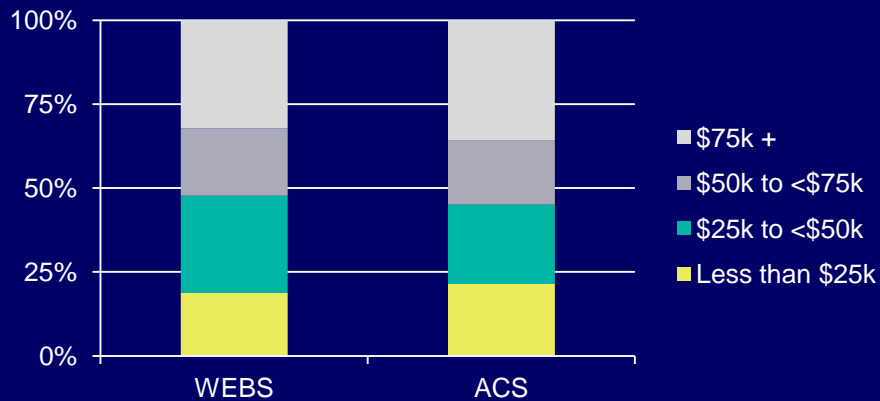
Household Ownership



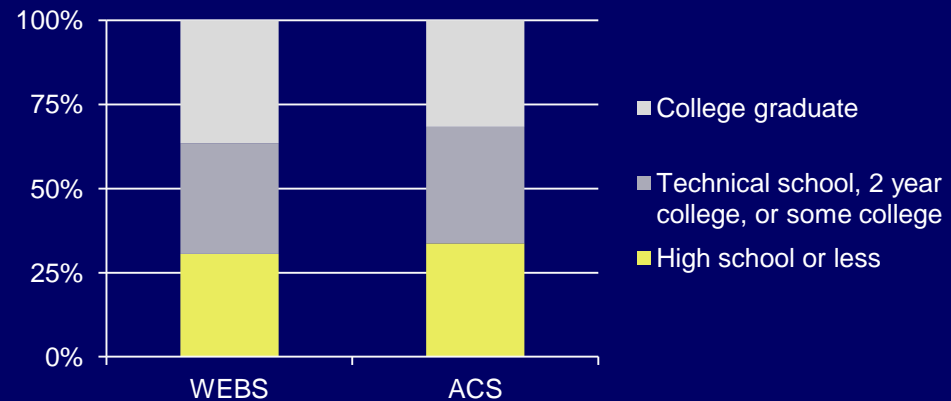
Sex



Household income



Education (age 25+)



Speciated and Total Arsenic

- Inorganic: Toxic
 - ✓ Arsenous (III) acid
 - ✓ Arsenic (V) acid
- Organic: Low toxicity
 - ✓ Monomethylarsonic acid (MMA)
 - ✓ Dimethylarsinic acid (DMA)
 - ✓ Arsenobetaine (AsB)
 - ✓ Arsenocholine
- Total arsenic



Arsenic metabolism in the body



Results Overview

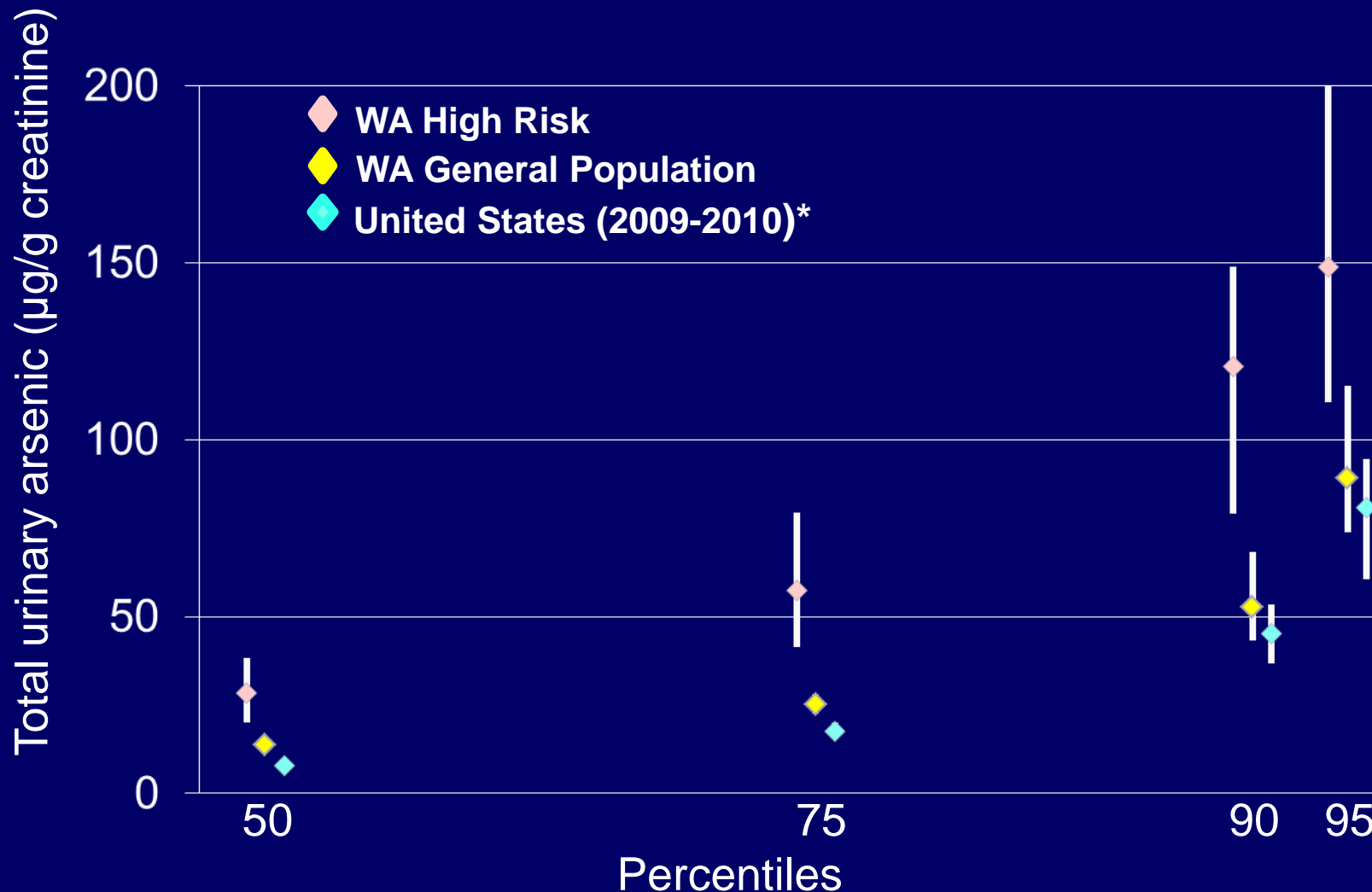
- New data: speciated arsenic and pesticide metabolites
- Compare national, state and local biomonitoring studies (NHANES, WEBS and South Whidbey Island)
- Assess potential exposure sources

Statistical analyses conducted in SAS/SUDAAN and R

- Percentiles with 95% CI
- Linear regression (log-transformed)

Total arsenic concentration in urine

U.S.* < Washington < high-risk population

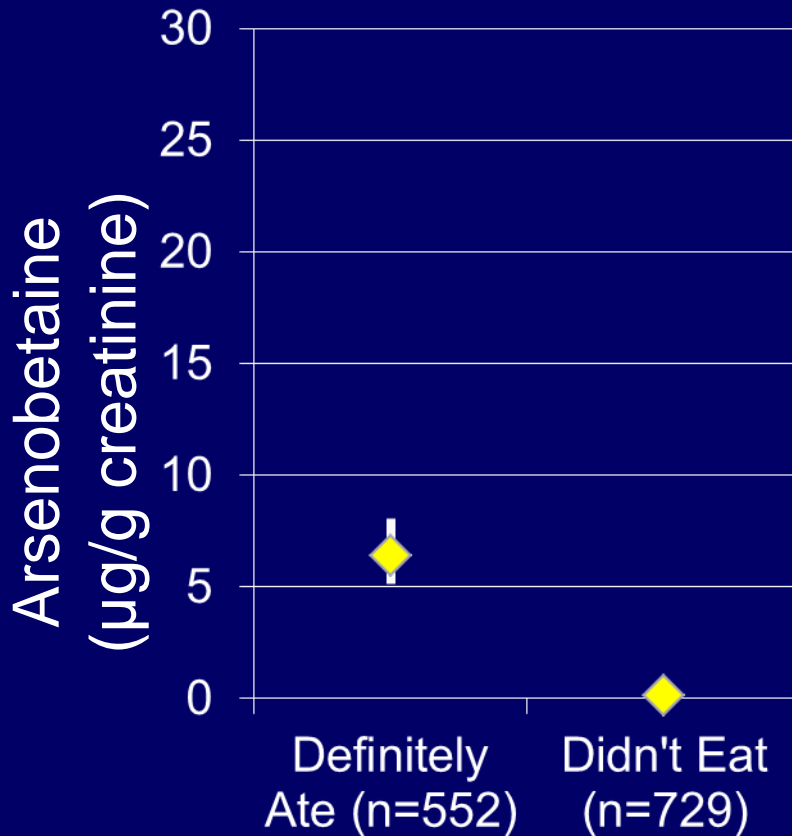


* 2009-2010 NHANES: Fourth National Report on Human Exposure to Environmental Chemicals, Updated Tables, September 2012 (<http://www.cdc.gov/exposurereport/>)

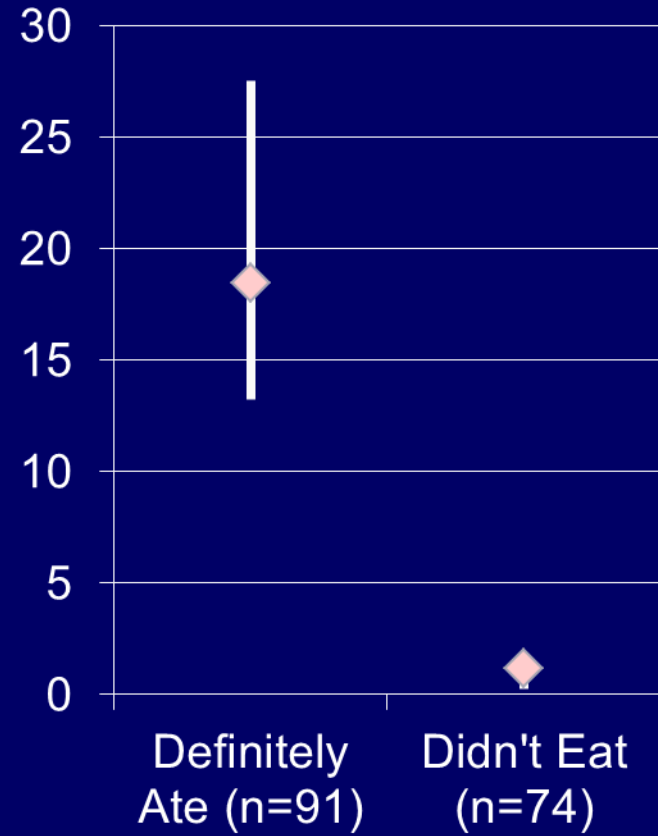
Arsenobetaine and seafood consumption

Medians (with CI_{95%})

General Population



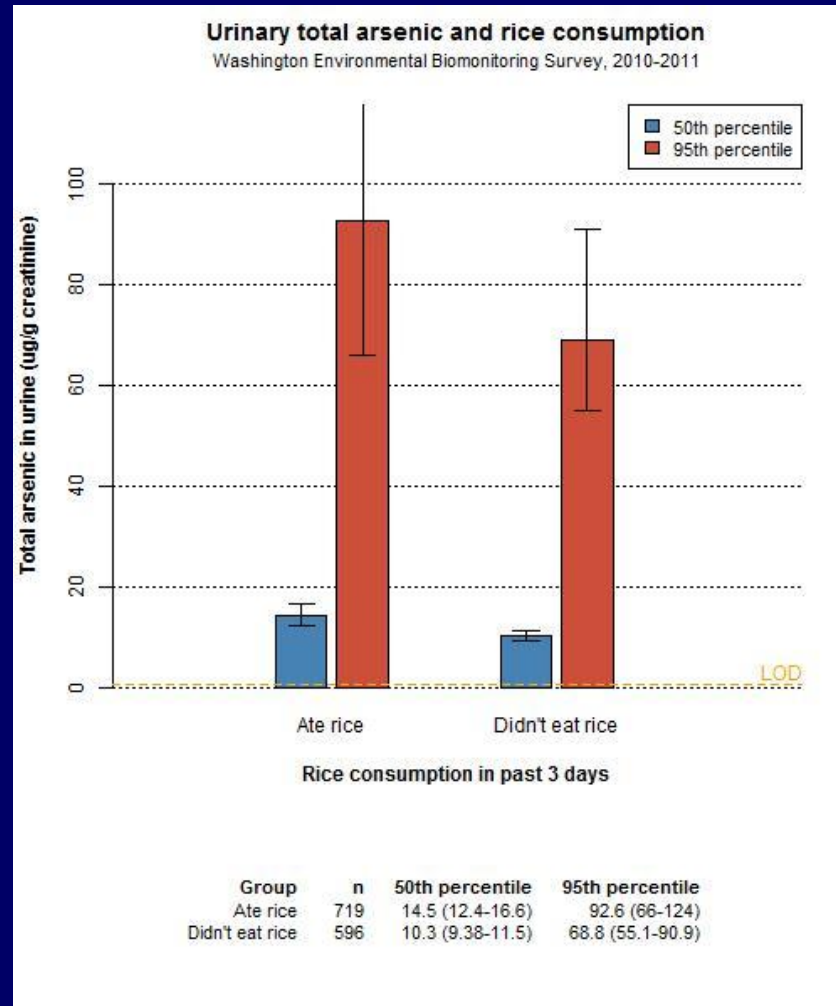
High Risk Sample



Eating fish, shellfish, kelp or sushi in past 3 days

Arsenic and rice consumption

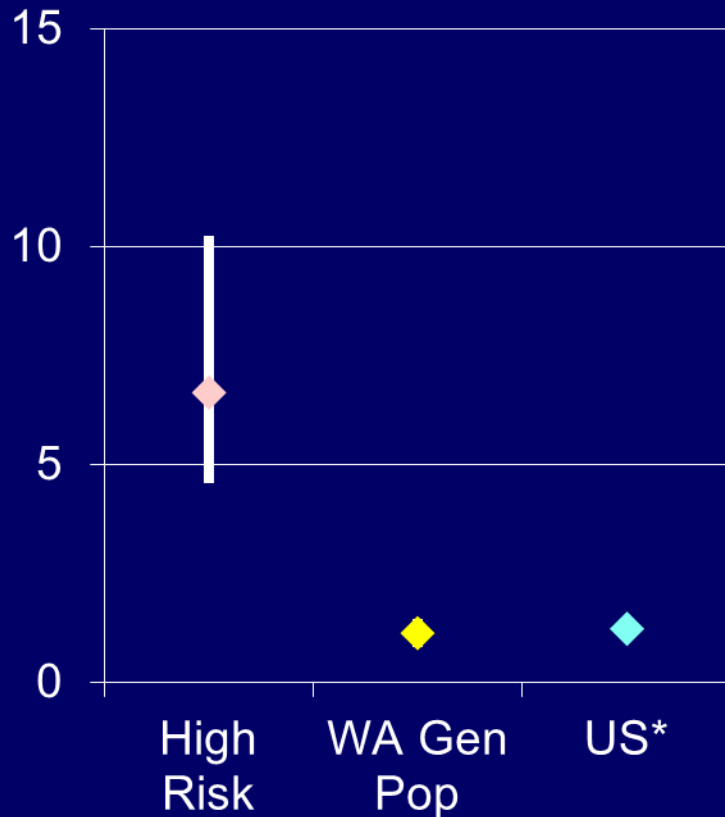
Medians and 95th percentile (with CI_{95%})



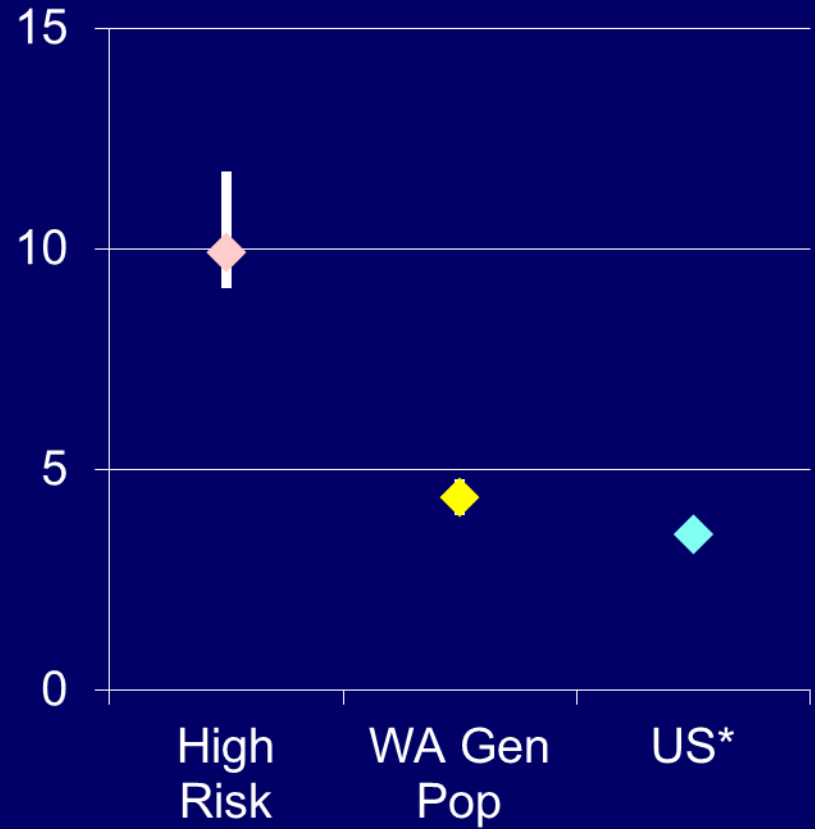
Eating rice in past 3 days

Speciated Arsenic

Urinary Arsenobetaine
Median, 95% CI
($\mu\text{g/g}$ creatinine)



Urinary Dimethylarsinic Acid
Median, 95% CI
($\mu\text{g/g}$ creatinine)



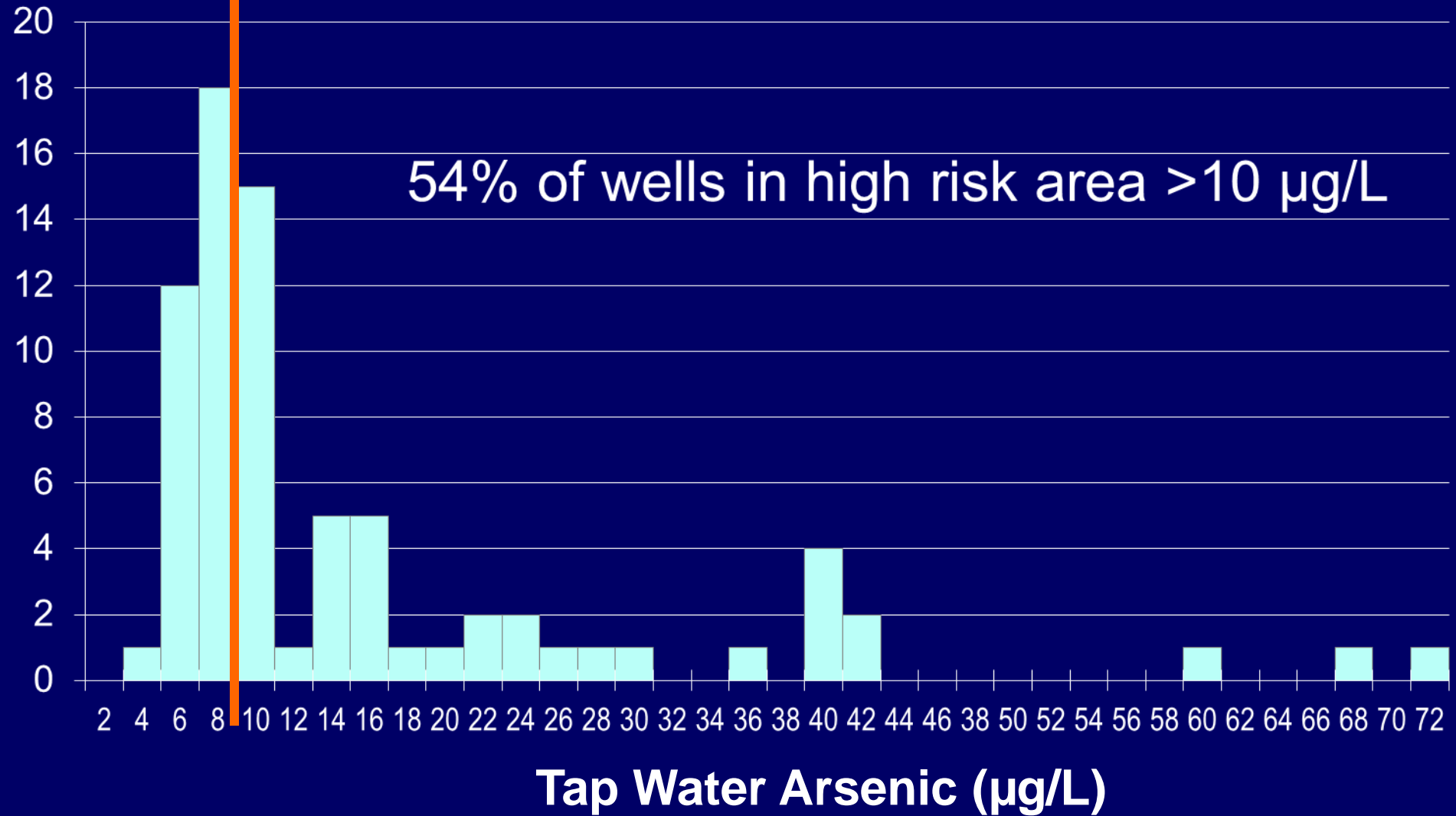
General Population: Water

- 76% of people are on public systems
 - ✓ Regulated to be $<10 \mu\text{g/L}$
- Among non-public systems
 - ✓ Only 3 samples $>10 \mu\text{g/L}$ (highest=35.6)

In the general population, weak relationship between levels of arsenic in tap water and urine ($R^2 = .017$)

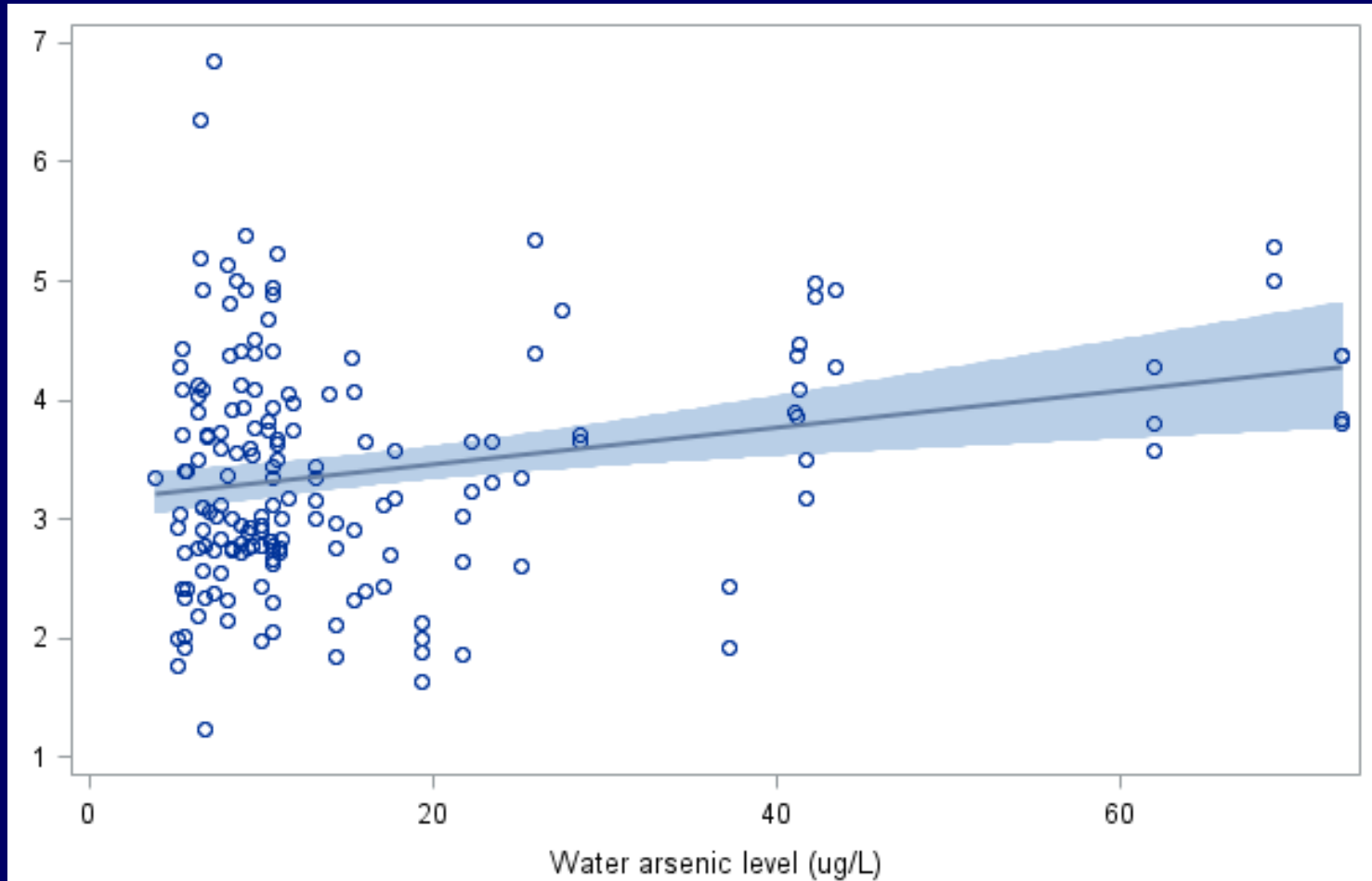
Whidbey Island: Total Arsenic in Tap Water

Number of wells



High risk area, tap water & total urinary arsenic ($R^2 = .062$)

Urinary As creatinine corrected
(ug/g), log transformed*



Tap Water As (ug/L)

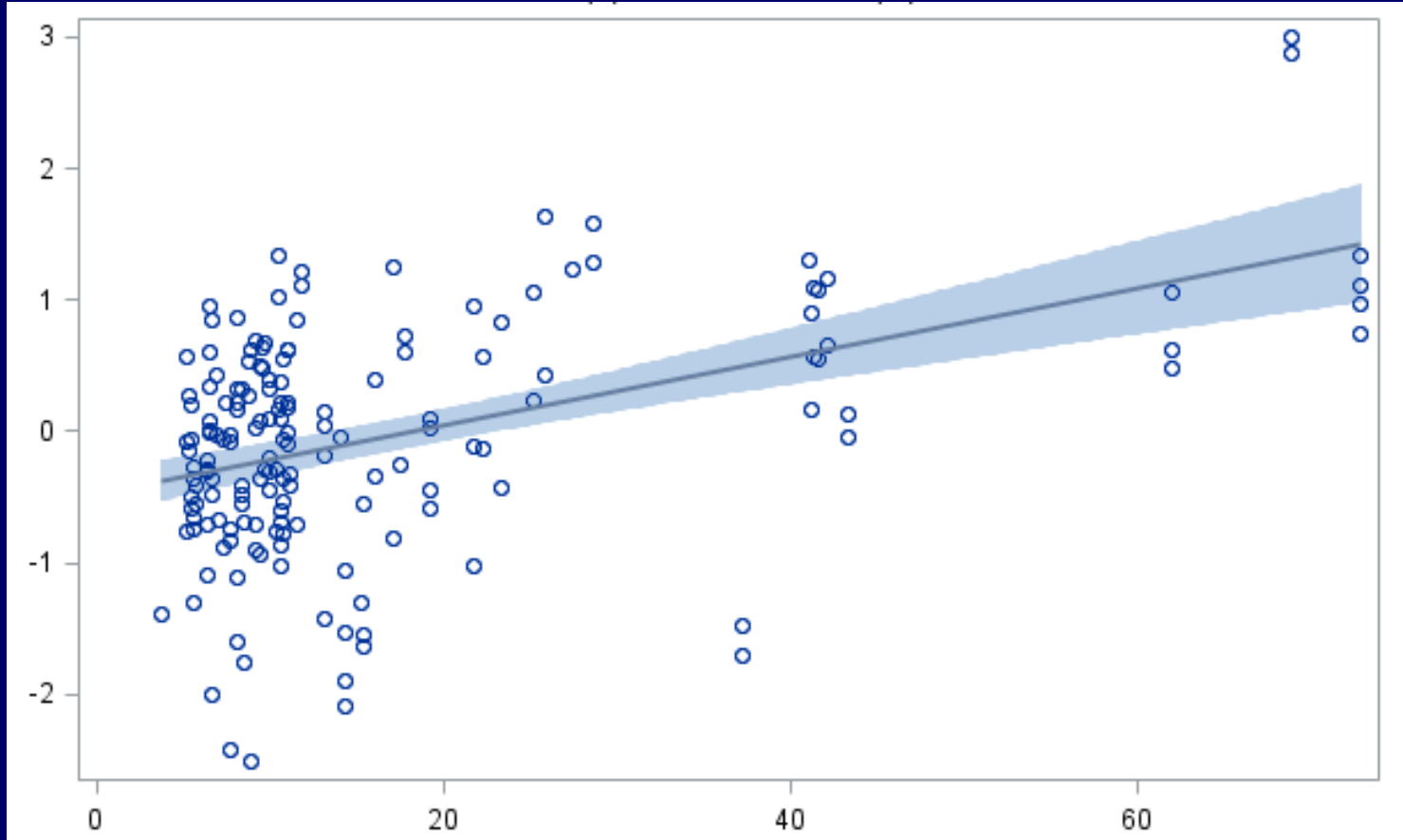
● observation

— regression line

■ 95% CI

High risk area, tap water & inorganic arsenic (strongest relationship, $R^2=.21$)

Urinary arsenic (V) and arsenous
(III) ($\mu\text{g/g}$, creatinine corrected),
log transformed



Total tap water arsenic ($\mu\text{g/L}$)

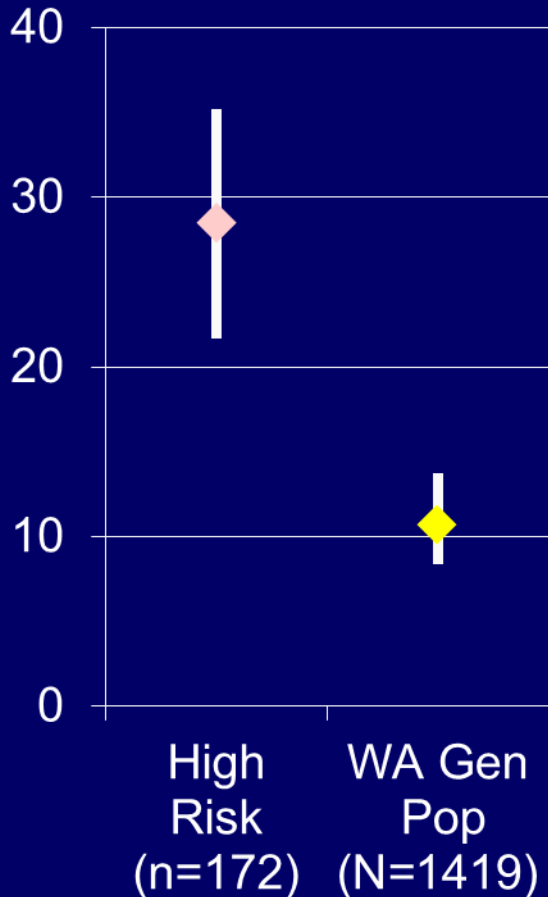
● observation

— regression line

95% CI

Larger percent of high risk sample had total urinary arsenic >50 μ g/L

Percent with
Total Urinary
Arsenic > 50 μ g/L



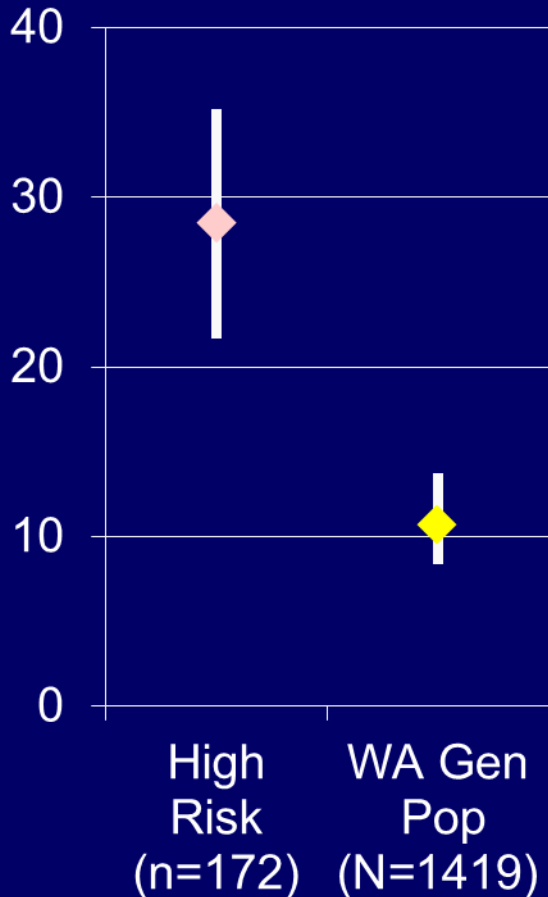
General population sample

152 people (10.8%) with $As_{TOT} > 50 \mu\text{g/L}$

- 131 reported “definitely” eating seafood
- 14 reported not eating seafood
 - ✓ 4 had $As_B \geq 90$ th percentile for their population
 - ✓ All on public water supplies and tap water < 10 $\mu\text{g As/L}$ (among the 7 people with water data)
- 7 missing or maybe ate

Larger percent of high risk sample had total urinary arsenic >50µg/L

Percent with
Total Urinary
Arsenic > 50 µg/L



High-risk sample

49 people (28.5%) with $As_{TOT} > 50 \mu\text{g/L}$

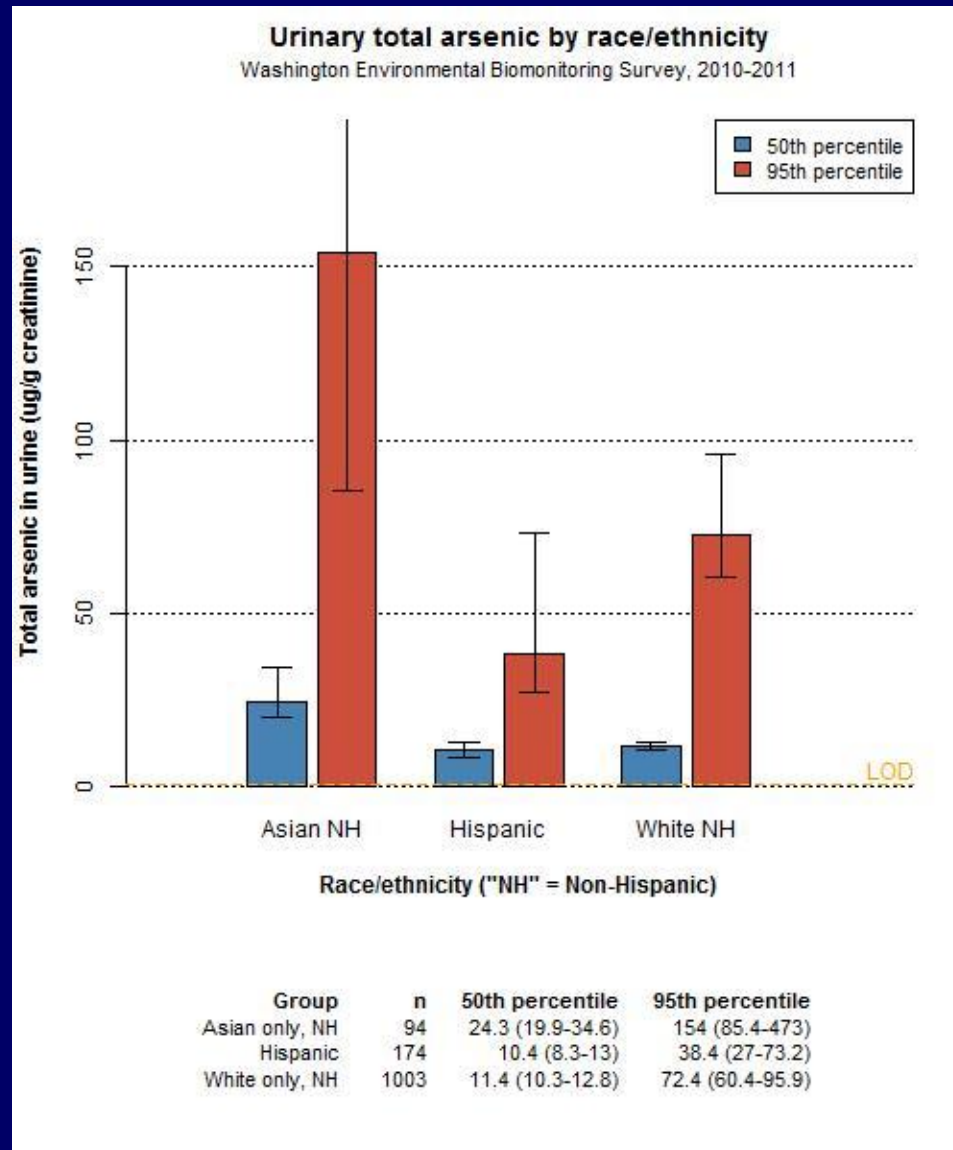
- 48 reported “definitely” eating seafood
- 1 reported not eating seafood
 - ✓ $AsB > 90\text{th percentile}$ (for general pop.)
- 26 people with tap water $As > 10 \mu\text{g/L}$

Conclusions: Sources of Arsenic

Among people with total arsenic $>50 \mu\text{g/L}$

- In both studies, most people reported eating seafood
- In the high risk population, most had elevated tap water levels
- In the general population, unknown source of exposure for people not reporting eating seafood
 - ✓ Not residential tap water
 - ✓ High arsenobetaine levels for some people might indicate
 - Misreporting
 - Other sources of AsB (such as mushrooms)

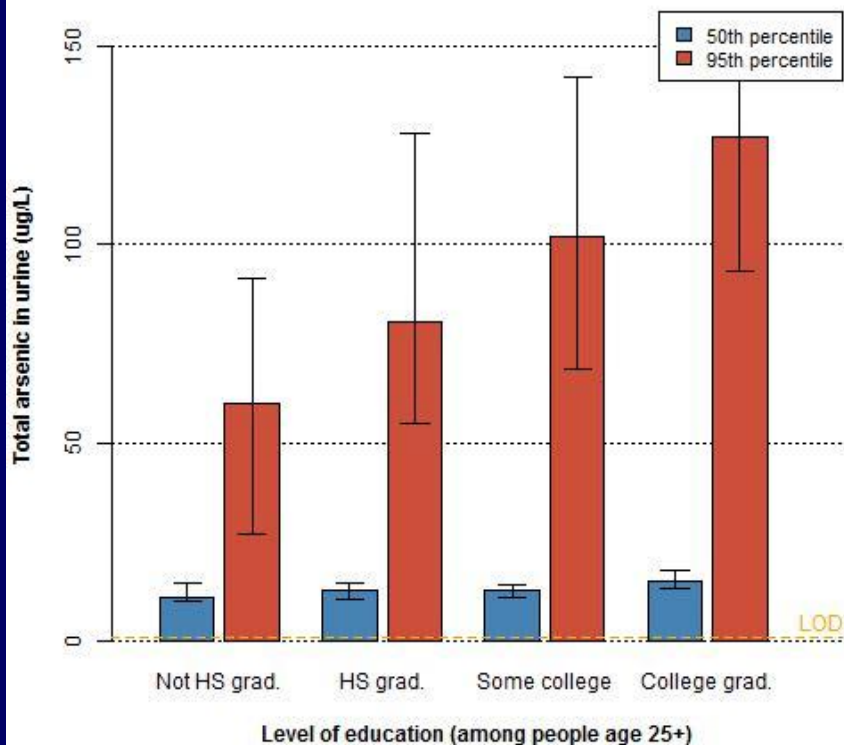
Other arsenic findings: Race/ethnicity



Other arsenic findings: Education/Income

Urinary total arsenic by level of education

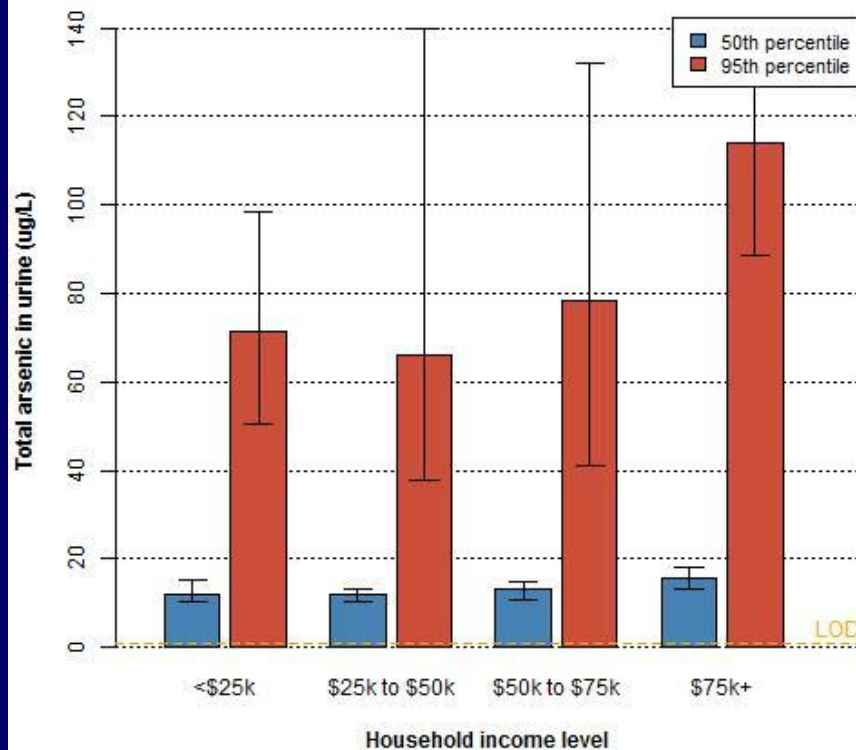
Washington Environmental Biomonitoring Survey, 2010-2011



Group	n	50th percentile	95th percentile
Did not graduate from HS	69	10.9 (10.1-14.5)	59.7 (26.9-91.6)
Graduated HS or GED	238	12.7 (10.6-14.5)	80.3 (54.9-128)
Some college or technical school	329	12.6 (11-14.2)	102 (68.7-142)
Graduated from 4-year college	368	15.1 (13.3-17.7)	127 (93.3-159)

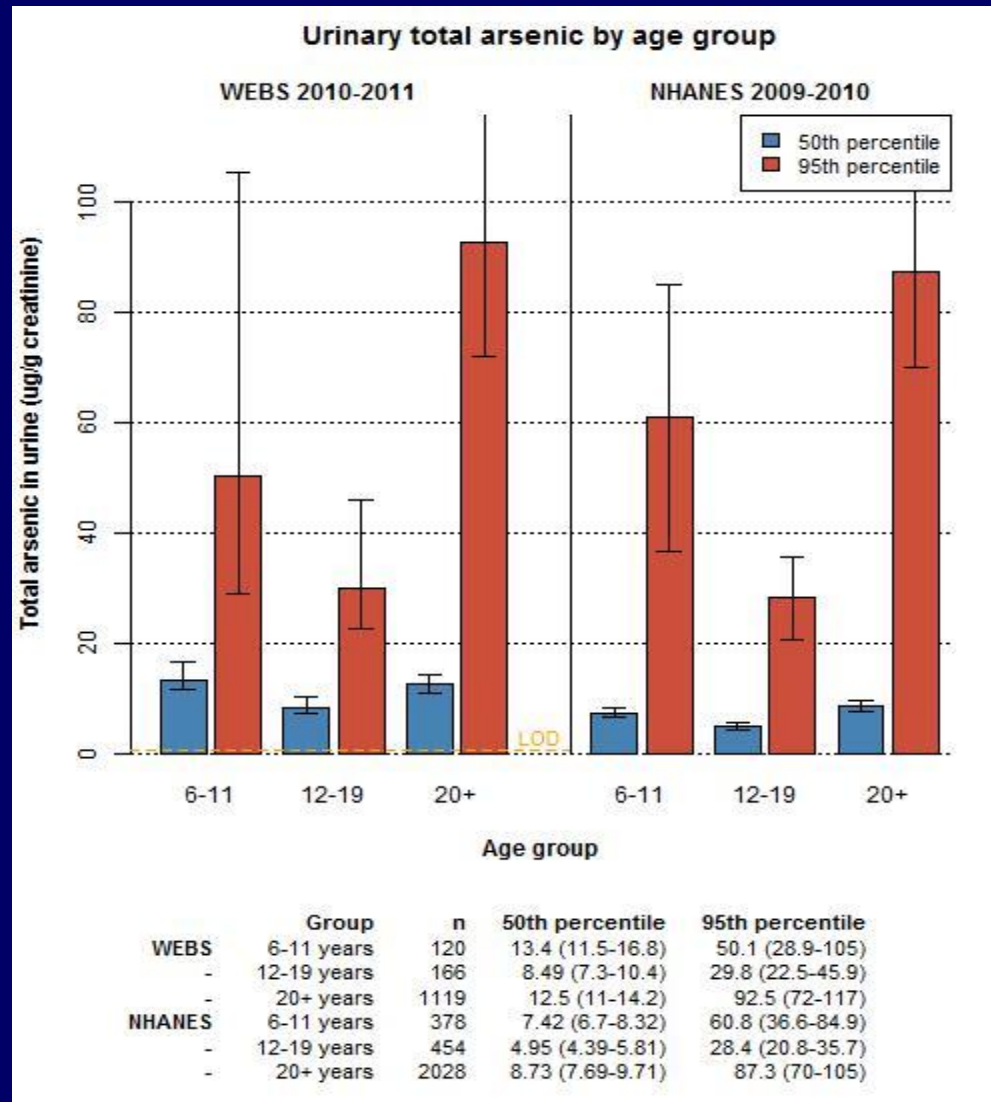
Urinary total arsenic by household income

Washington Environmental Biomonitoring Survey, 2010-2011



Group	n	50th percentile	95th percentile
Less than \$25,000	189	11.8 (10.2-15.3)	71.4 (50.4-98.6)
\$25k to less than \$50k	342	11.8 (10.4-13.3)	66 (37.9-140)
\$50k to less than \$75k	249	13.3 (10.8-14.6)	78.2 (41-132)
\$75k or more	434	15.5 (13.3-17.9)	114 (88.6-144)

Other arsenic findings: Age

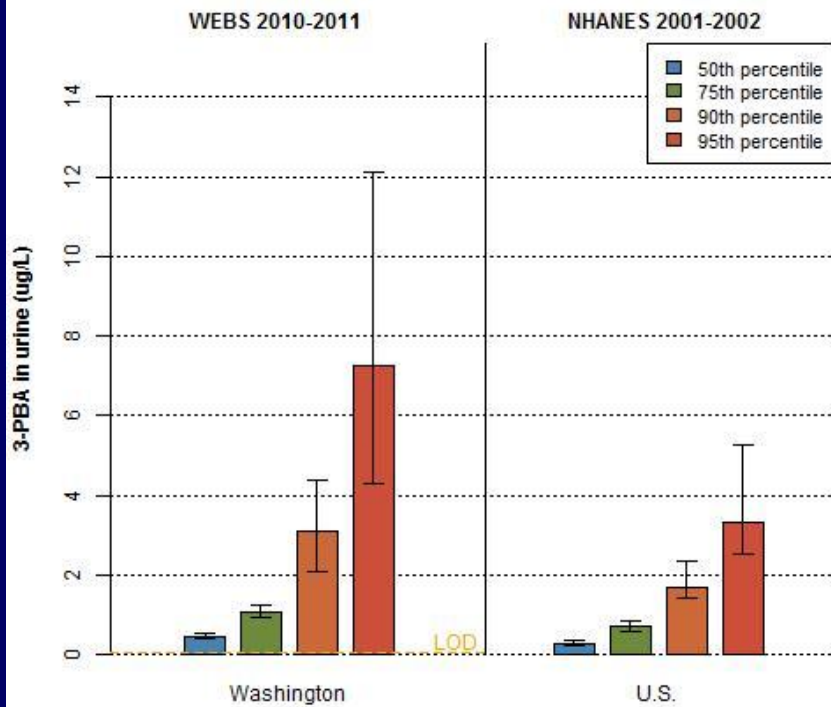


Pesticide background

- Organophosphates
 - ✓ Generally being phased out
 - ✓ Health effects relatively well understood
 - Chemical weapon (e.g. sarin gas)
 - Neurotoxicity and neurodevelopmental issues
 - ✓ Metabolite: TCPy (specific to chlorpyrifos)
- Pyrethroids
 - ✓ Common replacement for OPs
 - ✓ Health effects not as well understood
 - Potential for endocrine disruption
 - ✓ Metabolite: 3-PBA

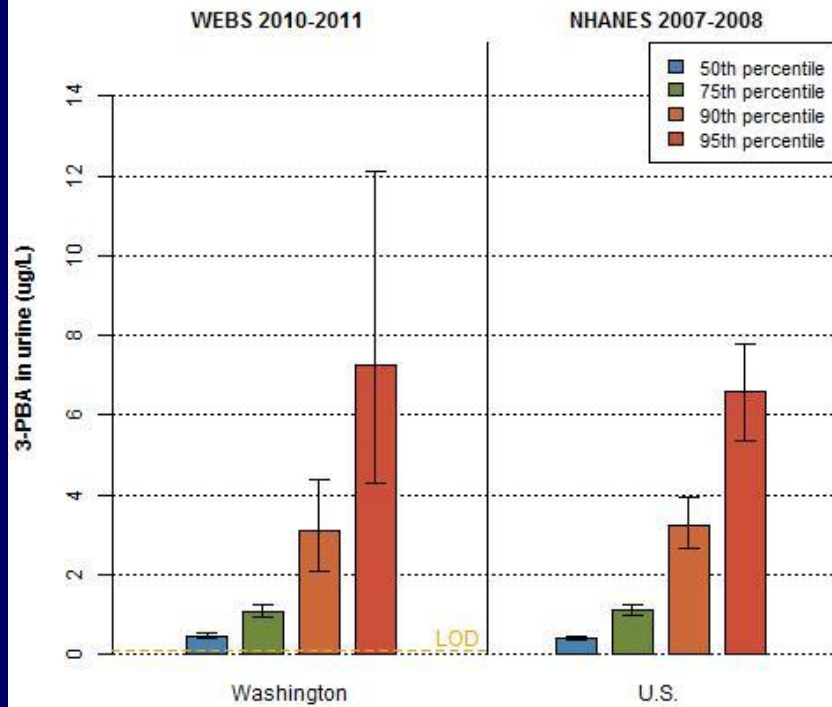
3-PBA results: WA and U.S.

Pyrethroid metabolite (3-PBA) in urine, Washington and U.S. levels



	n	50th pctl.	75th pctl.	90th pctl.	95th pctl.
WEBS	1419	0.459 (0.42-0.512)	1.08 (0.93-1.23)	3.11 (2.1-4.4)	7.26 (4.27-12.1)
NHANES	2539	0.28 (0.23-0.34)	0.7 (0.56-0.83)	1.69 (1.41-2.33)	3.32 (2.52-5.25)

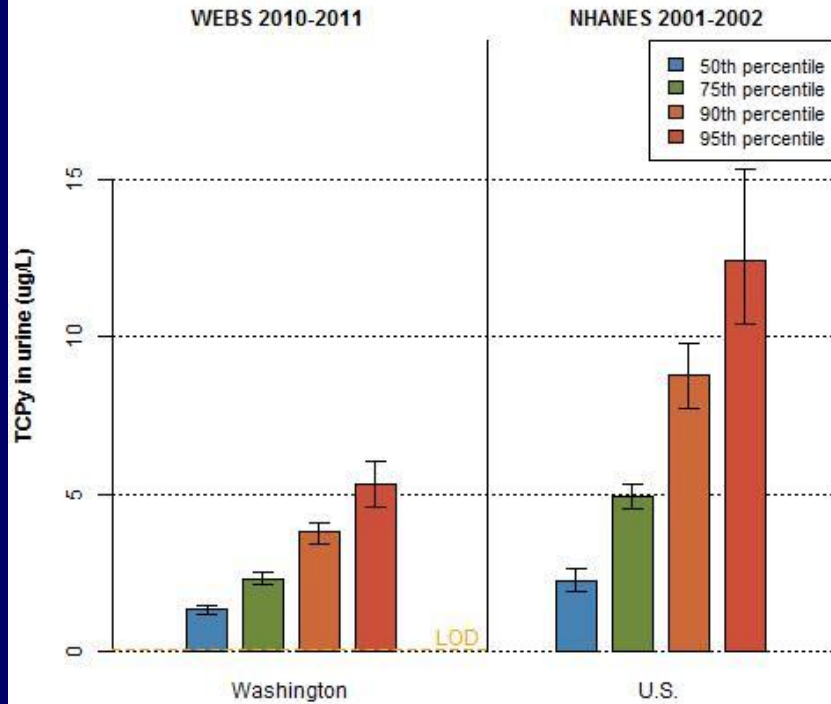
Pyrethroid metabolite (3-PBA) in urine, Washington and U.S. levels



	n	50th pctl.	75th pctl.	90th pctl.	95th pctl.
WEBS	1419	0.459 (0.42-0.512)	1.08 (0.93-1.23)	3.11 (2.1-4.4)	7.26 (4.27-12.1)
NHANES	2454	0.39 (0.35-0.44)	1.1 (0.98-1.22)	3.22 (2.67-3.93)	6.61 (5.36-7.79)

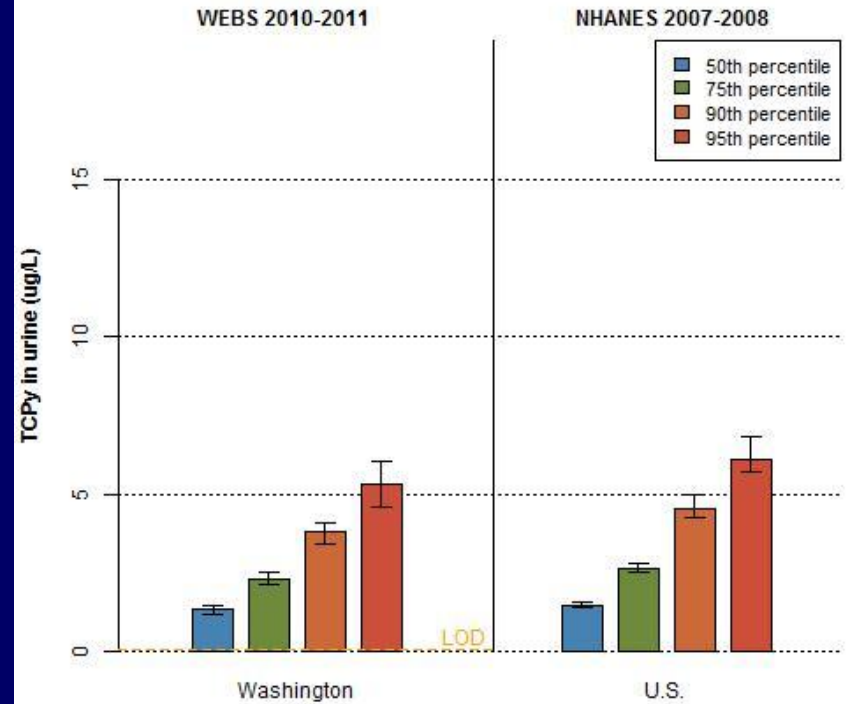
TCPy results: WA and U.S.

Chlorpyrifos metabolite (TCPy) in urine, Washington and U.S. levels



	n	50th pctl.	75th pctl.	90th pctl.	95th pctl.
WEBS	1419	1.33 (1.2-1.44)	2.3 (2.12-2.51)	3.81 (3.41-4.11)	5.34 (4.61-6.02)
NHANES	2509	2.22 (1.9-2.61)	4.95 (4.55-5.29)	8.8 (7.74-9.77)	12.4 (10.4-15.3)

Chlorpyrifos metabolite (TCPy) in urine, Washington and U.S. levels

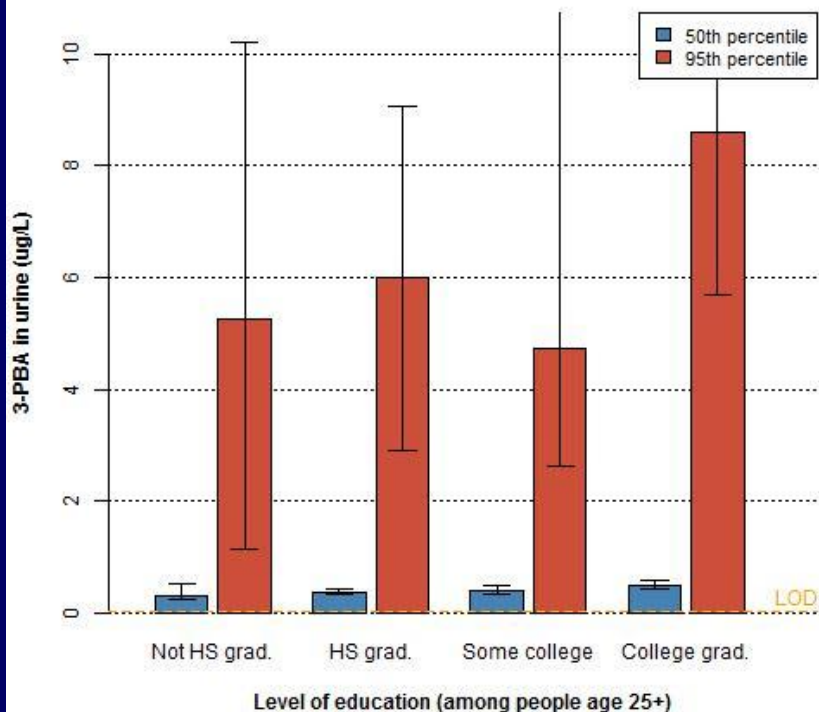


	n	50th pctl.	75th pctl.	90th pctl.	95th pctl.
WEBS	1419	1.33 (1.2-1.44)	2.3 (2.12-2.51)	3.81 (3.41-4.11)	5.34 (4.61-6.02)
NHANES	2588	1.48 (1.39-1.55)	2.63 (2.5-2.82)	4.55 (4.23-4.98)	6.1 (5.69-6.83)

Pesticide results: Education

Urinary pyrethroid metabolite (3-PBA) by level of education

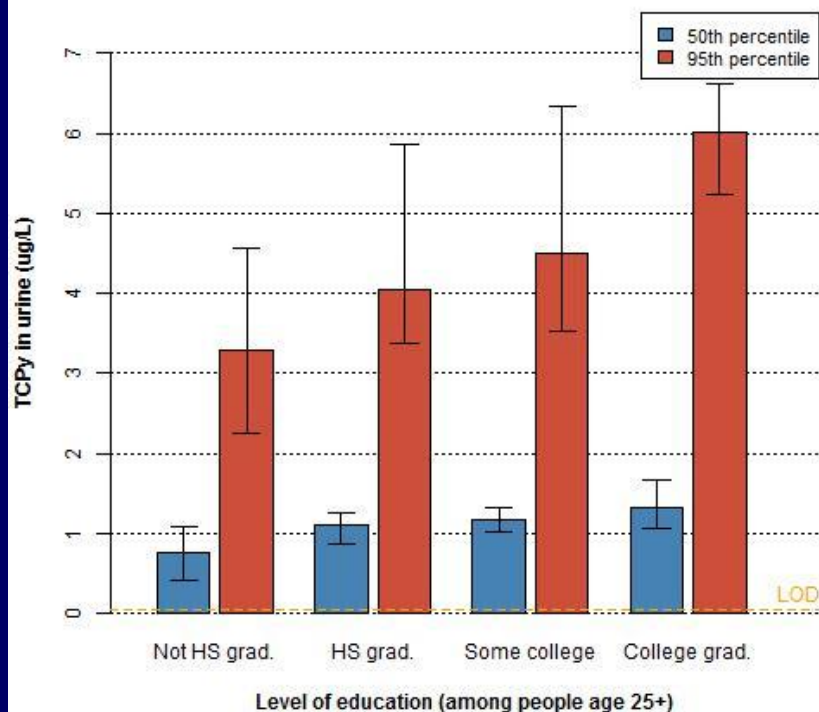
Washington Environmental Biomonitoring Survey, 2010-2011



Group	n	50th percentile	95th percentile
Did not graduate from HS	69	0.317 (0.24-0.52)	5.25 (1.15-10.2)
Graduated HS or GED	238	0.372 (0.328-0.437)	5.99 (2.92-9.08)
Some college or technical school	329	0.399 (0.33-0.499)	4.73 (2.62-10.9)
Graduated from 4-year college	368	0.491 (0.421-0.583)	8.6 (5.68-13.2)

Urinary chlorpyrifos metabolite (TCPy) by level of education

Washington Environmental Biomonitoring Survey, 2010-2011

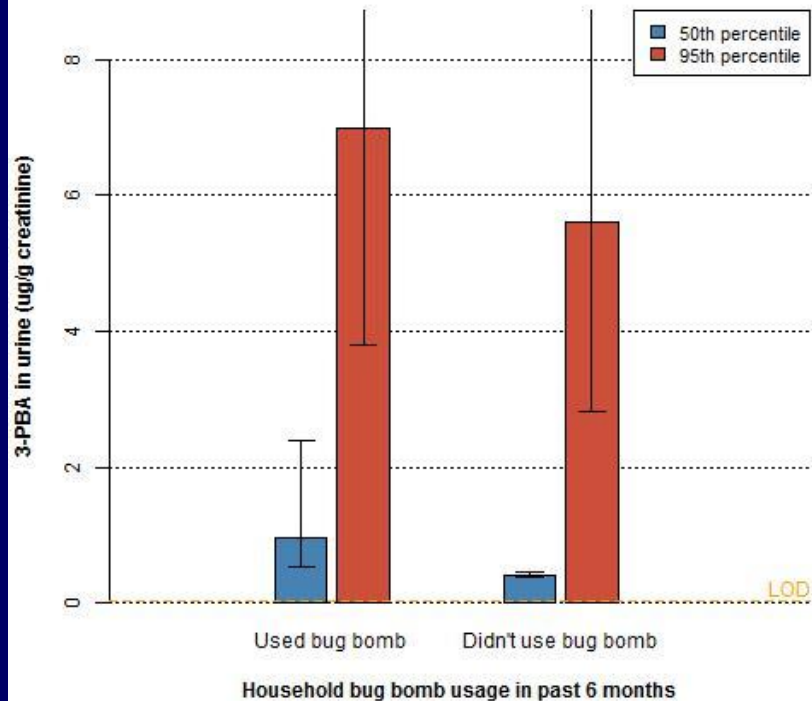


Group	n	50th percentile	95th percentile
Did not graduate from HS	69	0.748 (0.417-1.08)	3.28 (2.26-4.56)
Graduated HS or GED	238	1.1 (0.863-1.26)	4.05 (3.38-5.85)
Some college or technical school	329	1.17 (1.01-1.33)	4.49 (3.53-6.33)
Graduated from 4-year college	368	1.33 (1.06-1.67)	6.01 (5.24-6.62)

Pesticide results: Household bug bomb

Urinary pyrethroid metabolite (3-PBA) and using a bug bomb

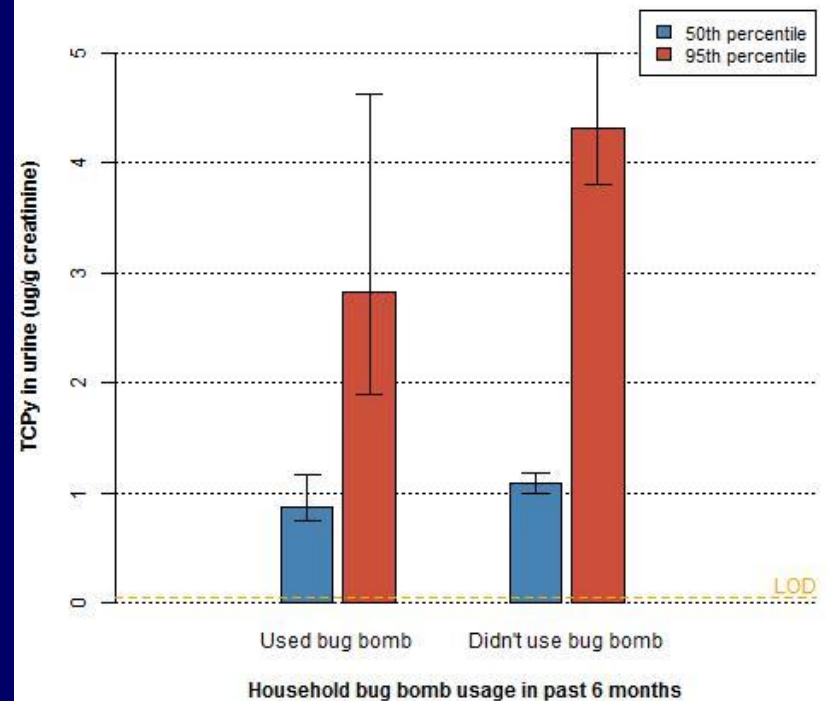
Washington Environmental Biomonitoring Survey, 2010-2011



Group	n	50th percentile	95th percentile
Used bug bomb	56	0.961 (0.54-2.38)	6.99 (3.81-13.7)
Didn't use bug bomb	1297	0.414 (0.374-0.447)	5.61 (2.83-12.5)

Urinary chlorpyrifos metabolite (TCPy) and using a bug bomb

Washington Environmental Biomonitoring Survey, 2010-2011

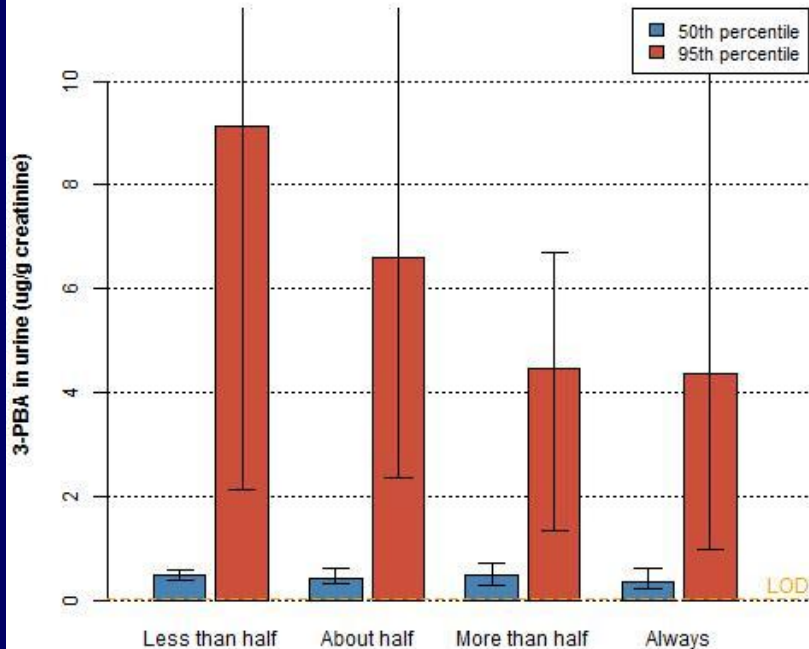


Group	n	50th percentile	95th percentile
Used bug bomb	56	0.867 (0.74-1.17)	2.82 (1.89-4.62)
Didn't use bug bomb	1297	1.08 (0.995-1.18)	4.31 (3.8-4.99)

Pesticide results: Eating organic foods

Urinary pyrethroid metabolite (3-PBA) and eating organic foods

Washington Environmental Biomonitoring Survey, 2010-2011

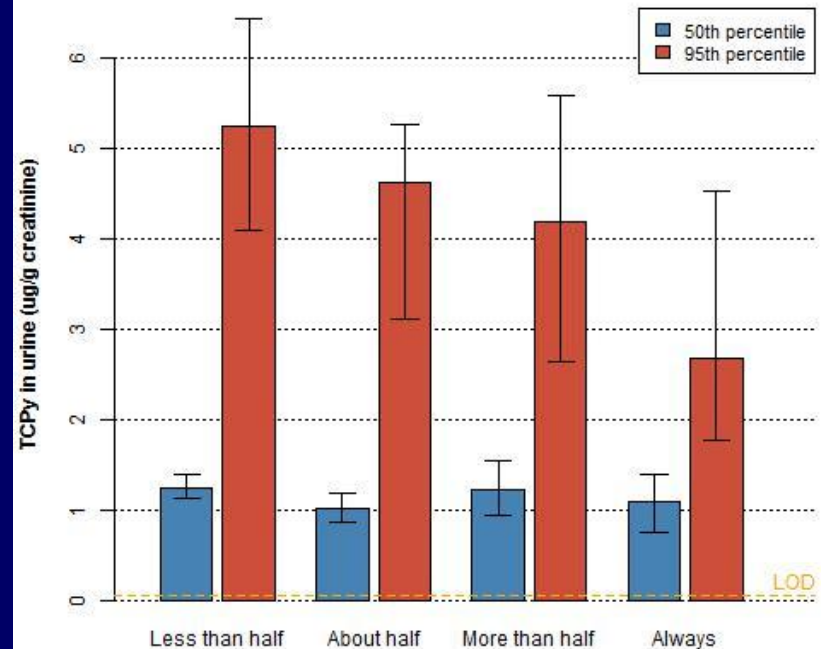


How much of the time eating organic fruits/vegetables in past 2 days

Group	n	50th percentile	95th percentile
Less than half the time	356	0.499 (0.406-0.583)	9.13 (2.13-55.4)
About half the time	155	0.434 (0.329-0.621)	6.61 (2.36-14.8)
More than half the time	80	0.484 (0.295-0.74)	4.47 (1.35-6.69)
Always	42	0.374 (0.222-0.626)	4.36 (0.997-57.9)

Urinary chlorpyrifos metabolite (TCPy) and eating organic foods

Washington Environmental Biomonitoring Survey, 2010-2011



How much of the time eating organic fruits/vegetables in past 2 days

Group	n	50th percentile	95th percentile
Less than half the time	356	1.24 (1.14-1.39)	5.25 (4.09-6.44)
About half the time	155	1.03 (0.876-1.19)	4.62 (3.12-5.27)
More than half the time	80	1.22 (0.944-1.55)	4.2 (2.65-5.6)
Always	42	1.09 (0.758-1.39)	2.68 (1.78-4.54)

Thank You

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