FOOD FORUM 2024 SESSION 1:
EQUITY CONSIDERATIONS

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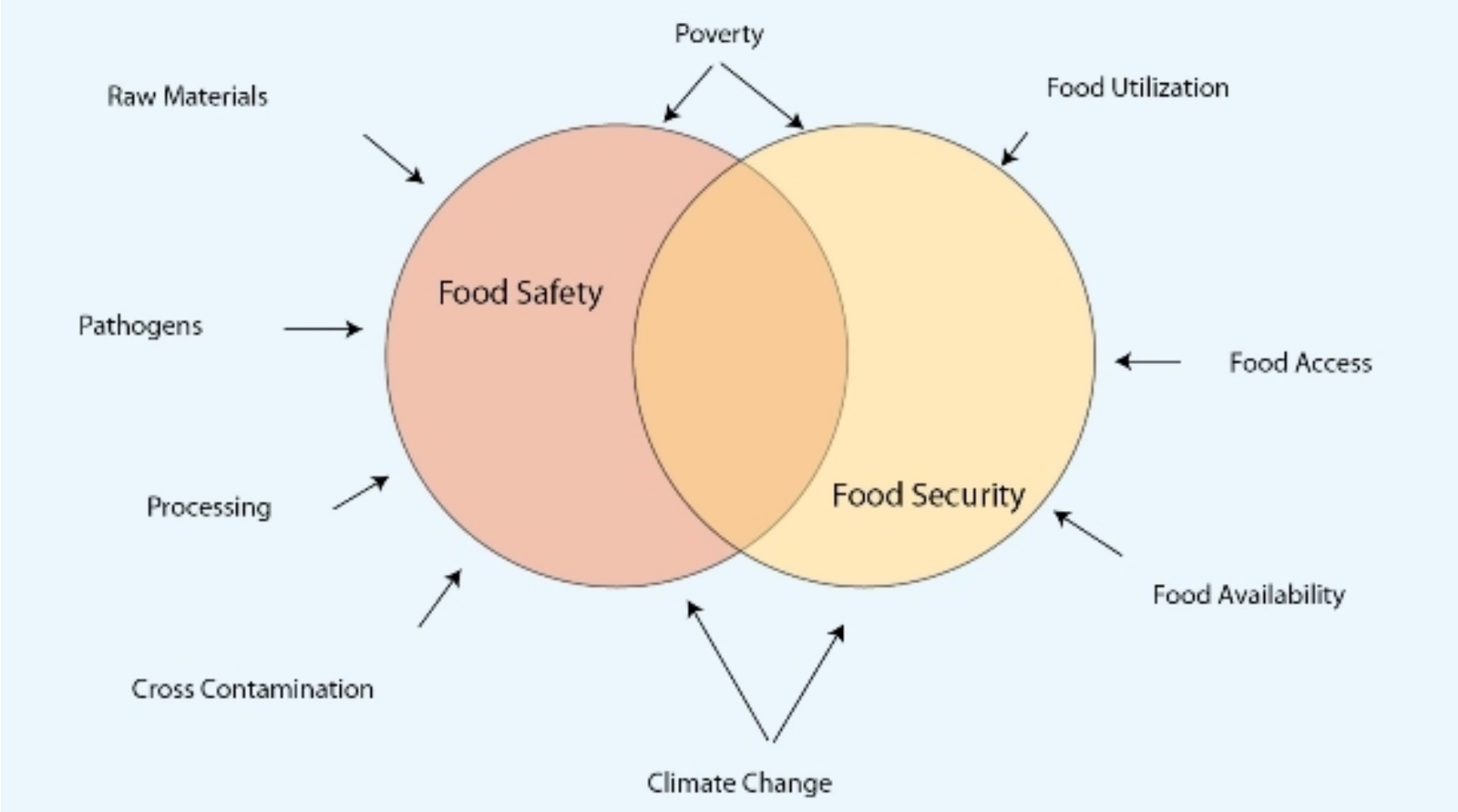
Disclosures

- Funding from NIH and private foundations.
- No conflicts to disclose.

Food Safety and Food Security

"All people, at all times, have physical, social and economic **access to sufficient, safe and nutritious food** that meets their **dietary needs** and **food preferences** for an active and healthy life."



Hanning, I. B., O'Bryan, C. A., Crandall, P. G. & Ricke, S. C. (2012) Food Safety and Food Security. *Nature Education Knowledge* 3(10):9

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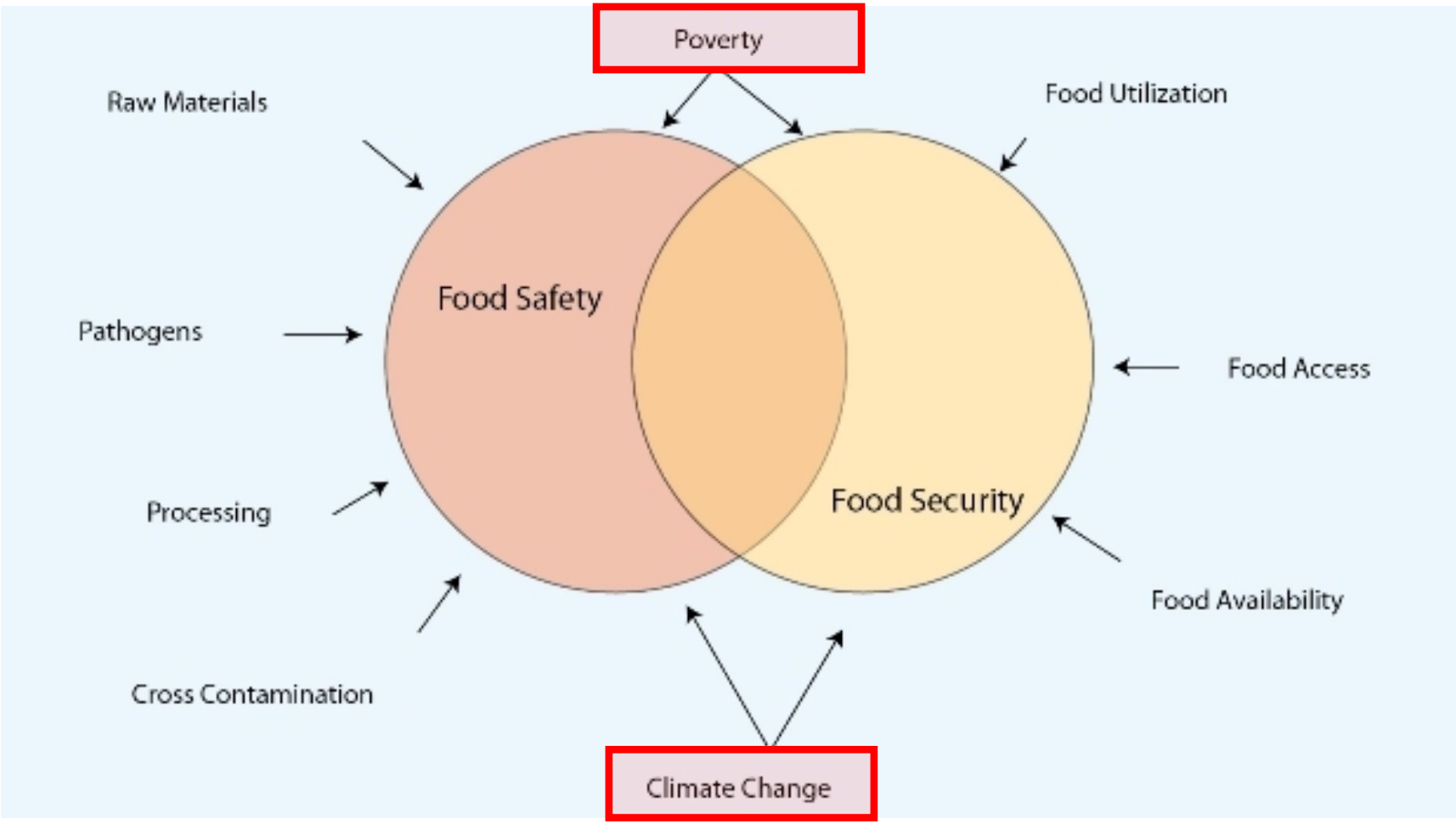

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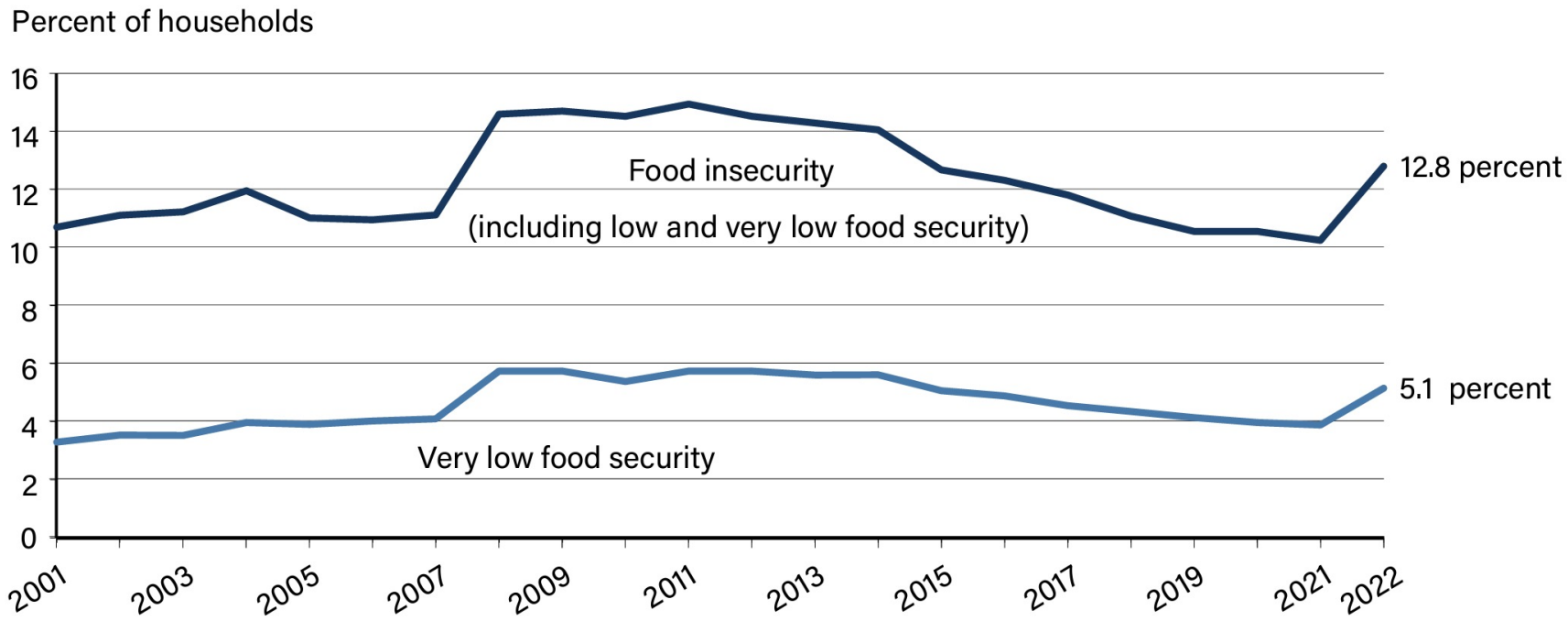
Food Security ← → Food Insecurity

Prevalence of food insecurity in 2022 increased from 2021



Source: USDA, Economic Reserach Service using data from U.S. Department of Commerce, Bureau of the Census, Current Population Survey Food Security Supplement.

In 2022, 12.8 percent of the US population (17.0 million households) were food insecure, including 3.3 million households with children.

How do we know what people in the U.S. eat?

nhanes

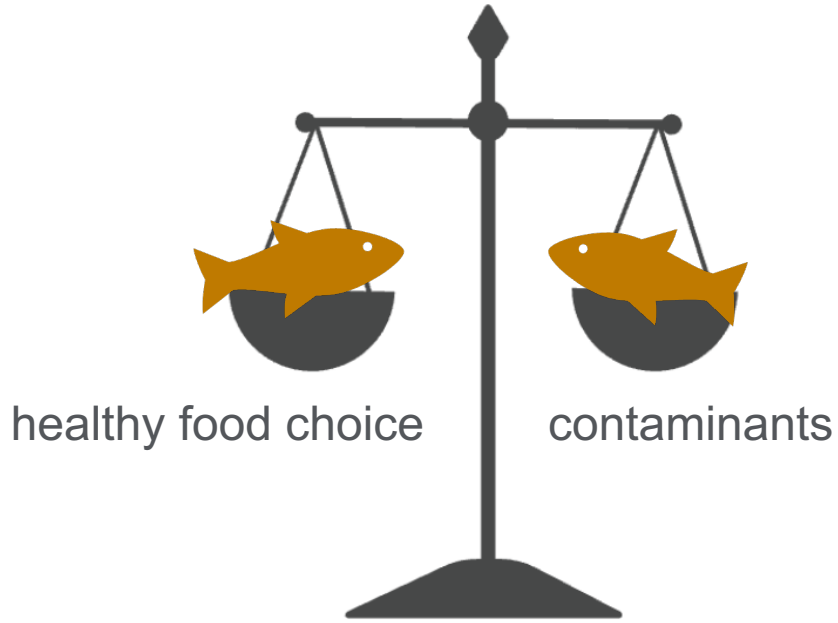
National Center for Health Statistics

National Health and Nutrition Examination Survey

- Complex, multistage, probability sampling design to select **participants representative of the civilian, non-institutionalized US population**

- NHANES oversamples persons 60 years of age and older, African Americans, and Hispanics.

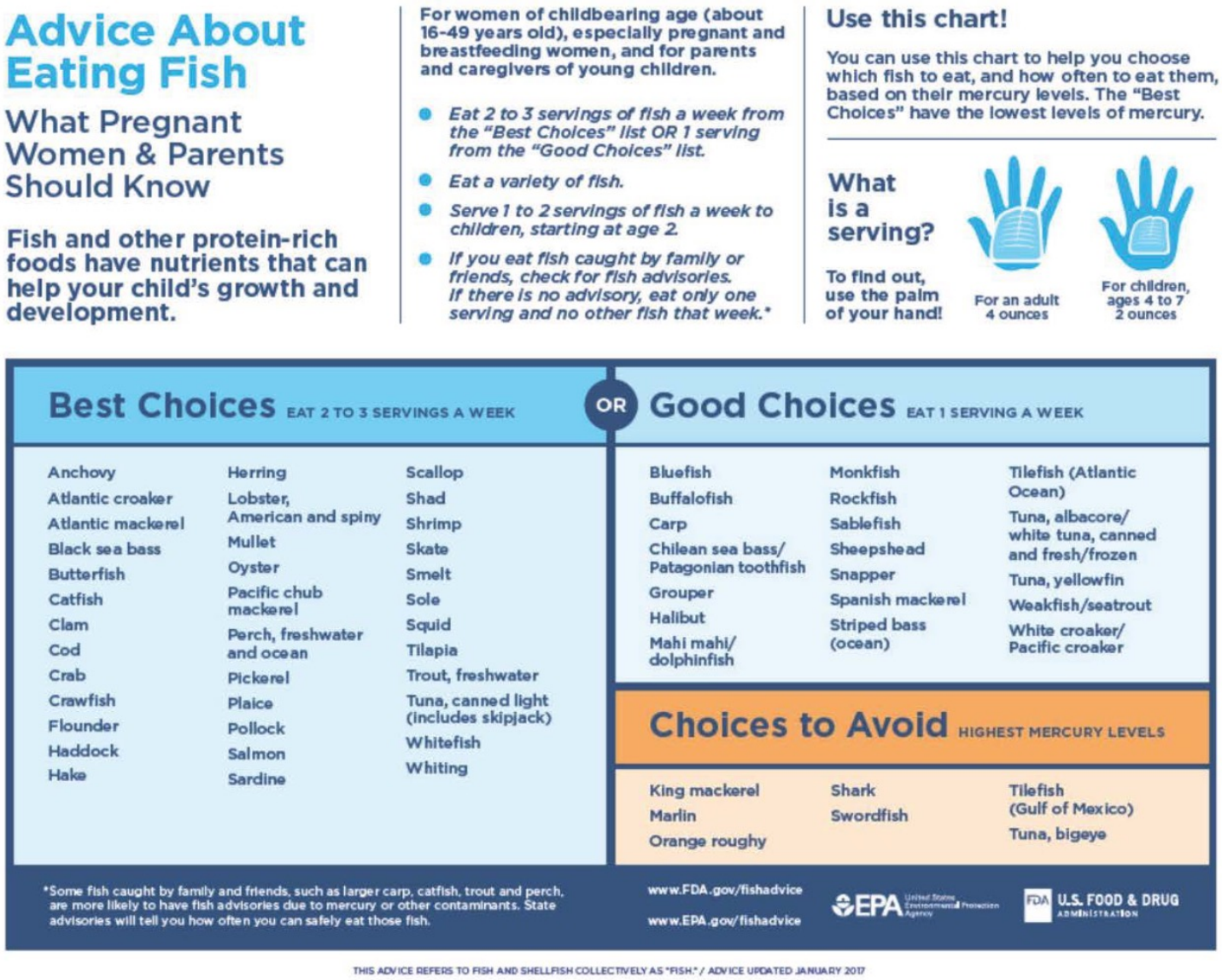
Example 1: Nutrients and Contaminants in Fish/Seafood



It is currently unclear how much seafood children or pregnant and lactating women are consuming, and what impact seafood consumption is having on children's growth and development.

https://nap.nationalacademies.org/catalog/27623/the-role-of-seafood-consumption-in-child-growth-and-development

How much fish and seafood is recommended?



Advice About Eating Fish

What Pregnant Women & Parents Should Know

Fish and other protein-rich foods have nutrients that can help your child's growth and development.

For women of childbearing age (about 16-49 years old), especially pregnant and breastfeeding women, and for parents and caregivers of young children.

- *Eat 2 to 3 servings of fish a week from the "Best Choices" list OR 1 serving from the "Good Choices" list.*
- *Eat a variety of fish.*
- *Serve 1 to 2 servings of fish a week to children, starting at age 2.*
- *If you eat fish caught by family or friends, check for fish advisories. If there is no advisory, eat only one serving and no other fish that week.**

Use this chart!

You can use this chart to help you choose which fish to eat, and how often to eat them, based on their mercury levels. The "Best Choices" have the lowest levels of mercury.

What is a serving?

To find out, use the palm of your hand!

For an adult 4 ounces

For children, ages 4 to 7 2 ounces

Best Choices EAT 2 TO 3 SERVINGS A WEEK

- Anchovy
- Atlantic croaker
- Atlantic mackerel
- Black sea bass
- Butterfish
- Catfish
- Clam
- Cod
- Crab
- Crawfish
- Flounder
- Haddock
- Hake
- Herring
- Lobster, American and spiny
- Mullet
- Oyster
- Pacific chub mackerel
- Perch, freshwater and ocean
- Pickerel
- Plaice
- Pollock
- Salmon
- Sardine
- Scallop
- Shad
- Shrimp
- Skate
- Smelt
- Sole
- Squid
- Tilapia
- Trout, freshwater
- Tuna, canned light (includes skipjack)
- Whitefish
- Whiting

OR

Good Choices EAT 1 SERVING A WEEK

- Bluefish
- Buffalofish
- Carp
- Chilean sea bass/ Patagonian toothfish
- Grouper
- Halibut
- Mahi mahi/ dolphinfish
- Monkfish
- Rockfish
- Sablefish
- Sheepshead
- Snapper
- Spanish mackerel
- Striped bass (ocean)
- Tilefish (Atlantic Ocean)
- Tuna, albacore/ white tuna, canned and fresh/frozen
- Tuna, yellowfin
- Weakfish/seatrout
- White croaker/ Pacific croaker

Choices to Avoid HIGHEST MERCURY LEVELS

- King mackerel
- Marlin
- Orange roughy
- Shark
- Swordfish
- Tilefish (Gulf of Mexico)
- Tuna, bigeye

*Some fish caught by family and friends, such as larger carp, catfish, trout and perch, are more likely to have fish advisories due to mercury or other contaminants. State advisories will tell you how often you can safely eat those fish.

www.FDA.gov/fishadvice

www.EPA.gov/fishadvice

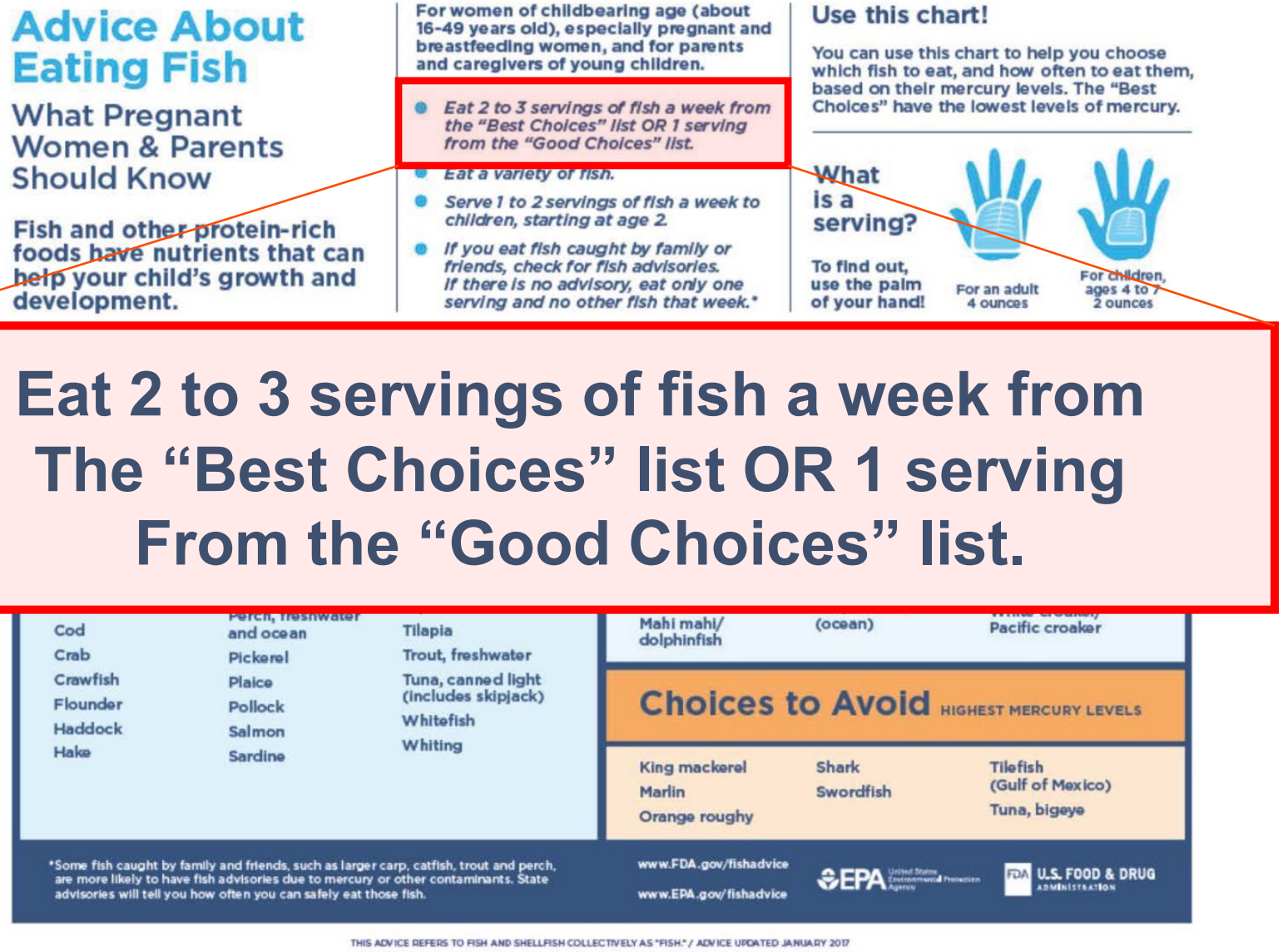
EPA United States Environmental Protection Agency

FDA U.S. FOOD & DRUG ADMINISTRATION

THIS ADVICE REFERS TO FISH AND SHELLFISH COLLECTIVELY AS "FISH." / ADVICE UPDATED JANUARY 2017

hthttps://www.healthychildren.org/English/ages-stages/prenatal/Pages/Fish-Pregnancy-What-is-Safe-to-Eat.aspx

How much fish and seafood is recommended?



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How much fish do pregnant women and children eat?

TABLE 3-6 Weighted Seafood Meal Frequency Among Women of Childbearing Age, by Percentage of Seafood Meals

	n, Weighted	0 Meals per Month, Percent (*n*)	Less Than 2 Meals per Week, Percent (*n*)	2 or more Meals per Week, Percent (*n*)
Overall	145,136,708	27 (3,694)	54 (7,392)	19 (2,646)
Race/Ethnicity				
Hispanic	29,442,289	26 (936)	58 (2,064)	16 (516)
Non-Hispanic Asian	9,262,960	21 (359)	42 (749)	37 (639)
Non-Hispanic White	18,261,908	22 (727)	57 (1,858)	21 (661)
Non-Hispanic Black	82,355,531	29 (1,478)	54 (2,372)	17 (687)
Other	5,814,021	28 (194)	53 (349)	20 (143)
Income (IPR)				
Less than 1.3	39,028,154	33 (1,570)	54 (2,616)	14 (664)
1.3–4.99	75,250,923	27 (1,748)	55 (3,787)	18 (1,342)
5+	30,857,631	20 (376)	53 (989)	27 (640)

NOTES: IPR = income poverty ratio; *n* = sample size. Values in parentheses are unweighted sample sizes. Seafood frequency measured using a 30-day food frequency questionnaire based on the total number of meals per month for all seafood species. Respondents not reporting food frequency are not presented in this table. See NHANES Data Analysis Methodology in Appendix E.
SOURCE: NHANES cycle years 2011–2012 through 2017–March 2020.

https://nap.nationalacademies.org/catalog/27623/the-role-of-seafood-consumption-in-child-growth-and-development

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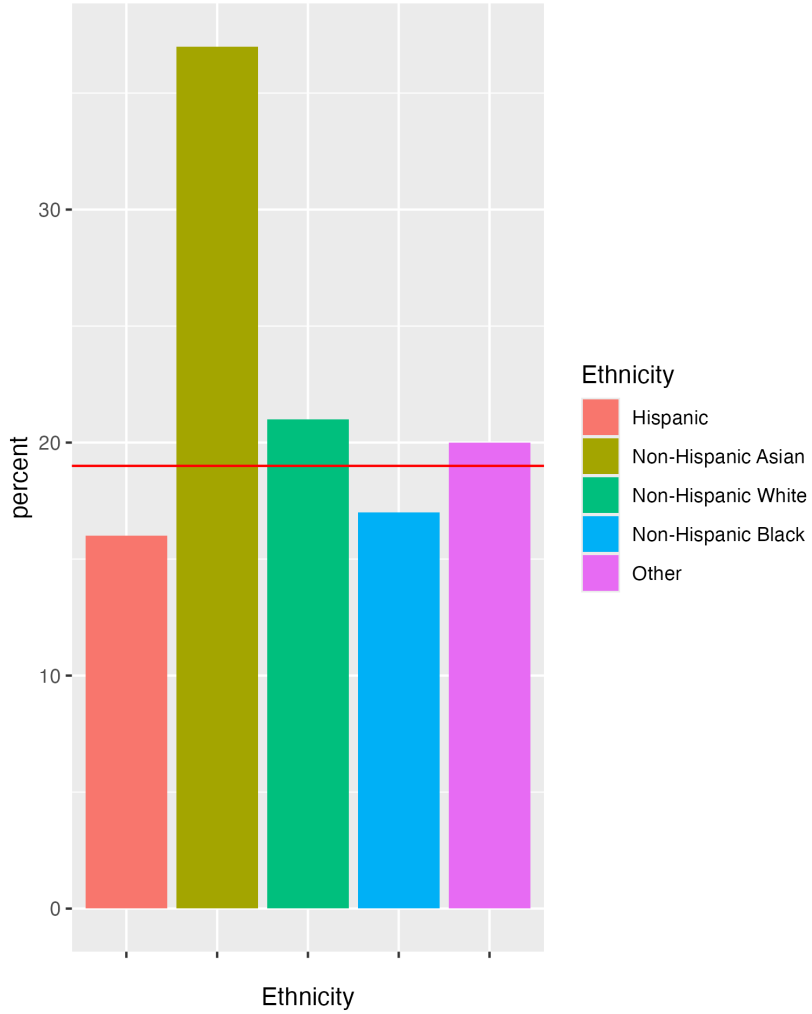

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How much fish do pregnant women and children eat?

TABLE 3-12 Weighted Seafood Meal Frequency, U.S. children, 2–19 Years

	n, Weighted	0 Meals per Month, Percent (*n*)	Less than 2 Meals per Week, Percent (*n*)	2 or more Meals per Week, Percent (*n*)
Overall	74,270,808	43 (5,372)	51 (6,631)	6.4 (926)
Males (years)				
2–5	7,908,059	46 (698)	49 (735)	5.9 (103)
6–11	12,925,783	43 (945)	50 (1,185)	6.9 (164)
12–19	17,022,525	42 (1,131)	51 (1,364)	7.0 (199)
Females (years)				
2–5	8,029,348	39 (602)	55 (828)	5.9 (124)
6–11	11,739,998	43 (909)	52 (1,183)	5.7 (163)
12–19	16,645,096	44 (1,087)	50 (1,336)	6.2 (173)
Race/Ethnicity				
Hispanic	17,869,766	44 (1,734)	50 (1,936)	5.4 (186)
Non-Hispanic Asian	3,428,654	31 (343)	50 (574)	19 (234)
Non-Hispanic White	10,429,463	36 (1,186)	56 (1,896)	8.1 (274)
Non-Hispanic Black	38,447,678	45 (1,708)	50 (1,762)	5.0 (159)
Other	4,095,247	43 (401)	48 (463)	9.1 (73)
Income (IPR)				
Less than 1.3	25,389,481	46 (2,488)	49 (2,788)	5.7 (325)
1.3–4.99	37,715,367	43 (2,448)	51 (3,172)	5.8 (455)
5+	11,165,960	36 (436)	54 (671)	9.8 (146)

NOTES: IPR = income-to-poverty ratio. Values in parentheses are unweighted sample sizes. Seafood frequency measured using a 30-day food frequency questionnaire based on the total number of meals per month for all seafood species. Respondents not reporting food frequency are not presented in this table; *n* = sample size. See NHANES Data Analysis Methodology in Appendix E.
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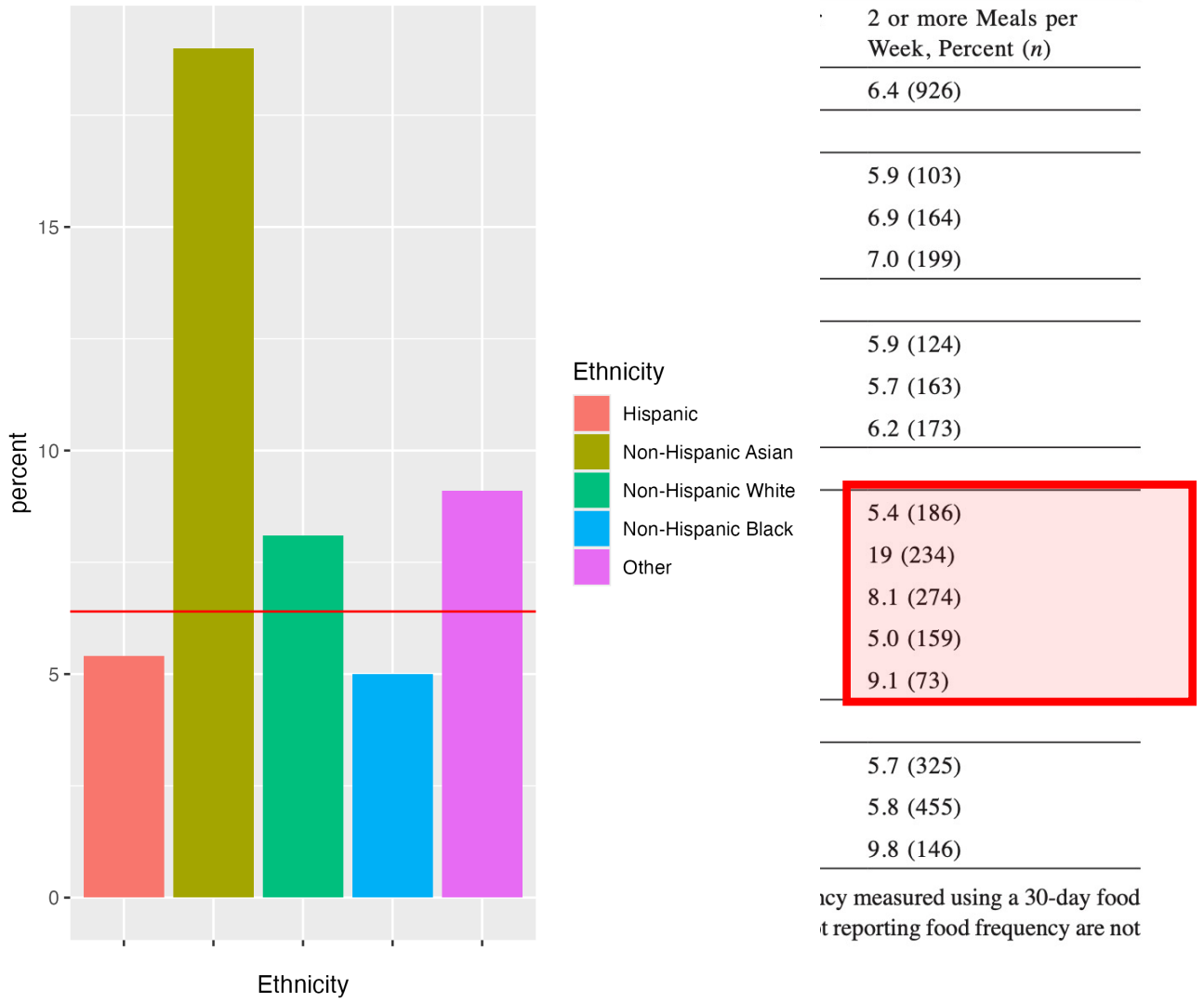

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How much seafood do Native Tribes and Indigenous Peoples eat?

The average Squamish tribal member reported consuming **25 times** the amount of shellfish compared with the national average.

Native tribes also reported eating **different species** and **parts of seafood** compared with the total U.S. population.

Judd, N. L. et al. 2004. Consideration of cultural and lifestyle factors in defining susceptible populations for environmental disease. Toxicology 198(1-3):121-133.
https://nwtreatytribes.org/tribe-reviving-traditional-shellfish-resources-management-practices/

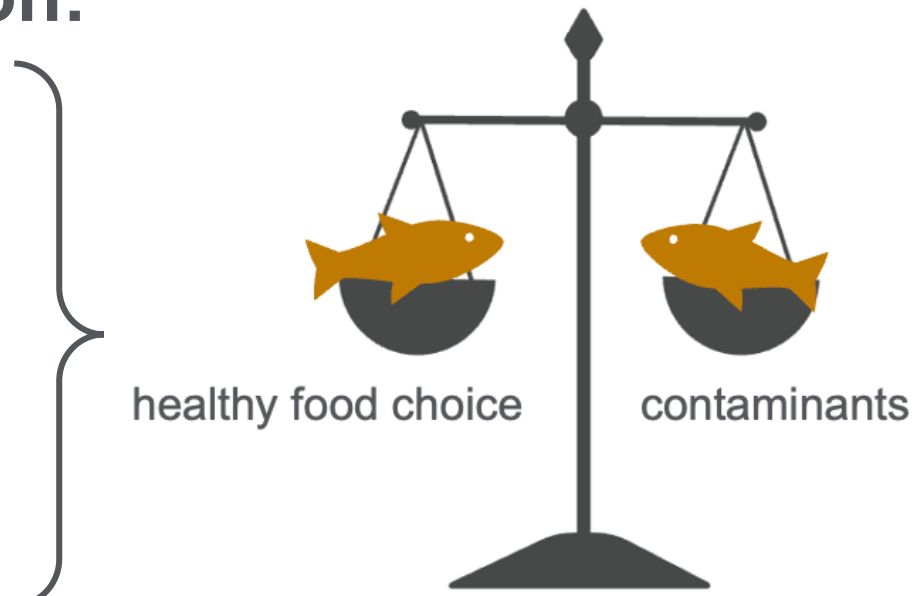
How much fish do pregnant women and children eat?

On average: not enough!

But: lots of variation.

Factors influencing seafood consumption:

- Cultural and lifestyle factors
- Ethnicity
- Native Tribes and Indigenous Peoples
- Recreational fishers
- Cost
- Knowledge
- Preparation skills



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Another Louisiana bayou is added to list of waterways with mercury-laden fish

Fishing spot near Baton Rouge added to list of almost 60 areas of concern

BY TRISTAN BAURICK | Staff writer May 25, 2021 2 min to read

Wayne Loney, right, and Dale Ray, both of Hammond, crab and fish near Bayou Lacombe on Thursday, July 2, 2020.

STAFF PHOTO BY CHRIS GRANGER

-VS-

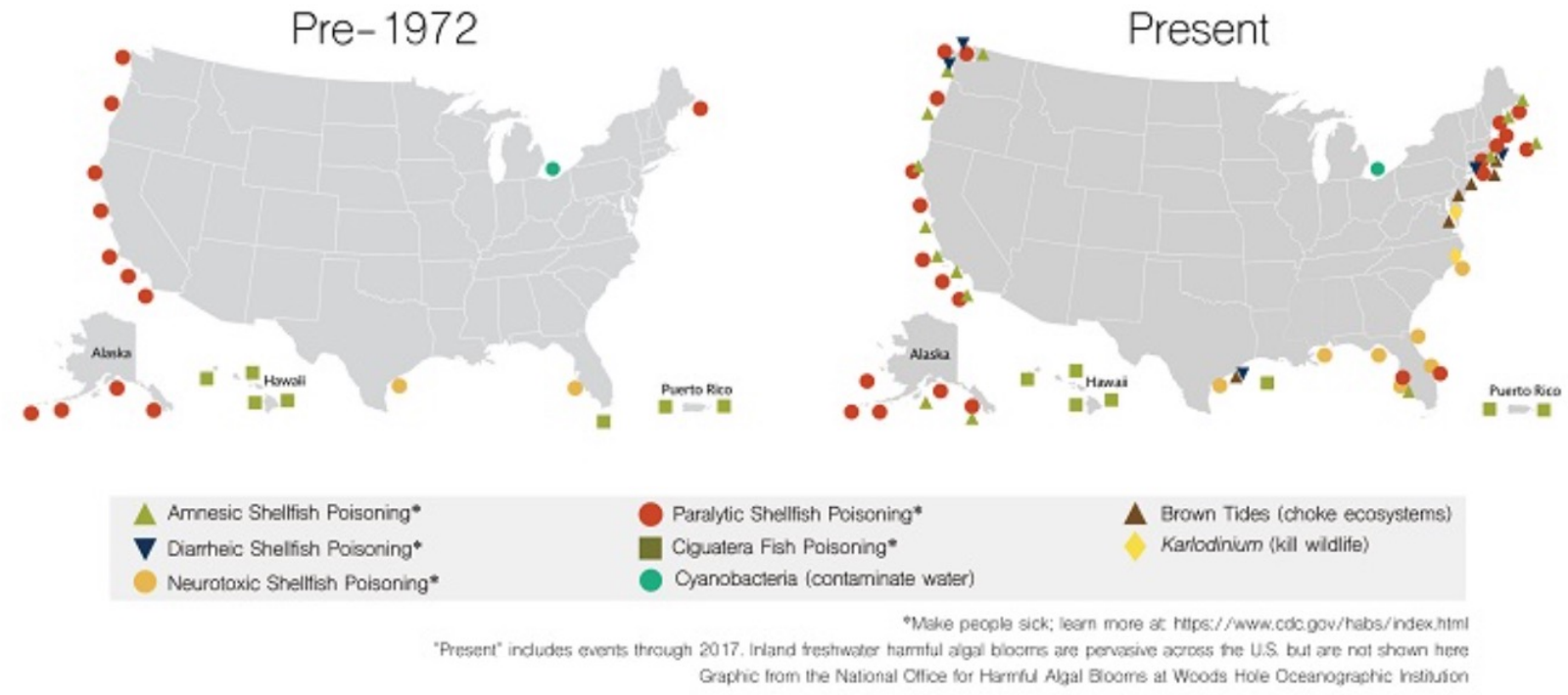
Whole Foods Market® Empowers Shoppers to Make Sustainable Seafood Choices with Color-Coded Rating System

Partners with Monterey Bay Aquarium and Blue Ocean Institute to create science-based wild-caught seafood rating program; plans to phase out red-rated species

https://www.nola.com/news/environment/another-louisiana-bayou-is-added-to-list-of-waterways-with-mercury-laden-fish/article_12fca09c-bd6d-11eb-abd2-33167fd8709f.html

https://www.prnewswire.com/news-releases/whole-foods-market-empowers-shoppers-to-make-sustainable-seafood-choices-with-color-coded-rating-system-102777114.html

How is **climate change** impacting seafood/fish safety?



Climate change affects conditions (e.g., water temperature, salinity) that promote the growth of harmful algal blooms, which are toxic to fish and humans.

https://www.fisheries.noaa.gov/west-coast/science-data/hitting-us-where-it-hurts-untold-story-harmful-algal-blooms#harmful-algal-blooms-put-people-out-of-work

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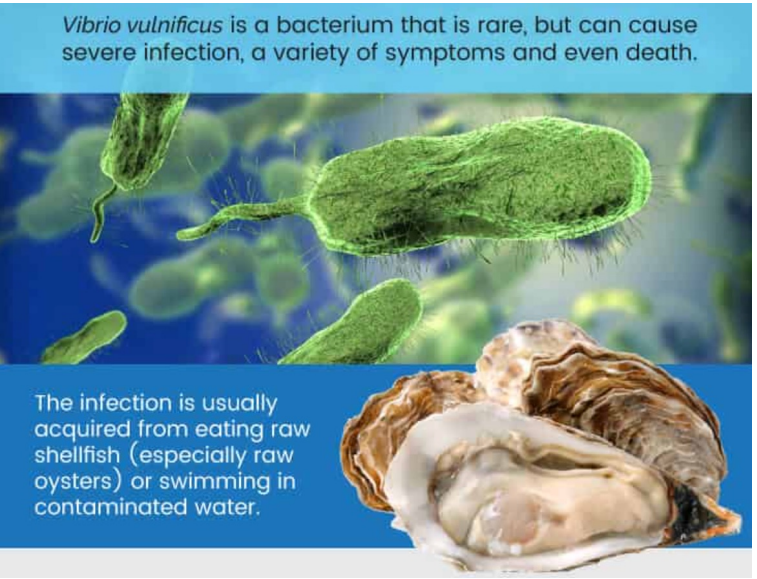
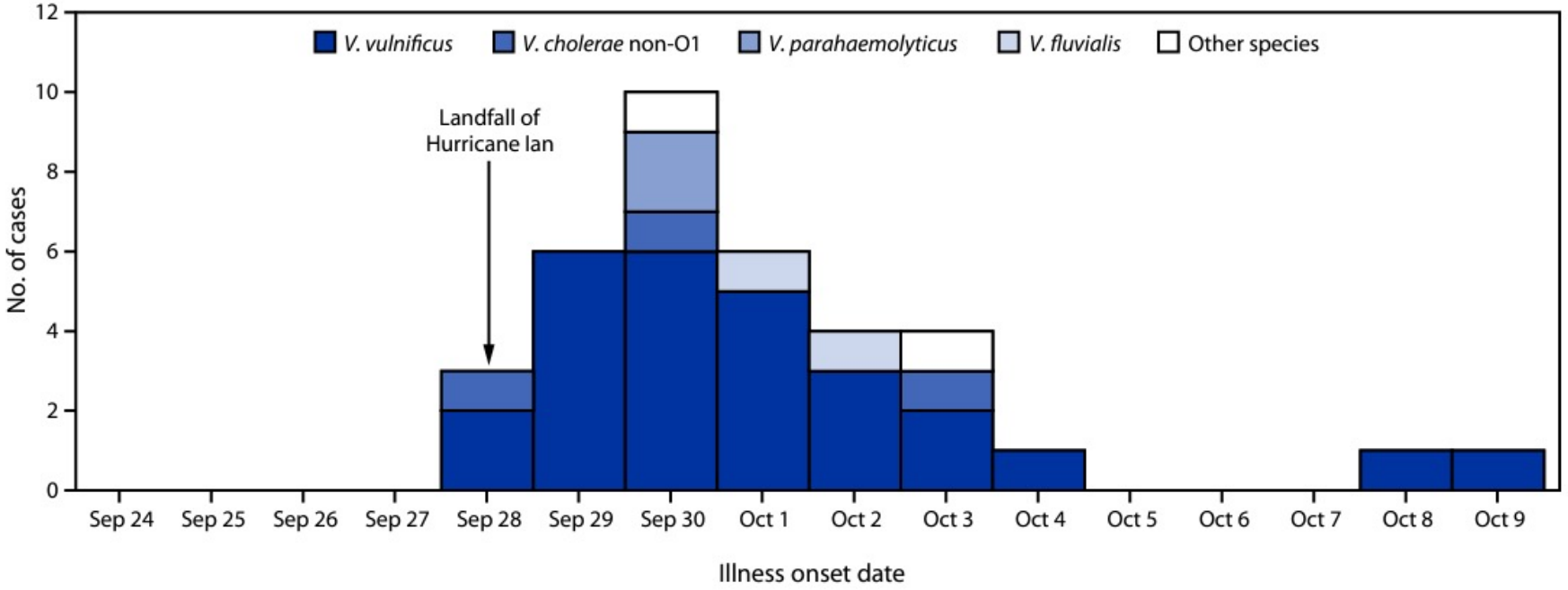


FIGURE. Hurricane Ian–associated vibriosis cases* (N = 38) and deaths† (N = 11), by illness onset date and *Vibrio* species — Florida, September 28–October 9, 2022



Flooding after hurricanes is associated with the growth of vibrio bacteria that contaminate shellfish, leading to outbreaks of vibriosis, a gastrointestinal illness that is potentially fatal.

https://www.cdc.gov/mmwr/volumes/72/wr/mm7218a5.htm

Example 2: Arsenic in rice

Rice plants are particularly efficient at absorbing arsenic from soil and water, making rice a primary source of dietary arsenic for many populations worldwide.

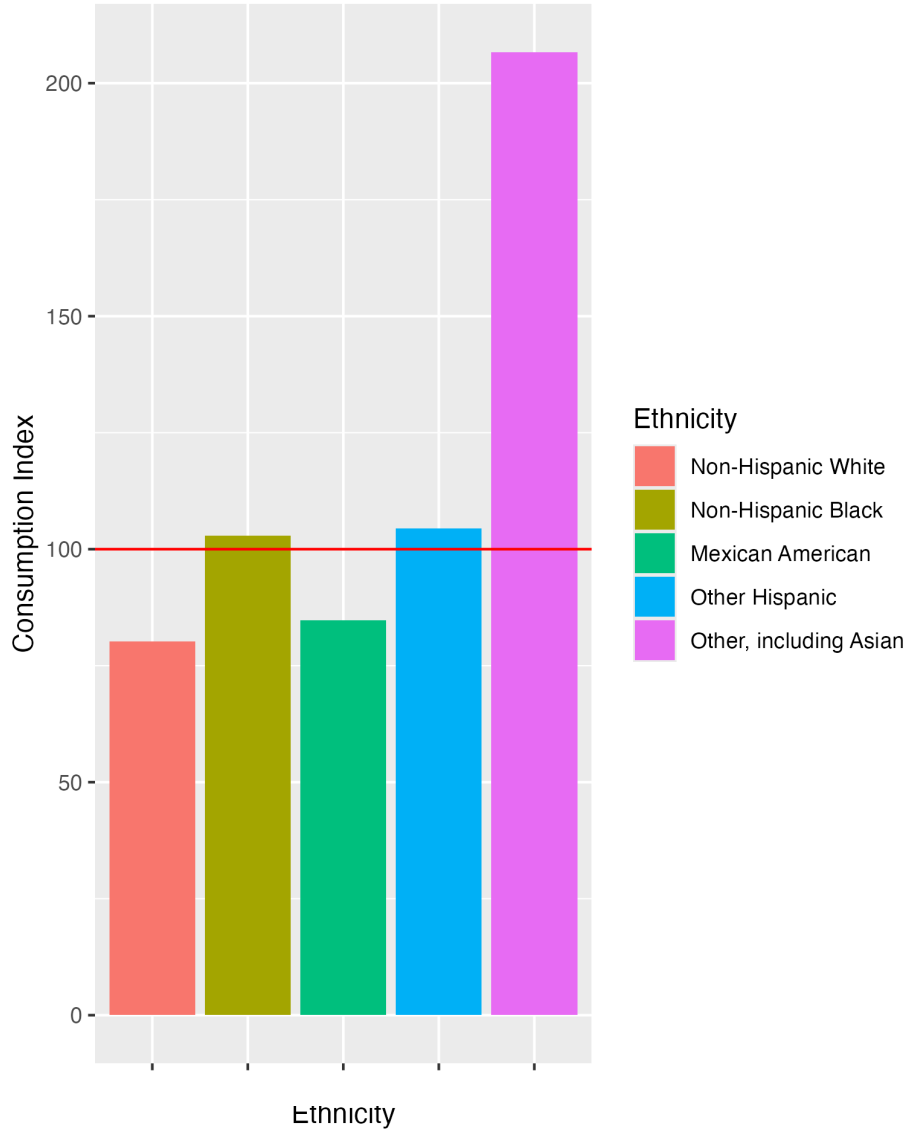
In areas where there is no arsenic in the drinking water (e.g., NYC), rice consumption is the primary source of inorganic As.

What do we know about rice consumption from NHANES?

Table 2. Share of population group who are consumers of white or brown rice and estimated mean intake, expressed as a percentage of consumers' mean intake by demographic characteristics, 1994-1996 and 2001-2002

Group	1994-1996[a] Total adults	1994-1996[a] Consumers of rice (≥¼ c)[b]	1994-1996[a] Consumption index[c]	2001-2002[a] Total adults	2001-2002[a] Consumers of rice (≥¼ c)[b]	2001-2002[a] Consumption index[c]
All individuals (n)	9,318	1,524		4,744	921	
Amount per day (g, dry weight)	11.8[d]	66.5[e]		11.4[d]	61.2[e]	
Individuals who are consumers (reference index value)			100.0			100.0
	←		%			→
Racial/ethnic group						
White, non-Hispanic	76.3	12.4	76.5	72.0	14.2	80.2
Black, non-Hispanic	11.0	21.3	97.7	10.6	23.6	102.9
Mexican American	4.0	28.1	76.8	7.1	23.4	84.8
Other Hispanic	4.8	39.9	134.3	5.9	30.2	104.4
Other[f]	3.9	64.8	173.4	4.4	45.0	206.7
Total	100.0			100.0		
Annual household income (% poverty threshold)						
0%-185%	26.7	18.9	108.3	30.0	19.5	110.0
>185%	73.3	16.8	96.7	70.0	17.6	95.1
Total	100.0			100.0		
Education						
Less than high school[g]	15.5	16.6	111.6	19.2	21.0	110.5
High school or GED[h]	34.4	13.8	98.3	25.3	13.5	92.3
Some college	35.7	19.0	98.6	55.4	19.3	98.5
5+ years of college[i]	13.1	23.0	95.5	—	—	—
Other[j]	1.2	21.8	102.9	0.1	37.7	74.0
Total	100.0			100.0		

[a]Source: Continuing Survey of Food Intakes by Individuals 1994-96 (Day 1 data); National Health and Nutrition Examination Survey 2001-2002 (1-day data). Index and percentages are based on weighted data.
[b]A portion of ¼ c cooked rice is equivalent to 14.1 g white rice (dry weight).
[c]The consumption index value was calculated as 100 times the ratio of mean intake of rice consumers in the demographic subpopulation group divided by the overall mean intake of rice consumers. An index value <100 indicates mean intake less than the mean of rice consumers; a value >100 indicates mean intake more than the mean of rice consumers.
[d]Day 1 average for total adult population (including those who do not consume).
[e]Day 1 average for adults consuming white or brown rice.
[f]Continuing Survey of Food Intakes by Individuals 1994-1996: Asian, Pacific Islander, American Indian, Alaskan Native, other. National Health and Nutrition Examination Survey 2001-2002: Other race, including Asian and multiracial.
[g]Continuing Survey of Food Intakes by Individuals 1994-1996: Includes never attended.
[h]GED=General Educational Development Testing Service crediting for high school equivalency.
[i]Some college and more combined for National Health and Nutrition Examination Survey 2001-2002.
[j]Continuing Survey of Food Intakes by Individuals 1994-1996: Question not asked/other/refused/don't know/not ascertained. National Health and Nutrition Examination Survey 2001-2002: Refused/don't know.



Batres-Marquez, SP, Jensen HH, Upton J. Rice consumption in the United States: Recent Evidence from Food Consumption Surveys. American Dietetic Association. May 8, 2009

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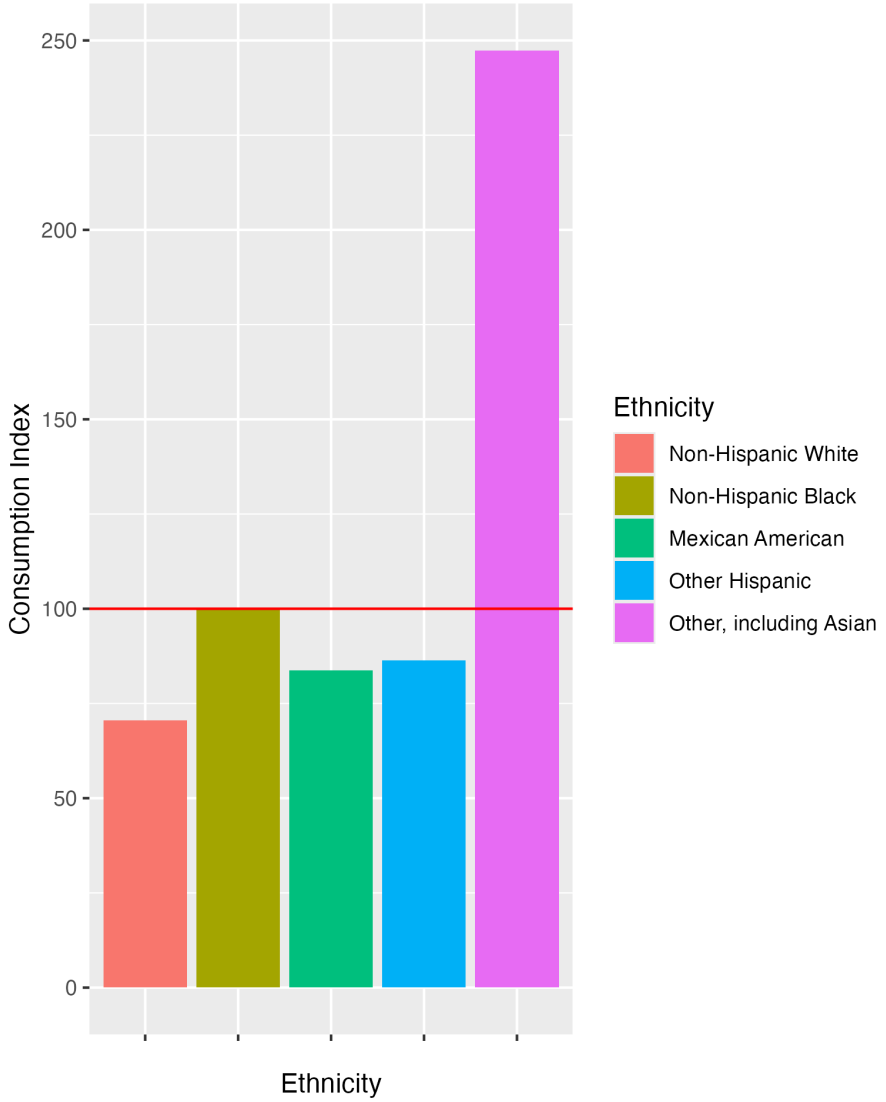

Table 3. Share of low-income population group who are consumers of white or brown rice and estimated mean intake, expressed as a percentage of consumers' mean intake by demographic characteristics, 1994-1996 and 2001-2002

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All individuals (n)	3,242	561		1,767	359	
Amount per day (g, dry weight)	13.8[d]	72.0[e]		13.3[d]	67.3[e]	
Individuals who are consumers (reference index value)			100.0			100.0
	%			%		
Racial/ethnic group						
White, non-Hispanic	59.2	10.0	79.3	56.1	13.4	70.6
Black, non-Hispanic	19.1	21.7	96.8	16.5	24.0	100.1
Mexican American	8.5	27.9	77.9	12.6	21.8	83.7
Other Hispanic	8.8	46.6	115.4	10.4	30.5	86.3
Other[f]	4.4	54.5	151.9	4.4	48.3	247.4
Total	100.0			100.0		
Education						
Less than high school[g]	34.5	19.0	109.6	38.1	21.7	104.3
High school or GED[h]	37.3	16.1	90.1	29.0	12.9	100.1
Some college	22.0	21.7	100.3	32.6	22.4	96.0
5+ y college[i]	4.4	30.4	95.4	—	—	—
Other[j]	1.8	16.6	103.2	0.3	57.6	67.3
Total	100.0			100.0		

[a]Source: Continuing Survey of Food Intakes by Individuals 1994-1996 (Day 1 data); National Health and Nutrition Examination Survey 2001-2002 (1-day data). Index and percentages are based on weighted data. Low-income population defined as individuals living in a household with income ≤185% of the poverty threshold.
[b]A portion of ¼ c cooked rice is equivalent to 14.1 g white rice (dry weight).
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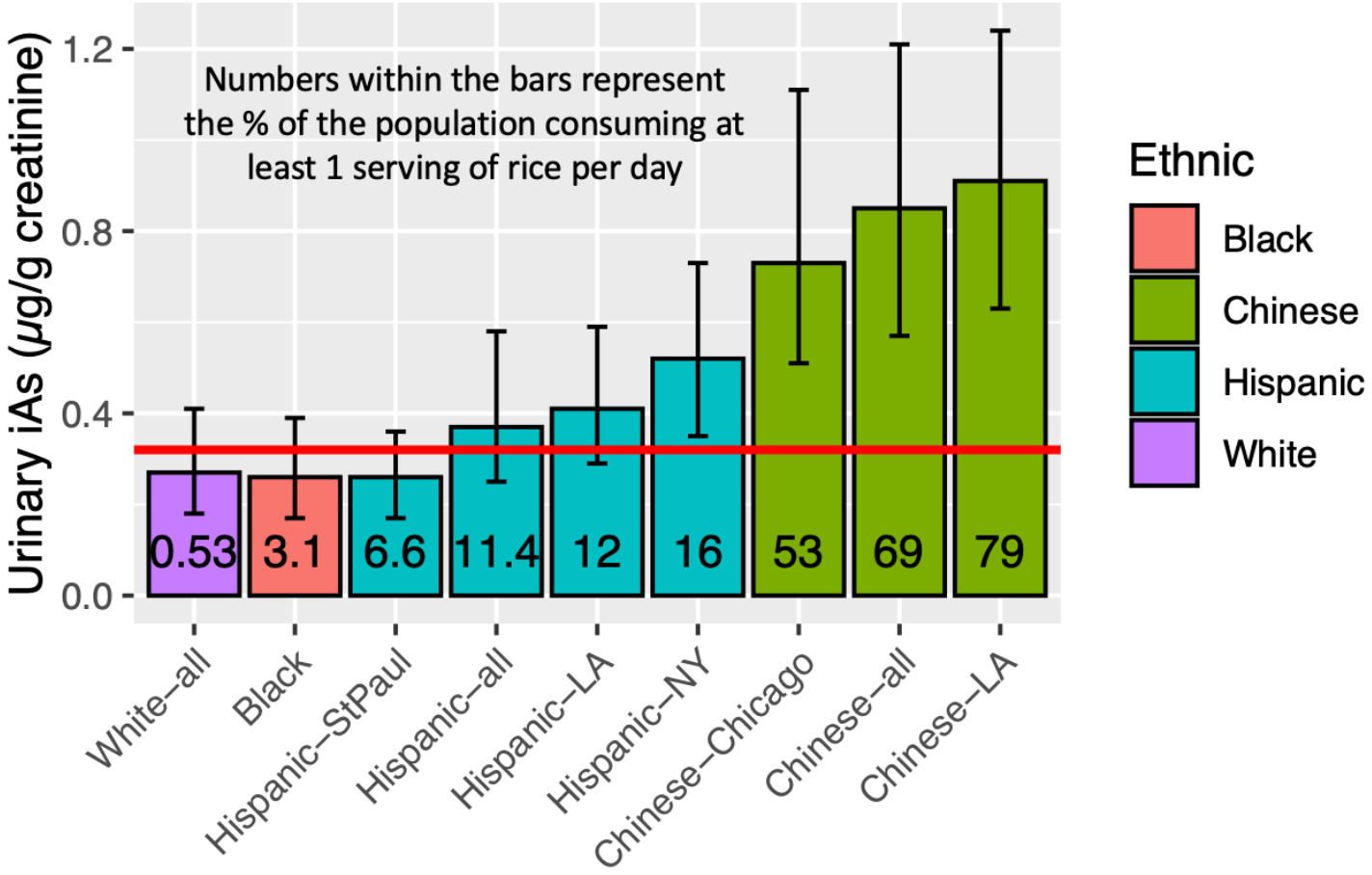
[i]Some college and more combined for National Health and Nutrition Examination Survey 2001-2002.
[j]Continuing Survey of Food Intakes by Individuals 1994-1996: Question not asked/other/refused/don't know/not ascertained. National Health and Nutrition Examination Survey 2001-2002: Refused/don't know.

Batres-Marquez, SP, Jensen HH, Upton J. Rice consumption in the United States: Recent Evidence from Food Consumption Surveys. American Dietetic Association. May 8, 2009

Rice consumption and arsenic exposure in MESA and NYC



Inorganic arsenic measured in urine among participants in the MESA cohort (N=6,999) stratified by ethnicity and location. Red line represents overall average iAs.

A. Navas-Acien, personal communication

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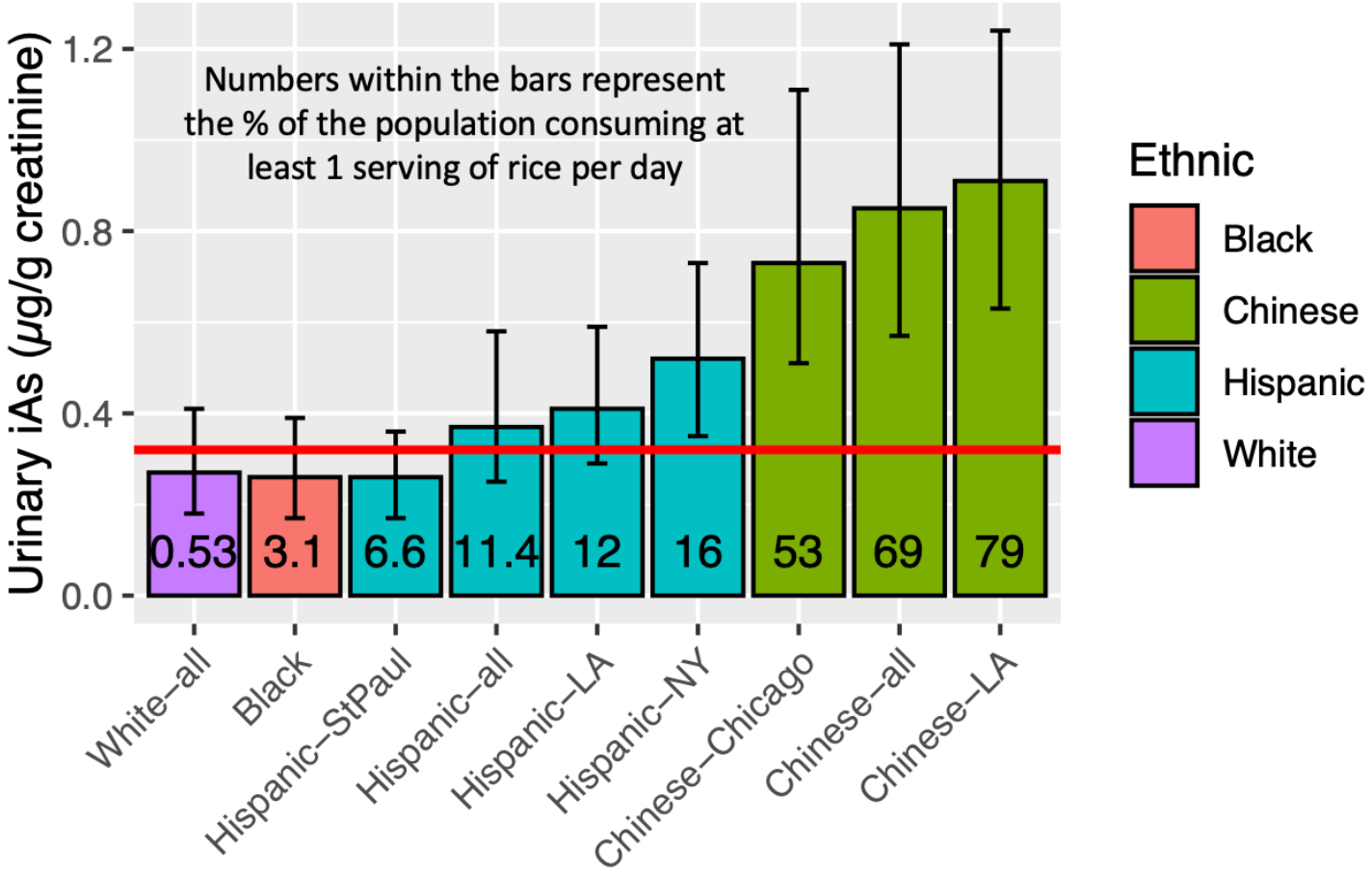

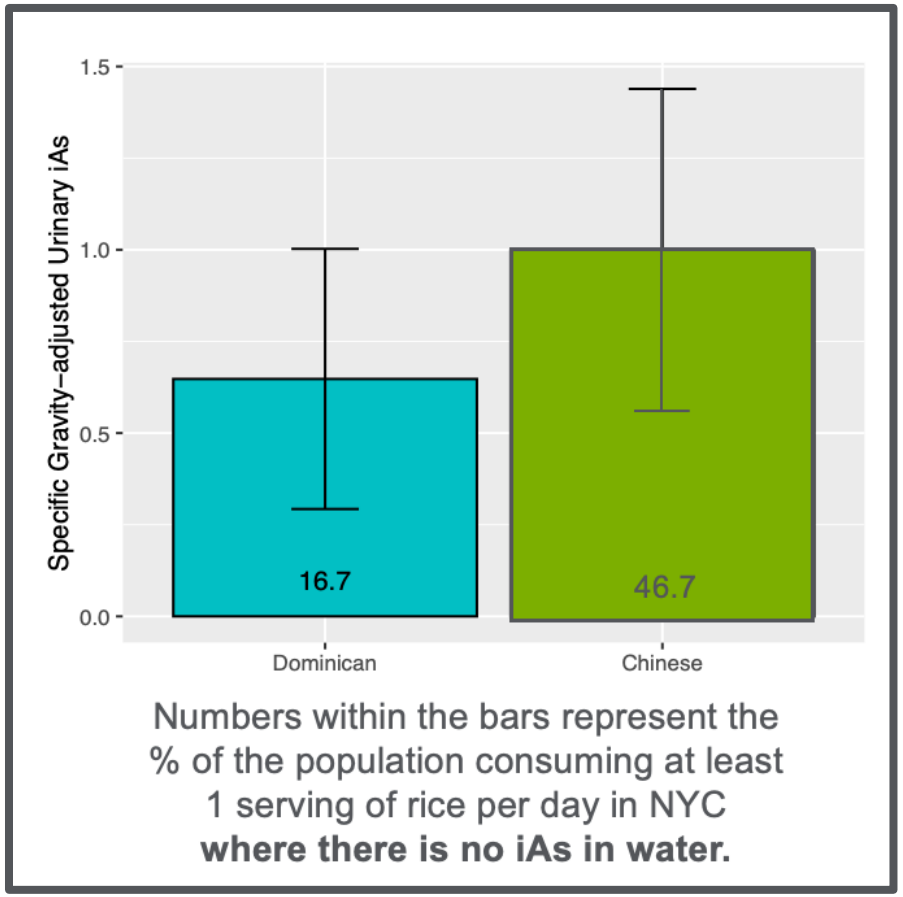

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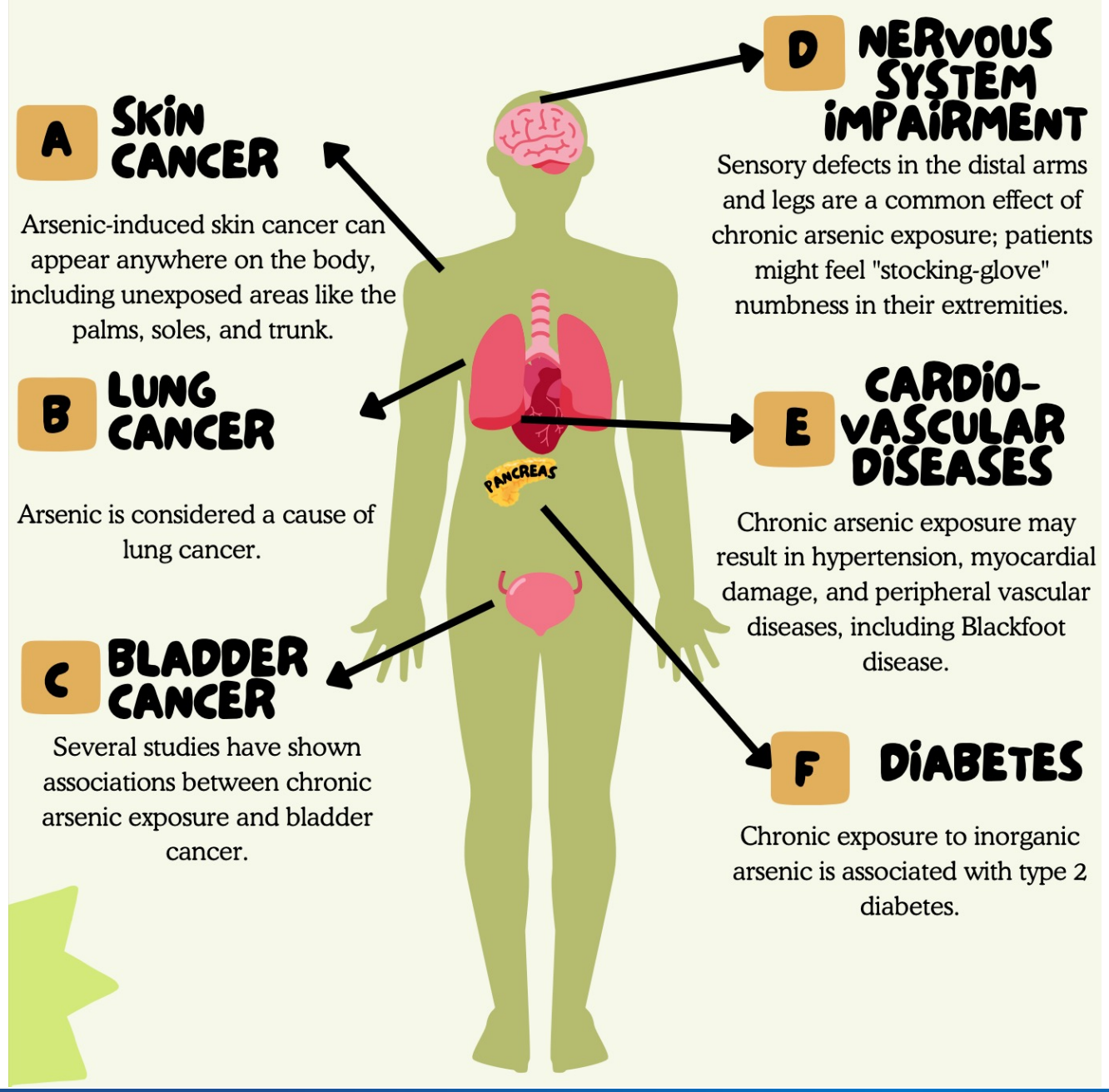
A
SKIN CANCER
Arsenic-induced skin cancer can appear anywhere on the body, including unexposed areas like the palms, soles, and trunk.
B
LUNG CANCER
Arsenic is considered a cause of lung cancer.
C
BLADDER CANCER
Several studies have shown associations between chronic arsenic exposure and bladder cancer.
D
NERVOUS SYSTEM IMPAIRMENT
Sensory defects in the distal arms and legs are a common effect of chronic arsenic exposure; patients might feel "stocking-glove" numbness in their extremities.
E
CARDIO-VASCULAR DISEASES
Chronic arsenic exposure may result in hypertension, myocardial damage, and peripheral vascular diseases, including Blackfoot disease.
F
DIABETES
Chronic exposure to inorganic arsenic is associated with type 2 diabetes.
PANCREAS

Arsenic is a greater concern for children since they eat about 3x more food per pound of body weight than adults.

Babies and young children can be more sensitive because their bodies are rapidly growing and they may not have fully developed systems to detoxify As as well as adults.

For babies and kids, studies have shown that having arsenic in their bodies over time can lead to:

- Lower IQ
- Impaired brain development
- Growth problems
- Breathing problems
- An unhealthy immune system
- Cancer as an adult

DARTMOUTH TOXIC METALS SUPERFUND RESEARCH PROGRAM

FDA action level:

100 microgram per kilogram (µg/kg)

-or-

100 parts per billion (ppb)

Baby cereal sold at Walmart recalled due to high levels of arsenic

Anna Medaris Oct 12, 2021, 11:11 AM EDT

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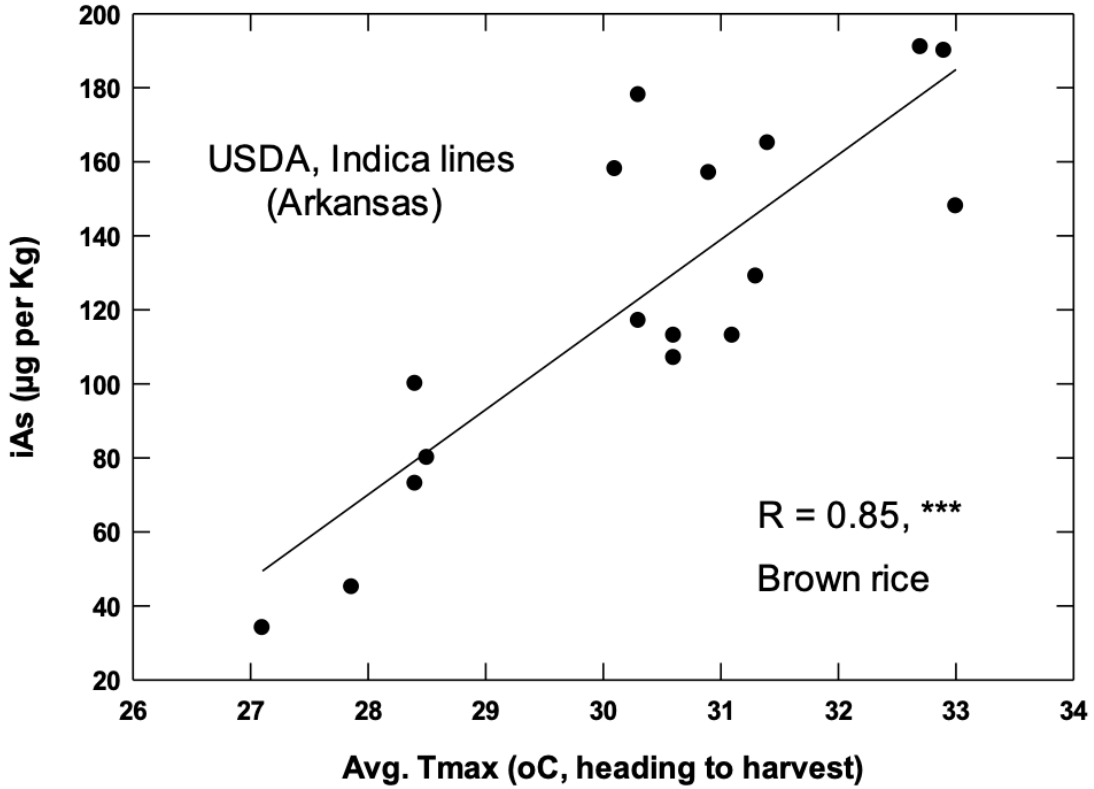
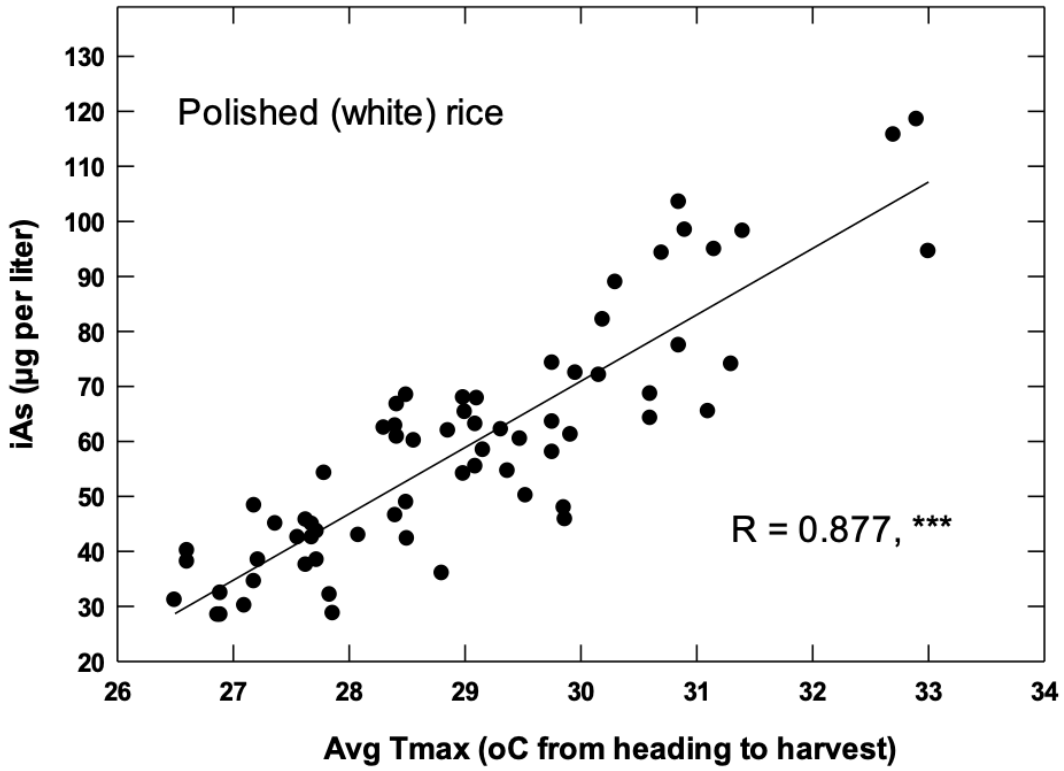
FDA

https://www.businessinsider.com/walmart-recalls-baby-rice-cereal-high-levels-arsenic-2021-10;
https://www.fda.gov/food/environmental-contaminants-food/closer-zero-reducing-childhood-exposure-contaminants-foods

Arsenic in rice in the context of **climate change**





With **higher ambient air temperatures**, all varieties of both brown rice and polished (white) **rice absorb more iAs**.

Zhu et al. Projected changes in carbon dioxide and temperature can significantly increase the health risks of inorganic arsenic from paddy rice in China and India. (under review)

Implications re: equity considerations

- NHANES is a great national resource for estimating how much food people eat *in general*.
  - NHANES is less good at understanding consumption patterns in population subgroups who may vary from the “national average”.

- Focused studies are needed to understand consumption behavior of subgroups (e.g., by ethnicity, life stage, poverty, etc.)
  - Risk associated with exposure is likely to be different than average in these subpopulations → culturally appropriate risk assessment and management.

- Climate change is likely to exacerbate these differences in exposure → risk
  - More work is needed to understand differences and to protect those who are most vulnerable and at highest risk.

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Thanks to collaborators on the 2023-2024 NASEM Seafood and Growth panel and others at Columbia, esp. Dr. Lew Ziska.

Questions/Comments?
jh2678@columbia.edu