

Shellfish Consumption and Blood PFAS Levels

A Cross-Sectional Study



University of
New Hampshire

Ryan Andrews, Sherman Bigornia & Maria Carlota Dao

Agriculture, Nutrition, and Food Systems, University of New Hampshire, Durham, New Hampshire, 03824

Introduction

- Per- and polyfluoroalkyl substances (PFAS), commonly referred to as “forever chemicals”, include thousands of synthetic compounds that are found in various products.
- PFAS have exceptional stability, allowing them to linger in the natural environment and accumulate in biological tissues.
- Shellfish have an extraordinary capacity for PFAS accumulation, making shellfish consumption a key route of dietary exposure in the general population.
- Higher circulating concentrations of PFAS in the human body have been linked to various chronic ailments.
- Regulatory changes over the past 20 years have led to shifts in which PFAS are commonly used.
- **Objective:** To determine if shellfish consumption predicts blood PFAS levels.
- **Hypothesis:** Shellfish consumption will be related to circulating PFAS levels (ng/mL) among adults in the US (≥18 years old).

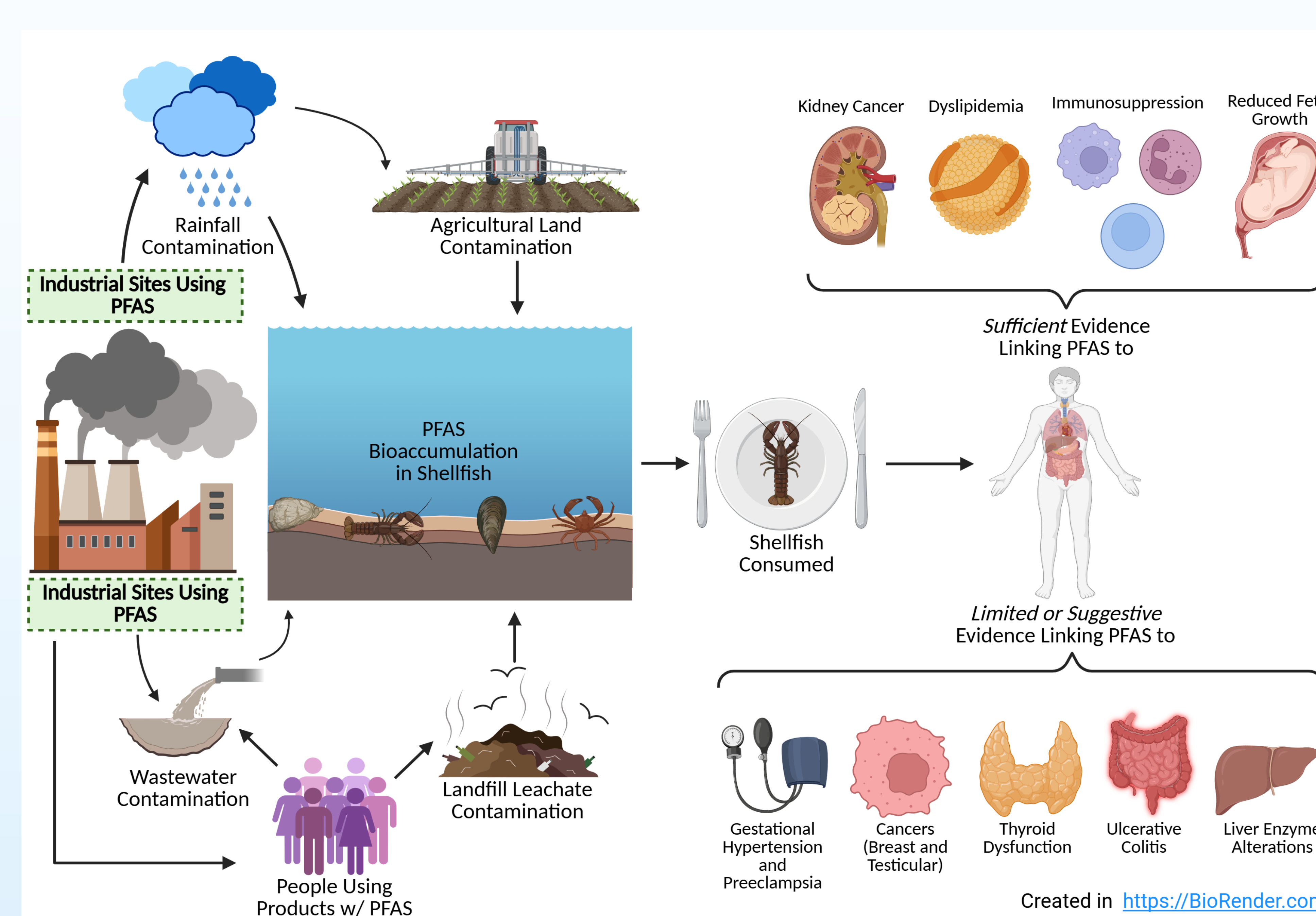


Figure 1. How PFAS bioaccumulate in shellfish and influence human health outcomes

Methods

- **Target population:** 2,414 adults, ≥18 years of age, from the National Health and Nutrition Examination Survey (NHANES) 2017 - March 2020 Pre-pandemic Data.
- **Primary exposure:** Daily shellfish consumption, measured via two 24-hour dietary recalls.
- **Primary outcome:** Serum concentration of nine PFAS (PFDE, PFHS, MPAH, PFNA, PFUA, NFOA, BFOA, NFOS, PFOS), measured via blood collection.
- **Statistical design:** For analyses of association between shellfish consumption and blood levels of PFAS, Spearman Rank Order Correlation was utilized. For analyses of association between low, medium, and high blood PFAS levels and shellfish consumption, Analysis of Covariance (ANCOVA) was utilized.
 - Note: Low/medium/high blood PFAS levels based on criteria from the National Academies of Sciences, Engineering, and Medicine: Guidance on PFAS Exposure, Testing, and Clinical Follow-Up (2022).
- **Covariates:** Age, gender, poverty to income ratio, race/ethnicity, and total-energy intake.
- **Statistical analyses:** IBM SPSS Statistics Version 30.0.0.0.

Results

Table 1. Population Characteristics (≥18 years old; N=2,414)

Population Characteristics*	N	%
Age		
18-39 years	811	33.6
40-59 years	773	32.0
≥60 years	830	34.4
Gender		
Men	1,188	49.2
Women	1,226	50.8
Poverty-to-Income Ratio^a		
<1	411	17.0
1-4	1,128	53.4
≥4	573	27.1
Missing	302	12.5
Ethnicity		
Mexican American	295	12.2
Other Hispanic	240	9.9
Non-Hispanic White	871	36.1
Non-Hispanic Black	631	26.1
Non-Hispanic Asian	262	10.9
Other Race (+Multi-Racial)	115	4.8
	Mean	SD
Dietary Intake Data		
Shellfish Intake, grams/day	8.3	3.6
Total Energy Intake, kcal/day	2021.3	488.2

* Includes adults who had PFAS biospecimen and shellfish consumption data

^a Lower income (PIR <1), middle income (PIR 1-4), higher income (PIR ≥4)

Key Finding #1: 85% of participants can be designated at medium risk and 12% at high risk for future health problems based on blood PFAS level categories.

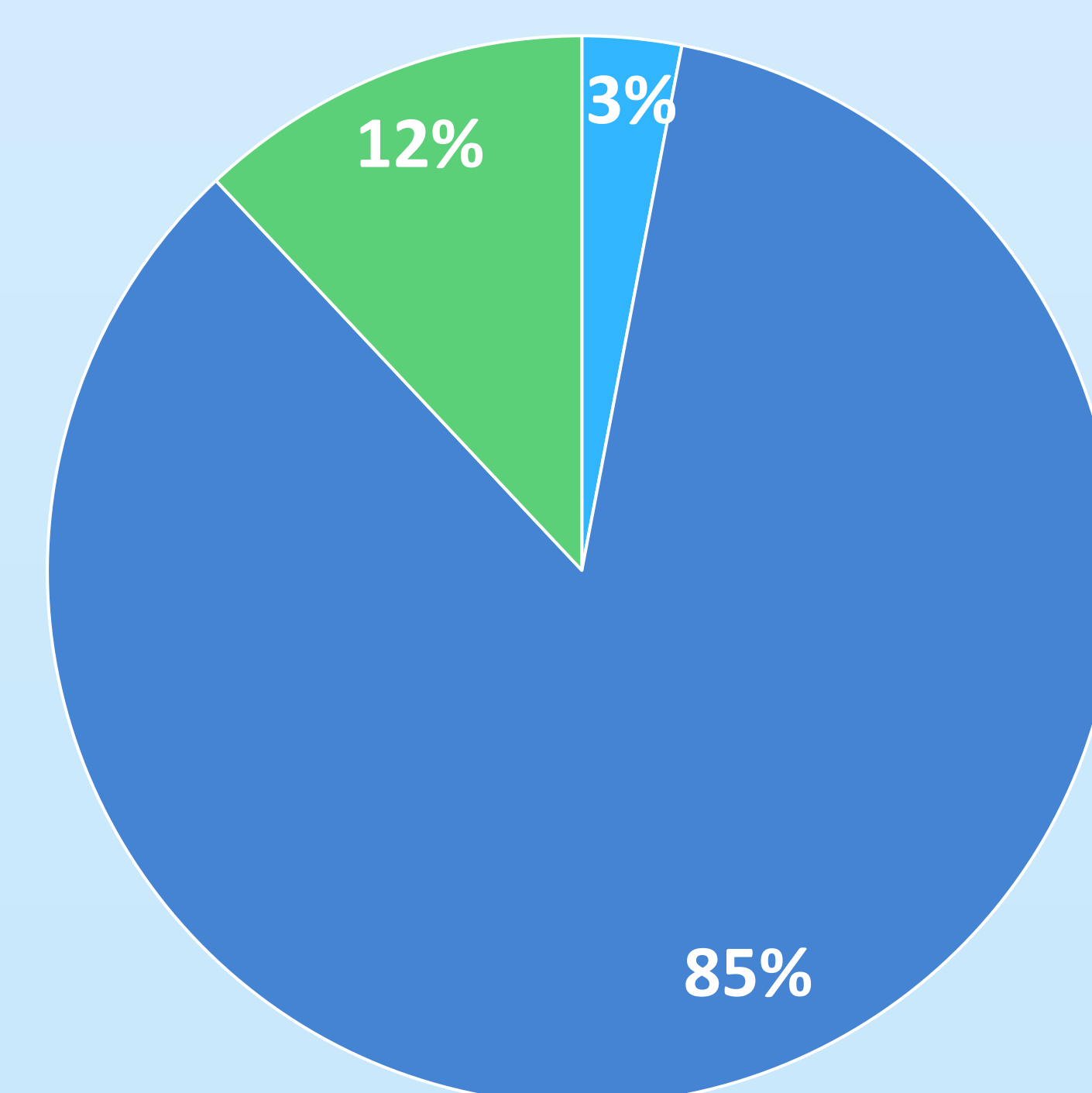


Figure 2. Percentage of participants at low (light blue), medium (dark blue), and high (green) blood PFAS levels (≥18 years; N=2,414)

Key Finding #2: There was no significant difference in mean shellfish consumption between the three blood PFAS level categories.

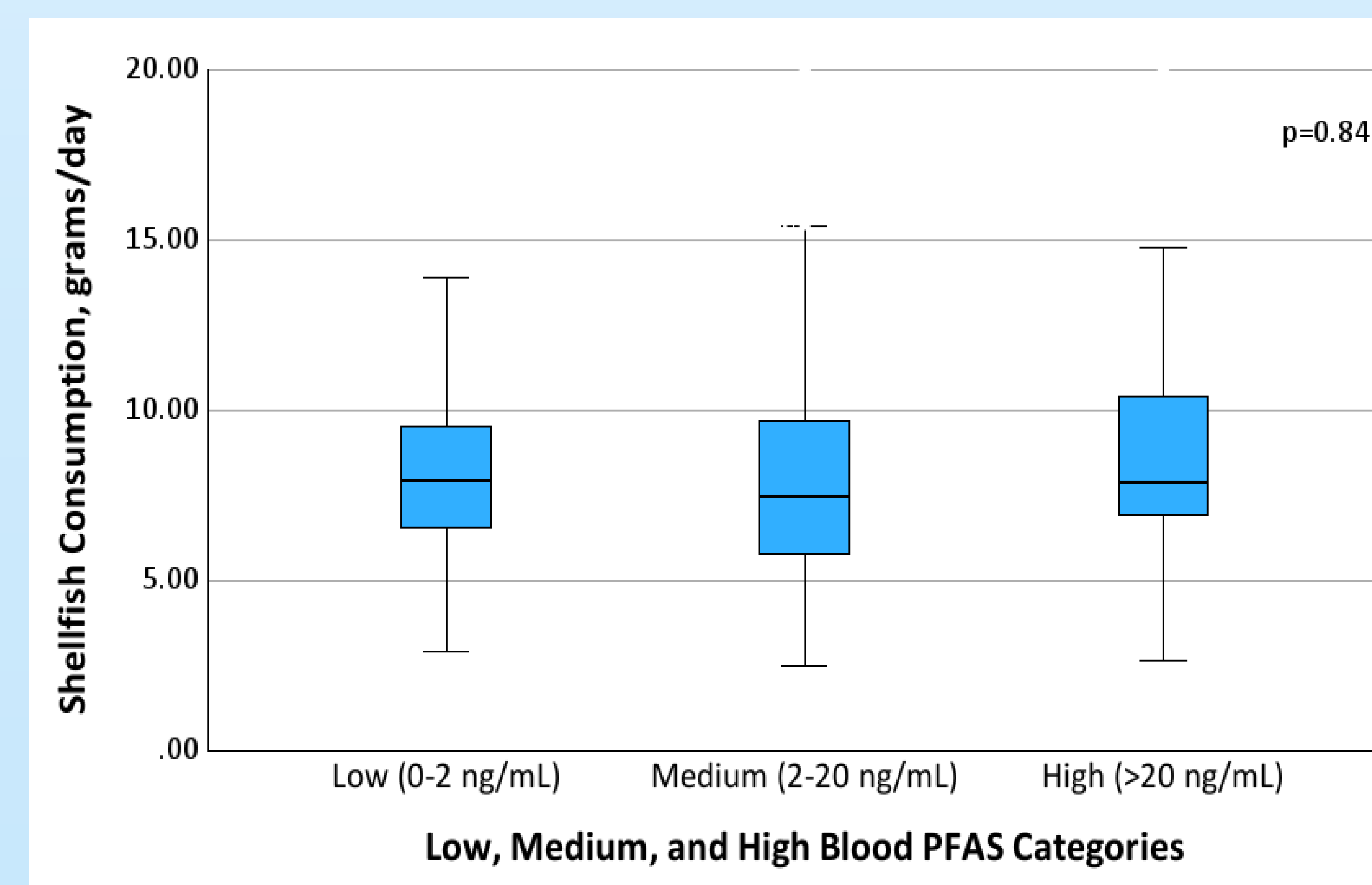


Figure 3. Mean shellfish intake among three blood PFAS level categories (Low N=58; Medium N=1,803; High N=251)

Discussion/Conclusion

- **Significance:** Determining what levels of shellfish consumption predict blood PFAS levels can help to inform guidance values for safe intake and steer future PFAS remediation efforts.
- **Limitations:** Legume and processed meat consumption were not included as covariates. NHANES PFAS analyses only allow for testing and identification of nine out of the over 10,000 PFAS that exist. Observational studies cannot determine causal relationships.
- **Future directions:** Expand the variety of PFAS analyzed in the NHANES sample. Conduct longitudinal studies with diet and blood PFAS levels.
- **Takeaways:** 1) 97% of participants had a blood PFAS level that may present a risk to their health. 2) There was no significant difference ($p=0.849$) in mean shellfish consumption between the three blood PFAS level categories. 3) Shellfish as a single dietary exposure doesn't strongly predict blood PFAS levels ($r_s=.134$, $p<0.001$).

Contact

For more information contact:
Ryan D. Andrews
ryan.andrews@unh.edu



References

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