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Supplemental Material

Serum Perfluorooctanoate (PFOA) and Perfluorooctane Sulfonate (PFOS) Concentrations and Liver Function Biomarkers in a Population with Elevated PFOA Exposure

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**Detail of between- and within-regression models**

Water district data available in the C8 Health Project questionnaire data were considered: using the geocoded locations of the address, combined with a detailed mapping of streets covered by each water districts piped water supplies, geocoded residences could be assigned a water district code. These analyses were restricted to those living in the six contaminated districts (Little Hocking Water Association of Ohio; City of Belpre, Ohio; Tupper Plains–Chester District of Ohio; Village of Pomeroy, Ohio; Lubeck Public Service District of West Virginia; Mason County Public Service District of West Virginia) at the time of the survey ($n=26,777$). For each water districts, on the ln-transformed scale, a mean PFOA value and a deviation from the mean for each individual was calculated as the difference between the individual level and the water district mean. Regression coefficients with relative standard errors (SE) and p-values were calculated for the association within water district and between water districts with both the mean ln-PFOA values, and the individual deviations, in a fully adjusted linear regression model. The significance of the difference between these within and between water district coefficients was also assessed. Models also included a random effect at the water district level.

**Formal model description:**

To estimate within and between water district ($i=1,..., 6$) coefficients relating log serum PFOA in individual $j$ in that district ($x_{ij}$) to numerical outcomes ($y_{ij}$), we fit the model:

$$y_{ij} = a + \beta_w(d_{ij}) + \beta_b\bar{x}_i + \{\text{covariate terms}\} + \alpha_i + \epsilon_{ij},$$

Where $d_{ij} = (x_{ij} - \bar{x}_i), \alpha_i \sim N(0, \sigma^2_\alpha), \text{and} \epsilon_{ij} \sim N(0, \sigma^2_\epsilon)$
To test the hypothesis $\beta_w = \beta_b$, we re-parameterised this relationship writing $\beta_{\text{diff}} = \beta_w - \beta_b$, giving:

$$E(y) = a + \beta_w(x_{i,j}) + \beta_{\text{difference}}\bar{x}_i + \{\text{covariate terms}\}$$

We used the Wald test for $\beta_{\text{diff}} = 0$ as a test for $\beta_w = \beta_b$.

For dichotomous outcomes we fit analogous logistic models, except that instead of fitting a random effect at water district level, which was computationally cumbersome, we used a sandwich (Huber-White) estimator of variance clustering by water district.