Supplementary materials

Serum Concentrations of Polyfluoroalkyl Compounds among Select Populations of Children and Adults in California

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Table S1. Demographics of study population\*

|  |  |  |
| --- | --- | --- |
| Demographics | Northern California Family Cohorta | Central California Older Adult Cohort  |
| N of Households | 90 | 49 |
| **Adult Sex**- female | 81 (90%) | 34 (69%) |
| **Adult Age** (Median: year) | 38.5 | 67.3 |
| **Child Sex-** female | 45 (50%) | — |
| **Child Age** (Median: year) | 5.5 | — |
| **Education** |  |  |
|  High school | 8 (9%) | 5 (10%) |
|  College degree or some college | 58 (64%) | 39 (80%) |
|  Master, Doctor, and professional degree | 23 (26%) | 5 (10%) |
| **Job Status** |  |  |
|  Employed | 38 (42%) | 18 (37%) |
|  Unemployed (including stay-at-home parents) | 44 (49%) | 30 (61%) |
|  Other | 6 (7%) | 1 (2%) |
| **Race/Ethnicity** |  |  |
|  White (not Hispanic) | 60 (67%) | 37 (76%) |
|  Asian (not Hispanic) | 7 (8%) | 0 (0%) |
|  Black (not Hispanic) | 2 (2%) | 1 (2%) |
| Other (not Hispanic) | 7 (8%) | 5 (10%) |
|  Hispanic (all races) | 13 (14%) | 6 (12%) |
| **Foreign Born** | 20 (22%) | 3 (6%) |
| **Homeowner** | 71 (79%) | 44 (90%) |
| **House Type** |  |  |
|  Single house detached | 75 (83%)  | 37 (76%) |
|  Single attached house | 3 (3%) | 9 (18%) |
|  Apartment | 11 (12%) | 3 (6%) |
| **Neighborhood Type** |  |  |
|  Commercial | 0 (0%) | 1 (2%) |
|  Residential | 72 (80%) | 41 (84%) |
|  Rural | 5 (6%) | 2 (4%) |
|  Combination of above | 11 (12%) | 5 (10%) |
| **Number of Children in the Household** (median) | 2 | 0 |

aDemographic information was missing for one household.

Table S2. Method detection limit and the percent of detection of PFCs in this study using liquid chromatography–isotope dilution tandem mass spectrometry.

|  |  |  |
| --- | --- | --- |
|  | **LOD (ng/ml)** | **%>LOD** |
| Me-PFOSA-AcOH | 0.17 | 63% |
| PFDA | 0.20 | 71% |
| PFHxS | 0.10 | 99% |
| PFNA | 0.10 | 100% |
| PFOA | 0.10 | 100% |
| PFOS | 0.20 | 100% |

Table S3. Comparison between PFC serum concentrations between demographic groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **chemical** | **Parameter** | **Estimate** | **Standard Error** | **t Value** | **Pr > |t|** | **Type III SS Pr > |F|** |
| Me-PFOSA-AcOH | Intercept | -1.06 | 0.1097 | -9.69 | <.0001 | <.0001 |
|  | Parent | -0.67 | 0.1453 | -4.58 | **<.0001** |  |
|  | Older adult | -0.31 | 0.1609 | -1.93 | 0.0553 |  |
|  | Child |   | . | . | . |  |
| PFDA | Intercept | -1.30 | 0.0786 | -16.58 | <.0001 | 0.0486 |
|  | Parent | -0.24 | 0.1042 | -2.28 | **0.0239** |  |
|  | Older adult | -0.23 | 0.1154 | -2.01 | **0.0458** |  |
|  | Child |   | . | . | . |  |
| PFHxS | Intercept | 0.26 | 0.0938 | 2.81 | 0.0054 | <.0001 |
|  | Parent | -0.81 | 0.1243 | -6.49 | **<.0001** |  |
|  | Older adult | 0.19 | 0.1377 | 1.41 | 0.1589 |  |
|  | Child |   | . | . | . |  |
| PFNA | Intercept | 0.61 | 0.0598 | 10.22 | <.0001 | <.0001 |
|  | Parent | -0.57 | 0.0792 | -7.17 | **<.0001** |  |
|  | Older adult | -0.23 | 0.0877 | -2.63 | **0.0091** |  |
|  | Child |   | . | . | . |  |
| PFOA | Intercept | 1.50 | 0.0667 | 22.42 | <.0001 | <.0001 |
|  | Parent | -0.87 | 0.0884 | -9.89 | **<.0001** |  |
|  | Older adult | -0.40 | 0.0979 | -4.14 | **<.0001** |  |
|  | Child |   | . | . | . |  |
| PFOS | Intercept | 1.84 | 0.0808 | 22.75 | <.0001 | <.0001 |
|  | Parent | -0.28 | 0.107 | -2.65 | **0.0086** |  |
|  | Older adult | 0.54 | 0.1185 | 4.57 | **<.0001** |  |
|  | Child |   | . | . | . |  |

Table S4. Estimated regression coefficients (and standard errors) of regression analysis with housing variables in predicting serum concentrations of polyfluoroalkyl compounds

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  Effect | Me-PFOSA-AcOH | PFDeA | PFHxS | PFNA | PFOA | PFOS |
| Intercept | -1.49(0.27)\*\* | -1.5(0.18)\*\* | -0.77(0.21)\*\* | -0.003(0.13) | 0.56(0.15)\*\* | 1.59(0.18)\*\* |
| Age group (ref=parents of young children) |  |  |  |  |  |  |
| Children | 0.68(0.08)\*\* | 0.26(0.09)\*\* | 0.87(0.11)\*\* | 0.6(0.07)\*\* | 0.91(0.08)\*\* | 0.32(0.09)\*\* |
| Older adults | 0.32(0.19)\* | 0.01(0.13) | 1.05(0.16)\*\* | 0.37(0.1)\*\* | 0.53(0.11)\*\* | 0.8(0.14)\*\* |
| Home type - apartment (ref=single family house) | -0.04(0.24) | -0.23(0.16) | -0.05(0.19) | -0.1(0.12) | -0.2(0.13) | -0.21(0.16) |
| House built after 1977 | -0.21(0.17) | -0.27(0.11)\*\* | 0.16(0.13) | -0.08(0.08) | -0.02(0.09) | -0.01(0.11) |
| House value ($1,000,000) | 0.05(0.28) | -0.13(0.18) | 0.1(0.22) | -0.08(0.13) | -0.01(0.15) | -0.13(0.19) |
| Rent vs own | -0.04(0.22) | 0.15(0.14) | 0.04(0.17) | 0.14(0.1) | 0.0004(0.12) | 0.05(0.15) |
| House area (1,000 sqft) | -0.15(0.13) | 0.1(0.08) | 0.02(0.1) | 0.08(0.06) | 0.08(0.07) | 0.02(0.08) |
| # of furniture manufactured between 1980 and 2004 in the sampled room | 0.07(0.05) | -0.04(0.04) | 0.03(0.04) | -0.03(0.03) | -0.03(0.03) | 0.02(0.04) |

\* Statistical significance *p*<0.10 (two-sided). \*\* Statistical significance *p*<0.05 (two-sided).

Table S5. Food variables selected by regression model in predicting serum concentrations of PFCs (ng/ml) for adults in California, USA (2008-2009) (N=128)a,b. (Results shown are the regression slope estimate and the standard error.)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Effects | PFOS | PFOA | PFNA | PFDeA | PFHxS | Me-PFOSA-AcOH |
| Intercept | 0.16 (0.21) | -0.16(0.20) | -0.69(0.16) | -1.69(0.14) | -1.83(0.26) | -2.65(0.27) |
| Age (year) | 0.03(0.004) | 0.02(0.004) | 0.01(0.003) |  | 0.03(0.005) | 0.02(0.005) |
| Frequency of having pre-packed food (ref=never)  |   |   |   |   |
| <1 time/week |  |  |  |  |  | 0.38(0.18) |
| ≥1 time/week |  |  |  |  |  | -0.14(0.17) |
| Frequency of having fast food (ref=never) |   |   |   |   |   |
| <1 time/week |  |  |  |  |  |  |
| ≥1 time/week |  |  |  |  |  |  |
| Frequency of eating (time/week) |  |  |  |  |  |  |
| butter or margarine |  | 0.03(0.02) | 0.05(0.02) | 0.06(0.02) |  |  |
| dairy fat |  |  |  | -0.01(0.01) |  | 0.03(0.01) |
| poultry |  |  |  |  |  |  |
| pork |  | 0.08(0.04) | 0.06(0.03) | 0.11(0.04) |  |  |
| beef | 0.09(0.04) |  |  |  |  | -0.09(0.04) |
| canned meat | -0.82(0.18) |  | -0.33(0.13) | -0.40(0.17) | -0.51(0.22) |  |
| canned meat entrées | 0.20(0.07) |  |  |  | 0.22(0.09) | 0.20(0.08) |
| canned fish | -0.13(0.08) | -0.20(0.07) | -0.15(0.06) | -0.14(0.07) |  |  |
| tuna and white fish |  |  | 0.08(0.05) | 0.16(0.07) | 0.17(0.09) |  |
| salmon |  |  |  |  |  |  |
| fresh water fish | 0.46(0.14) |  |  |  |  |  |
| potatoes |  |  |  |  |  |  |
| French fries |  | 0.15(0.08) |  |  |  |  |
| graham crackers |  |  | 0.28(0.13) |  |  | 0.42(0.21) |
| crackers other than graham crackers | -0.06(0.02) |  |  |  | -0.05(0.03) |  |
| cookies |  |  |  |  |  |  |
| chips |  |  |  |  |  |  |
| popcorn |  |  |  |  |  |  |
| using microwave to cook popcorn | 0.24(0.12) |  |  |  |  |  |
| R-Square | 0.44 | 0.18 | 0.21 | 0.13 | 0.31 | 0.19 |

a The total sample size for the child population is 149. The actual number of observations used is 128 due to missing responses for some questions.

bStepwise selection model was used to screen variables, where effects entering the model at the significance level of 0.15 and staying in the model at the significance level of 0.10. The selected model is chosen to yield the minimum Akaike information criterion (AIC) value.

Table S6. Food variables selected by regression model in predicting serum concentrations of PFCs (ng/ml) for children in California, USA (2008-2009) (N=55)a,b. (Results shown are the regression slope estimate and the standard error.)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Effect | PFOS | PFOA | PFNA | PFDeA | PFHxS | Me-PFOSA-AcOH |
| Intercept | 1.37(0.22) | 1.35(0.11) | 0.19(0.20) | -1.25(0.09) | -0.32(0.25) | -1.82(0.22) |
| Age (year) | 0.09(0.04) |  | 0.13(0.05) |  |  |  |
| Frequency of having pre-packed food (ref=never) |  |  |  |  |  |
| <1 time/week |  |  | 0.33(0.20) |  |  |  |
| ≥1 time/week |  |  | -0.10(0.15) |  |  |  |
| Frequency of having fast food (ref=never) |  |  |  |  |  |  |
| <1 time/week |  |  |  |  |  |  |
| ≥1 time/week |  |  |  |  |  |  |
| Frequency of eating (time/week) |  |  |  |  |  |  |
| butter or margarine |  |  |  |  |  |  |
| dairy fat |  |  |  |  |  |  |
| poultry |  | 0.05(0.03) |  |  |  |  |
| pork |  |  |  |  |  |  |
| beef |  |  |  |  |  |  |
| canned meat |  |  |  |  |  |  |
| canned meat entrées |  |  |  | -0.27(0.17) |  |  |
| canned fish |  |  |  |  |  | 0.66(0.22) |
| tuna and white fish | 0.10(0.07) |  | -0.17(0.08) |  |  |  |
| salmon |  |  |  |  |  |  |
| fresh water fish |  |  |  |  |  |  |
| hotdogs | 0.17(0.09) |  |  |  |  | 0.35(0.19) |
| chicken nuggets |  |  |  |  | 0.14(0.09) |  |
| potato | -0.06(0.03) |  |  |  |  |  |
| French fries |  |  |  |  |  |  |
| graham crackers |  |  |  |  |  |  |
| crackers other than graham crackers | -0.03(0.01) |  |  |  |  |  |
| cookies |  |  |  |  |  |  |
| chips |  |  |  |  |  |  |
| popcorn |  |  |  |  |  |  |
| using microwave to cook popcorn |  |  |  |  |  | 0.46(0.23) |
| breastfeeding (ref=none to 1.5 months) |  |  |  |  |  |  |
| breastfed for 3-6 months | -0.13(0.22) |  |  |  | 0.06(0.32) |  |
| breastfed for 6-12 months | 0.005(0.19) |  |  |  | 0.64(0.27) |  |
| breastfed for >12 months | 0.34(0.19) |  |  |  | 0.56(0.28) |  |
| R-Square | 0.25 | 0.03 | 0.15 | 0.03 | 0.11 | 0.21 |

a The total sample size for the child population is 68. The actual number of observations used is 55 due to missing responses for some questions.

bStepwise selection model was used to screen variables, where effects entering the model at the significance level of 0.15 and staying in the model at the significance level of 0.10. The selected model is chosen to yield the minimum Akaike information criterion (AIC) value.