**Supplementary Material**

**Occurrence and human exposure assessment of perfluorinated substances in house dust from three European countries.**

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| **Table S1.** Details of questionnaire sent to the participants of the study |
|  |
| **Building characteristics** |
| Adults (number at home) |
| Children (number at home) |
| Location type (city/countryside) |
| Surroundings of the location house (industrial site/ agricultural site/residential zone/other) |
| Type of building (flat/detached house) |
| Proximity < 1 km to a fire-fighting station (yes/no) |
| Floor level of the house (ground floor/1st -10th floor) |
| Building edification age (year) |
| Size of the house in (m2) |
| Has the kitchen been vacuumed? (yes/not) |
| Number of times the living room is vacuumed/washed per month (n)  |
| Type of flooring (laminate flooring/wood flooring/carpeting/ceramic tile/ resilient flooring (PVC, vinyl...)/other) |
| Heating system used in the house (central heating/electric units/fireplace/air conditioning/other) |
| Average indoor temperature (ºC)  |
| Natural ventilation (min/week)  |
|  |
| **Textile contribution** |
| Sum of textiles (carpets, curtains and sofas) in the house (n) |
| Percentage of floor covered by textiles (%) |
| Use of carpet or furniture stain protector (yes/not) |
| Use of waterproofing/wax coating sprays (yes/not) |
| Sofas, furniture or other surfaces/materials vacuumed apart from floor? (yes/not) |
|  |
| **Electric and electronic devices (EED) contribution** |
| Number of televisions at home (n) |
| Age of the TV apparatus (year) |
| Number of computers at home (n) |
| Age of personal computer (year) |
| Number of printers at home (n) |
| Sum of EED (n) |
| Use of EED (hours/week) |
|  |
| **Activities done at home** |
| Painting (yes/not) |
| Gardening (yes/not)) |
| Revealing photographs at home (yes/not) |
| Do it yourself (yes/not) |
|  |
| **Other questions** |
| Do you have kitchen utensils of nonstick material? (yes/not) |
| Do you usually buy fresh packaged food? (yes/not) |
| Do you own waterproof, windproof or breathable clothing? (yes/not) |

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| **Table S2.-** Limits of quantification (LOQ) and concentrations ng/g of SRM 2585 (mean + SD; n=3) in the present study, NIST certificate and other studies. |
|  |  | LOQ | SRM | NIST 2018a | Other studies |
| perfluorobutanesulfonate  | PFBS | 0.57 | 96.8 ± 0.6 | N.A. | 64.5 ± 5.1b |
| perfluorohexanesulfonate | PFHxS | 0.18 | 1108.5 ± 153.9 | 1440 ± 250 | 1400 ± 170c |
| perfluorooctanesulfonate | PFOS | 0.04 | 1658.3 ± 64.8 | 2310 ± 420 | 2280 ± 200c, 1990 ± 78e, 1752 ± 31f |
| perfluorodecanesulfonate | PFDS | 0.01 | 486.8 ± 25.5 | N.A. | 638 ± 90.5b |
| perfluorobutanoic acid  | PFBA | 0.15 | 263.5 ± 1.3 | 230 ± 16 | 249 ± 25c |
| perfluoropentanoic acid | PFPeA | 0.03 | 119.8 ± 9.3 | N.A. | 226 ± 31c |
| perfluorohexanoic acid  | PFHxA | 0.12 | 276.6 ± 12.0 | 260 ± 25 | 279d |
| perfluoroheptanoic acid  | PFHpA | 0.27 | 271.2 ± 28.5 | 249 ± 32 | 259d |
| perfluorooctanoic acid  | PFOA | 0.11 | 418.9 ± 24.8 | N.A. | 561d, 673 ± 26e, 766 ± 38f |
| perfluorononanoic acid  | PFNA | 0.06 | 96.6 ± 2.4 | 99.4 ± 4.9 | 101 ± 5c |
| perfluorodecanoic acid | PFDA | 0.07 | 49.3 ± 4.5 | N.A. | 38.6d |
| perfluoroundecanoic acid  | PFUdA | 0.02 | 38.5 ± 1.1 | N.A. | 47d |
| perfluorododecanoic acid  | PFDoA | 0.03 | 28.8 ± 1.7 | 34.6 ± 4.5 | 37d |
| perfluorotridecanoic acid  | PFTrDA | 0.04 | 35.6 ± 8.4 | 29.4 ± 4.6 | 30d |
| perfluorotetradecanoic acid  | PFTeDA | 0.06 | 22.6 ± 4.3 | N.A. | 19.3d |
| perfluorohexadecanoic acid  | PFHxDA | 0.02 | 10.0 ± 1.3 | N.A. | N.A. |
| perfluorooctadecanoic acid  | PFODA | 0.04 | 10.6 ± 1.1 | N.A. | N.A. |
| perfluorooctanesulfonamide | FOSA | 0.01 | 8.8 ± 1.9 | N.A. | 9.84d |
| N-methyl perfluorooctanesulfonamide  | N-MeFOSA | 0.005 | N.D. | N.A. | N.A. |
| N-ethyl perfluorooctanesulfonamide  | N-EtFOSA | 0.003 | N.D. | N.A. | N.A. |

N.D.: not detected. N.A.: not available; a National Institute of Standards & Technology (NIST), 2018); b Average, c reference and d information values from Reiner et al., 2015; e Björklund et al., 2009; f Goosey and Harrad, 2011.

**Table S3.** Median concentrations in ng/g (number of samples; sampling year) reported in the literature for house dust collected from Belgium, Italy and Spain

|  |  |  |  |
| --- | --- | --- | --- |
|  | Belgium median( n; year) | Spain (median, n, year) | Italy (median, n, year) |
| PFBS | 0 (45; 2008)a | 0.37 (10; 2009)c; 1.44 (10; 2009)d |  |
| PFHxS | 0.1 (45; 2008)a | 0.45 (10; 2009)c; 0.39 (10; 2009)d |  |
| PFOS | 0.5 (45; 2008)a; 0.73 (40; 2008)b | 2.45 (10; 2009)c; 5.29 (10; 2009)d |  |
| PFBA | 0.2 (45; 2008)a | 19.0 (10; 2009)c |  |
| PFPeA |  | 0.37 (10; 2009)c; 0.37 (10; 2009)d |  |
| PFHxA | 0.3 (45; 2008)a | 1.01 (10; 2009)c; 3.39 (10; 2009)d |  |
| PFHpA |  | 1.20 (10; 2009)c; 0.90 (10; 2009)d |  |
| PFOA | 0.7 (45; 2008)a ; 0.72 (40; 2008)b | 4.20 (10; 2009)c; 8.81 (10; 2009)d |  |
| PFNA | 0.1 (45; 2008)a | 0.87 (10; 2009)c; 1.72 (10; 2009)d |  |
| PFDA | 0.2 (45; 2008)a | 1.45 (10; 2009)c; 3.72 (10; 2009)d |  |
| PFUdA |  | 0.6 (10; 2009)c; 1.09 (10; 2009)d |  |
| PFDoA |  | 0.93 (10; 2009)c ; 1.97 (10; 2009)d |  |
| PFTrDA |  | 0.16 (10; 2009)c; 0.72 (10; 2009)d |  |
| PFTeDA |  | 0.29 (10; 2009)c; 1.08 (10; 2009)d |  |
| PFHxDA |  | 0.69 (10; 2009)c |  |
| PFODA |  | 0.46 (10; 2009)c |  |

a D’Hollander et al., 2010; b Cornelis et al., 2012; c Ericson Jogsten et al., 2012; d Eriksson and Kärrman, 2015.

**Table S4**. Spearman`s Rho correlation matrix. Only data obtained from questionnaire that obtained significant correlations are shown

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ∑PFCA | ∑PFCA |  | Edif. | ∑Text.  | Floor |
|   | PFBS | PFHxS | PFOS | ∑PFSAs | PFPeA | PFHxA | PFHpA | PFOA | PFNA | PFDA | PFUdA | PFDoA | PFTrDA | PFTeDA | PFHxDA | PFODA | ∑PFCAs | (<7)a | (≥7)b | TPFASs |  (age) | (n) | (%) |
| PFBS | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |  |  |
| PFHxS | 0.55 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |
| PFOS | -0.196 | 0.616\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |
| ∑PFSAs | 0.942\*\* | 0.747\*\* | 0.509\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |
| PFPeA | 0.464 | -0.156 | 0.027 | 0.142 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |
| PFHxA | 0.176 | 0.197 | 0.429 | 0.254 | -0.119 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |
| PFHpA | 0.664\* | 0.211 | -0.112 | 0.148 | 0.447\* | 0.511\* | 1 |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |
| PFOA | 0.318 | 0.438\* | 0.705\*\* | 0.362\*\* | 0.054 | 0.293 | 0.315\* | 1 |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |
| PFNA | 0.571 | 0.615\*\* | 0.438 | 0.485\*\* | 0.159 | 0.22 | 0.445\* | 0.754\*\* | 1 |  |  |  |  |  |  |  |  |  |   |  |  |  |  |
| PFDA | 0.341 | 0.570\*\* | 0.434\* | 0.429\*\* | 0.172 | 0.366\* | 0.464\*\* | 0.688\*\* | 0.766\*\* | 1 |  |  |  |  |  |  |  |  |   |  |  |  |  |
| PFUdA | 0.298 | 0.188 | 0.395\* | 0.286 | 0.353 | 0.105 | 0.284 | 0.631\*\* | 0.799\*\* | 0.649\*\* | 1 |  |  |  |  |  |  |  |   |  |  |  |  |
| PFDoA | 0.533\* | 0.454\* | 0.450\* | 0.437\*\* | -0.154 | 0.428\* | 0.382\* | 0.736\*\* | 0.785\*\* | 0.854\*\* | 0.770\*\* | 1 |  |  |  |  |  |  |   |  |  |  |  |
| PFTrDA | 0.817\*\* | 0.448 | 0.233 | 0.487\*\* | 0.477 | 0.289 | 0.509\*\* | 0.709\*\* | 0.740\*\* | 0.758\*\* | 0.652\*\* | 0.723\*\* | 1 |  |  |  |  |  |   |  |  |  |  |
| PFTeDA | 0.249 | 0.578\*\* | 0.445\*\* | 0.411\*\* | 0.464\* | 0.303 | 0.417\*\* | 0.625\*\* | 0.643\*\* | 0.738\*\* | 0.578\*\* | 0.705\*\* | 0.913\*\* | 1 |  |  |  |  |   |  |  |  |  |
| PFHxDA | 0.546\* | 0.544\*\* | 0.277 | 0.323\* | 0.348 | 0.022 | 0.451\*\* | 0.487\*\* | 0.609\*\* | 0.680\*\* | 0.493\*\* | 0.644\*\* | 0.789\*\* | 0.813\*\* | 1 |  |  |  |   |  |  |  |  |
| PFODA | 0.225 | 0.371 | 0.384 | 0.369\* | 0.244 | 0.073 | 0.438\* | 0.640\*\* | 0.616\*\* | 0.772\*\* | 0.504\*\* | 0.660\*\* | 0.808\*\* | 0.826\*\* | 0.876\*\* | 1 |  |  |   |  |  |  |  |
| ∑PFCAs | 0.355 | 0.134 | 0.425\*\* | 0.262\* | 0.466\* | 0.441\*\* | 0.745\*\* | 0.643\*\* | 0.698\*\* | 0.788\*\* | 0.622\*\* | 0.800\*\* | 0.843\*\* | 0.731\*\* | 0.622\*\* | 0.782\*\* | 1 |  |   |  |  |  |  |
| ∑PFCA(<7)a | 0.458 | -0.085 | 0.189 | 0.141 | 0.585\*\* | 0.622\*\* | 0.880\*\* | 0.299\* | 0.380\* | 0.482\*\* | 0.339\* | 0.469\*\* | 0.467\*\* | 0.447\*\* | 0.297\* | 0.413\*\* | 0.784\*\* | 1 |   |  |  |  |  |
| ∑PFCA(≥7)b | 0.204 | 0.2 | 0.447\*\* | 0.225 | 0.352 | 0.252 | .741\*\* | 0.726\*\* | 0.764\*\* | 0.816\*\* | 0.691\*\* | 0.827\*\* | 0.849\*\* | 0.738\*\* | 0.607\*\* | 0.771\*\* | 0.918\*\* | 0.571\*\* | 1 |  |  |  |  |
| TPFASs | 0.708\*\* | .0400\* | 0.454\*\* | 0.568\*\* | 0.451\* | 0.465\*\* | 0.708\*\* | 0.584\*\* | 0.677\*\* | 0.775\*\* | 0.566\*\* | 0.794\*\* | 0.841\*\* | 0.713\*\* | 0.617\*\* | 0.737\*\* | 0.889\*\* | 0.719\*\* | 0.804\*\* | 1 |  |  |  |
| Edif (age) | -0.218 | 0.157 | 0.406\*\* | -0.074 | -0.265 | 0.101 | 0.002 | 0.103 | 0.138 | -0.053 | 0.116 | -0.055 | -.339\* | -0.041 | -0.074 | -0.108 | -0.027 | 0.068 | 0.033 | -0.039 | 1 |  |  |
| ∑Textiles | -0.135 | 0.148 | -0.074 | -0.118 | 0.1 | 0.248 | 0.193 | 0.197 | 0.209 | 0.13 | 0.357\* | 0.265 | 0.108 | 0.14 | 0.101 | 0.166 | 0.163 | 0.168 | 0.248\* | 0.099 | -0.065 | 1 |  |
| Floor (%)d | 0.083 | 0.456\* | 0.075 | 0.006 | -0.315 | 0.228 | 0.227 | 0.197 | 0.123 | 0.057 | -0.006 | 0.234 | 0.094 | 0.06 | 0.079 | 0.172 | 0.048 | 0.124 | 0.076 | 0.091 | 0.139 | 0.550\*\* | 1 |

\* p < 0.05; \*\* p < 0.01; a Sum of short chain PFCAs (PFBA, PFPeA, PFHxA and PFHpA) ; b sum of longt chain PFCAs (PFOA, PFNA, PFDA, PFUdA, PFDoA, PFTrDA, PFTeDA, PFHxDA and PFODA); c Sum of textiles (carpets, curtains and sofas) in the house (n); d Percentage of the floor covered by textiles.

**Table S5**. Median (min.-max.) concentrations (ng/g) obtained in household dust according to location surroundings (industrial, agricultural, residential and other).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Industrial | Agricultural | Residential  | Other |
| PFBS | 0.4 (n.d. - 11.7) | 0.4 (n.d. - 2.03) | 0.4 (n.d. - 56.7) | 6.5 (n.d. - 10.1) |
| PFHxS | 0.13 (n.d. - 7.26) | 0.13 (n.d. - 5.29) | 0.13 (n.d. - 11.3) | 0.58 (n.d. - 2.02) |
| PFOS | 1.78 (n.d. - 3.45) | 0.39 (n.d. - 2.71) | 0.23 (n.d. - 11.9) | 0.44 (n.d. - 1.40) |
| **∑PFSAsa** | 3.27 (1.74 - 15.2) | 0.99 (n.d. - 8.40) | 1.93 (n.d. - 59.6) | 8.69 (1.47 - 10.3) |
|  |  |  |  |  |
| PFBA | n.d. | 0.40 (n.d. - 6.99) | 0.08 (n.d. - 20.9) | n.d. |
| PFPeA | 0.15 (n.d. - 1.99) | 0.12 (n.d. - 1.86) | 0.01 (n.d. - 21.3) | 0.32 (n.d. - 2.48) |
| PFHxA | 1.53 (n.d. - 3.56) | 0.08 (n.d. - 5.48) | 0.26 (n.d. - 28.3) | 0.94 (n.d. - 1.51) |
| PFHpA | 4.40 (2.04 - 15.9) | 3.03 (0.49 - 4.87) | 0.45 (n.d. - 105) | 0.37 (0.29 - 4.77) |
| **∑PFCAs(<7)b** | 5.73 (2.55 - 17.9) | 4.30 (1.43 - 13.4) | 2.23 (n.d. - 108) | 1.80 (n.d. - 8.66) |
| PFOA | 9.85 (1.75 - 16.8) | 1.19 (0.78 - 3.64) | 1.15 (0.21 - 53.0) | 1.65 (1.57 - 2.98) |
| PFNA | 1.50 (n.d. - 6.54) | 0.62 (n.d. - 1.88) | 0.06 (n.d. - 9.04) | 0.06 (n.d. - 0.49) |
| PFDA | 1.68 (n.d. - 15.8) | 0.53 (n.d. - 1.12) | 0.35 (n.d. - 25.8) | 0.56 (n.d. - 0.74) |
| PFUdA | 0.88 (0.22 - 2.55) | 0.54 (0.09 - 0.81) | 0.11 (n.d. - 7.68) | 0.13 (n.d. - 0.60) |
| PFDoA | 1.01 (n.d. - 5.52) | 0.53 (n.d. - 0.87) | 0.23 (n.d. - 19.7) | 0.32 (n.d. - 0.66) |
| PFTrDA | 1.23 (n.d. - 6.84) | 0.72 (n.d. - 2.14) | 0.17 (n.d. - 11.1) | 0.86 (n.d. - 4.00) |
| PFTeDA | 4.12 (n.d. - 16.1) | 1.38 (0.13 - 3.32) | 0.76 (n.d. - 38.4) | 1.92 (1.11 - 5.03) |
| PFHxDA | 2.11 (n.d. - 4.58) | 0.62 (0.18 - 1.54) | 0.61 (n.d. - 14.9) | 1.08 (n.d. - 4.83) |
| PFODA | 1.18 (n.d. - 3.27) | 0.63 (n.d. - 1.85) | 0.31 (n.d. - 4.96) | 1.13 (n.d. - 4.62) |
| **∑PFCAs(≥7)c** | 26.0 (3.52 - 66.2) | 7.17 (2.22 - 13.3) | 4.46 (1.14 - 129) | 8.11 (4.13 - 21.9) |
| **∑PFCAsd** | 31.5 (9.25 - 76.7) | 14.3 (4.22 - 22.5) | 7.80 (2.02 - 149) | 9.91 (4.59 - 30.6) |
|  |  |  |  |  |
| **FOSA** | 0.01 (n.d. - 1.05) | n.d. | 0.01 (n.d. - 0.43) | 0.01 (n.d. - 0.01) |
| **∑PFASse** | 35.7 (24.3- 79.7) | 16.8 (5.10 – 31.0) | 10.2 (3.13 - 155) | 15.9 (11.3 - 40.9) |

n.d. = not detected;

a Sum of perfluoroalkane sulfonic acids: PFBS, PFHxS and PFOS;

b Sum of perfluoroalkyl carboxylic acids: PFBA, PFPeA, PFHxA, PFHpA;

c Sum of perfluoroalkyl carboxylic acids PFOA, PFNA, PFDA, PFUdA, PFDoA, PFTrDA, PFTeDA, PFHxDA and PFODA:

d Sum of perfluoroalkyl carboxylic acids: PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUdA, PFDoA, PFTrDA, PFTeDA, PFHxDA and PFODA;

e Sum of ∑PFSAs, ∑PFCAs and FOSA.

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