Annex D - Statement for use of the EFSA 2020 Opinion on the risks to human health related to the presence of perfluoroalkyl substances in food in UK risk assessments

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Indoor air exposures

1. A literature search was carried out for concentrations of PFASs in air. There were only 2 studies for which indoor air samples had been measured for one or more of PFOS, PFOA, PFHxS and/or PFNA in homes. Tables 1 to 4 show the study information and dust concentrations for PFOS and PFOA, PFHxS and PFNA, respectively. Data for the branched and linear isomers of chemicals were summed to provide a single value.

Table 1. Concentrations of PFOS in indoor air (pg/m^3) in UK and EU studies where samples were taken in homes, after 2008.

Region, country	Year of sampling	No. of samples	Mean LB-UB (pg/m^3) (SEM[a], SD[b] or 95% CI[c])	Median (pg/m^3)	Range (pg/m^3)	LOD[a] LOQ[b] (pg/m^3)	Detection frequency (%)	Reference
Kuopio, Finland	2014-2015	57 branched PFOS	0.74 (0.51[b])	0.67		0.22[a]	93 (>LOD)	Winkens et al., 2017
Kuopio, Finland	2014-2016	57 linear PFOS	1.3 (0.89[b])	1.2		0.47[a]	88 (>LOD)	Winkens et al., 2017
Kuopio, Finland (Sum of branched and linear PFOS)			2	1.87				
Birmingham UK	2008 - 2009	20	38	11	1.0 - 400	1	90 (>LOD)	Goosey and Harrad, 2012

Values are given to 2 significant figures. SEM – standard error of the mean; LB - lower bound assigns the value of zero to non-quantified data; UB - upper bound assigns the value of the LOD/LOQ to non-quantified data; SD – standard deviation; 95% CI – 95th percent confidence interval; LOD – limit of detection; LOQ – limit of quantification.

Table 2. Concentrations of PFOA in indoor air (pg/m^3) in UK and EU studies where samples were taken in homes, after 2008.

Region, country	Year of sampling	No. of samples	Mean LB-UB (pg/m^3) (SEM[a], SD[b] or 95% CI[c])	Median (pg/m^3)	Range (pg/m^3)	LOD[a] LOQ[b] (pg/m^3)	Detection frequency (%)	Reference
Kuopio, Finland	2014-2015	57	NC			0.20[a]	5 (>LOD)	Winkens et al., 2017
Kuopio, Finland	2014-2015	57	21 (18[b])	15		4.5[a]	98 (>LOD)	Winkens et al., 2018
Sum of branched and linear	n/a	n/a	21	15		n/a	n/a	n/a
Birmingham UK	2008 - 2009	20	52	24	1.9 - 440	1.9	n/a	Goosey et al., 2012

Values are given to 2 significant figures. SEM – standard error of the mean; LB - lower bound assigns the value of zero to non-quantified data; UB - upper bound assigns the value of the LOD/LOQ to non-quantified data; SD – standard deviation; 95% CI – 95th percent confidence interval; NC not calculated; LOD – limit of detection; LOQ – limit of quantification.

Table 3. Concentrations of PFHxS in indoor air (pg/m^3) in UK and EU studies where samples were taken in homes, after 2008.

Region, country	Year of sampling	No. of samples	Mean LB-UB (pg/m^3) (SEM[a], SD[b] or 95% CI[c])	Median (pg/m^3)	Range (pg/m^3)	LOD[a] LOQ[b] (pg/m^3)	Detection frequency (%)	Reference
Kuopio, Finland	2014-2015	57	NC			0.25[a]	2 (>LOD)	Winkens et al., 2017
Kuopio, Finland	2014-2015	57	NC			0.52[a]	16 (>LOD)	Winkens et al., 2018
Sum of branched and linear PFHxS	n/a	n/a	NC			n/a	n/a	n/a
Birmingham UK	n/a	20	36	23	1.1 - 220	1.1	n/a	Goosey et al., 2012

Values are given to 2 significant figures. SEM – standard error of the mean; LB - lower bound assigns the value of zero to non-quantified data; UB - upper bound assigns the value of the LOD/LOQ to non-quantified data; SD – standard deviation; 95% CI – 95th percent confidence interval; NC not calculated; LOD – limit of detection; LOQ – limit of quantification.

Table 4. Concentrations of PFNA in indoor air (pg/m^3) in UK and EU studies where samples were taken in homes, after 2008.

Region, country	Year of sampling	No. of samples	Mean LB-UB (pg/m3) (SEM[a], SD[b] or 95% CI[c])	Median (pg/m^3)	Range (pg/m^3)	LOD[a] LOQ[b] (pg/m^3)	Detection frequency (%)	Reference
Kuopio, Finland	2014-2015	57	3.1 (2.5[b])	2.4	0.95 - 17	0.57	100 (>LOD)	Winkens et al., 2017

Values are given to 2 significant figures. SEM – standard error of the mean; LB - lower bound assigns the value of zero to non-quantified data; UB - upper bound assigns the value of the LOD/LOQ to non-quantified data; SD – standard deviation; 95% CI – 95th percent confidence interval; LOD – limit of detection; LOQ – limit of quantification.

2. The maximum values from the datasets for PFOS (400 pg/m^3) and PFOA (440 pg/m^3) are both from the study by Goosey and Harrad (2012) and are approximately 3 - 4-fold the next highest values for each of the chemicals. Using these values in the exposure calculation is a conservative approach.

3. The exposure estimates are based on concentrations derived as an average of the median (Table 5) or maximum (Table 6) values reported in the literature.

Table 5. Concentrations derived (ng/g) as an average of the median values reported in the literature.

Chemical	**Average of reported median values (pg/m^3)**	**References**
PFOS	6.4	Goosey and Harrad, 2012; and Winkens et al., 2017
PFOA	20	Goosey and Harrad, 2012; and Winkens et al., 2017

PFHxS	12	Goosey and Harrad, 2012; and Winkens et al., 2017
PFNA	2.4	Winkens et al., 2017

Concentrations are given to 2 sig. figs.

Table 6. Concentrations derived as an average of the maximum values reported in the literature.

Chemical	**Average of reported maximum values (ng/g)**	**References**
PFOS	200	Goosey and Harrad, 2012; and Winkens et al., 2017
PFOA	270	Goosey and Harrad, 2012; and Winkens et al., 2017
PFHxS	220	Goosey and Harrad, 2012; and Winkens et al., 2017
PFNA	17	Winkens et al., 2017

Concentrations are given to 2 sig. figs.

4. Inhalation rates were taken from the EPA Exposure Factors Handbook (2011) Exposure Factors Handbook 2011 Edition (Final Report) | Science Inventory | US EPA. The number of age groups for which inhalation rates were provided was greater than the 6 population groups. The inhalation rates selected were those that covered much of the UK population group. Average bodyweights for the UK populations were calculated from NDNS (18 months – 95 years) and DNSIYC (4 – 18 months) data for different age groups. These are all shown in Table 7.

5. Exposures from inhalation were calculated for median and high concentrations of PFOS, PFOA, PFHxS and PFNA and mean inhalation rates, for each UK population group (Table 8).

Table 7. Dust ingestion rates and average UK bodyweights for UK population groups.

Population group (age range)	**Mean inhalation rates (m^3/day)**	**average UK bodyweight (Kg)**
Infants (0 - 6 months)	3.4	7.8
Toddlers (7 months - 4 yrs)	9.3	16
Children (5 - 11 yrs)	12	31
Teenagers (12 - 19 yrs)	17	63
Adults (20 - 59 yrs)	16	79
Seniors (60+ yrs)	15	77

6. For the average median PFASs concentrations in indoor air in homes, the following ranges of exposures were calculated for all UK population groups for each of the compounds (Table 8):

- PFOS (6.4 pg/m^3): 0.0085 – 0.027 ng/kg bw per week
- PFOA (20 pg/m^3): 0.027 – 0.083 ng/kg bw per week
- PFHxS (12 pg/m^3): 0.016 – 0.050 ng/kg bw per week
- PFNA (2.4 pg/m^3): 0.0032 – 0.010 ng/kg bw per week

7. For the average maximum PFASs concentrations in indoor air in homes, the following ranges of exposures were calculated for all UK population groups for each of the compounds (Table 8):

- PFOS (200 pg/m^3): 0.27 – 0.83 ng/kg bw per week
- PFOA (270 pg/m^3): 0.36 – 1.1 ng/kg bw per week
- PFHxS (220 pg/m^3): 0.29 – 0.91 ng/kg bw per week
- PFNA (17 pg/m^3): 0.023 – 0.070 ng/kg bw per week

8. For all PFASs considered, toddlers had the highest exposures via inhalation and seniors had the lowest exposures.

Table 8. Estimated exposures for PFOS, PFOA, PFHxS and PFNA (ng/kg bw per week) from indoor air for UK population groups (mean inhalation rates (m^3/day).

Exposure (ng/kg bw/week)	**Infants**	**Toddlers**	**Children**	**Teenagers**	**Adults**	**Seniors**
PFOS 6.4 pg/m^3	0.020	0.027	0.017	0.012	0.0093	0.0085
PFOS 200 pg/m^3	0.61	0.83	0.53	0.38	0.29	0.27
PFOA 20 pg/m^3	0.061	0.083	0.053	0.038	0.029	0.027
PFOA 270 pg/m^3	0.83	1.1	0.71	0.51	0.39	0.36
PFHxS 12 pg/m^3	0.037	0.050	0.032	0.023	0.017	0.016
PFHxS 220 pg/m^3	0.68	0.91	0.58	0.42	0.32	0.29
PFNA 2.4 pg/m^3	0.0074	0.010	0.0063	0.0046	0.0035	0.0032
PFNA 17 pg/m^3	0.052	0.070	0.045	0.032	0.025	0.023

Mean inhalation rates: infants 3.4 m^3/day; toddlers 9.3 m^3/day; children 12 m^3 /day; teenagers 17 m^3/day; adults 16 m^3/day and seniors 15 m^3/day.

References

Bates, B.; Collins, D.; Jones, K.; Page, P.; Roberts, C.; Steer, T.; Swan, G.(2020) National Diet and Nutrition Survey Results from years 9, 10 and 11 (combined) of the Rolling Programme (2016/2017 to 2018/2019)
Available at: National Diet and Nutrition Survey (publishing.service.gov.uk)

Bates, B.; Cox, L.; Nicholson, S.; Page, P.; Prentice, A.; Steer, T.; Swan, G. (2016) National Diet and Nutrition Survey Results from Years 5 and 6 (combined) of the Rolling Programme (2012/2013 – 2013/2014)
Available at: Main heading (publishing.service.gov.uk)

Bates, B.; Lennox, A.; Prentice, A.; Bates, C.; Page, P.; Nicholson, S.; Swan, G. (2014) National Diet and Nutrition Survey Results from Years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/2012)
Available at: Main heading (publishing.service.gov.uk)

DH (2013). Diet and Nutrition Survey of Infants and Young Children (DNSIYC), 2011.
Available at: Diet and nutrition survey of infants and young children, 2011 - GOV.UK (www.gov.uk)

Goosey E and Harrad S. (2012). Perfluoroalkyl substances in UK indoor and outdoor air: Spatial and seasonal variation, and implications for human exposure. Environment International. **45:** 86-90.

Roberts, C.; Steer, T.; Maplethorpe, N.; Cox, L.; Meadows, S.; Page, P.; Nicholson, S.; Swan, G. (2018) National Diet and Nutrition Survey Results from Years 7 and 8 (combined) of the Rolling Programme (2014/2015 – 2015/2016)
Available at: National Diet and Nutrition Survey (publishing.service.gov.uk)

U.S. EPA. (2011). Exposure Factors Handbook 2011 Edition (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, 2011.
Available at: Exposure Factors Handbook 2011 Edition (Final Report) | Science Inventory | US EPA

Winkens K, Koponen J, Schuster J, Shoeib M, Vestergren R, Berger U, Karvonen AM, Pekkanen J, Kiviranta H and Cousins IT. (2017). Perfluoroalkyl acids and their

precursors in indoor air sampled in children's bedrooms. Environmental Pollution. **222:** 423-432.