Supporting Information for Carignan et al., 2013

"Flame Retardant Exposure among Collegiate U.S. Gymnasts"

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6 pages, 4 tables and 2 figures

Surface wipes.

Methods. In Gym 1 we collected one surface wipe from each of the four gymnastics apparatus: the top of the vaulting horse, mats beneath the beam and uneven bars, and a mat on the floor exercise area. We also collected a surface wipe from two dusty spaces in the gym: a mat on the far edge of the loose foam pit and from the edge of a mat on the opposite side of the gym. In Gym 2 we collected one surface wipe from a dusty space within 30 cm of the loose foam pit. For each sample, we soaked a 7.6 by 7.6-cm sterile gauze pad in 3 ml of isopropyl alcohol, wiped 232 cm^2 of the target surface, and placed the gauze in a clean glass vial. The vial was wrapped in foil and bubble-wrap, sealed in a polyethylene zip bag and stored at -20° C. One field blank was collected in the same manner, but without wiping a surface. Wipe samples were analyzed using GC/ECNI-MS as previously described by Stapleton et al. (2008) and with the modifications described for handwipes.

Results. We detected ΣPentaBDE, TBB and TBPH in all surface wipe samples (SI Table S3b). TDCPP and TCPP were detected in 60% of surface wipes collected from Gym 1. Both TPP and TDCPP were detected in the single surface wipe collected from Gym 2. TPP and TCPP were not measured in surface wipes from Gyms 1 and 2, respectively. PentaBDE was the dominant flame retardant in surface wipes collected from all sample locations in both Gym 1 and Gym 2. Median loadings of TBB and TBPH in surface wipes from Gym 1 were higher than in the single wipe sample from Gym 2.

Table S1. PBDEs (<50% detect), BB153, organochlorine pesticides and PCBs in gymnast serum.

Analyte	Detection Frequency (%)	Maximum MDL (ng/g lipid)	GM (ng/g lipid)	Range (ng/ g lipid)
Polybrominated diphenyl ethers				
BDE-17	0	2.2	NA	<MDL
BDE-66	0	2.2	NA	<MDL
BDE-154	45	13.6	NR	<MDL–6.8
BDE-183	0	1.2	NA	<MDL
BDE-209	0	22.3[a]	NA	<MDL
Organochlorine pesticides				
hexachlorobenzene	0	20.2	NA	<MDL
β-hexachlorocyclohexane	0	11.1	NA	<MDL
γ-hexachlorocyclohexane	0	11.1	NA	<MDL
oxychlordane	9	11.1	NR	<MDL–9.0
trans-nonachlor	9	11.1	NR	<MDL–11.5
p,p'-DDE	100	11.1	56.8	26.5–89.1
o,p'-DDT	0	11.1	NA	<MDL
p,p'-DDT	0	11.1	NA	<MDL
Mirex	0	11.1	NA	<MDL
Polychlorinated biphenyls[b]				
PCB 28	0	3.0	NA	<MDL
PCB 74	82	2.2	2.1	<MDL–7.6
PCB 99	45	2.2	NR	<MDL–3.3
PCB 118	82	2.2	2.0	<MDL–8.1
PCB 138, 158	91	2.2	3.0	<MDL–20.9
PCB 146	9	2.2	NR	<MDL–6.5
PCB 153	100	2.2	5.3	2.0–45.4
PCB 156	36	2.2	NR	<MDL–14.4
PCB 157	9	2.2	NR	<MDL–3.7
PCB 167	9	2.2	NR	<MDL–2.5
PCB 170	55	2.2	1.66	<MDL–11.9
PCB 180	100	2.2	3.6	1.2–27.3
PCB 187	18	2.2	NR	<MDL–6.1
PCB 194	27	2.2	NR	<MDL–3.4
PCB 196, 203	27	2.2	NR	<MDL–2.5
PCB 199	27	2.2	NR	<MDL–3.5

[a]The MDL was 22.3 in one sample and <14 ng/g lipid for the remaining samples.
[b]PCBs 44, 49, 52, 66, 87, 101, 105, 110, 128, 149, 151, 172, 177, 178, 183, 189, 195, 206 and 109 had detection frequencies of 0% and maximum MDLs of 2.2 ng/g lw.
MDL: Method detection limit
NA: Not applicable
NR: GM is not reported as detection frequency is <50%.

Table S2. Comparison of GM (95% confidence interval) concentrations of PentaBDEs and POPs in gymnast serum to other U.S. populations (ng/g lw).

Population:	Office Workers[1]	Pregnant Women[2]	General U.S.[3]	U.S. Teenagers[3]	Californians[4]	Gymnasts	Foam Recyclers and Carpet Installers[5]
Sample Size:	(n=31)	(n=137)	(n≥2000)	(n≥600)	(n≥250)	(n=11)	(n=15)
Sample Year:	2009	2008–2010	2003–2004	2003–2004	2003–2004	2012	2006
Age Range:	25–64	18–39	12–85	12–19	12–60[+]	18–22	22–56
PentaBDEs							
BDE 28	1.1 (0.7–1.5)	NR	1.2 (1.0–1.4)	1.3 (1.2–1.5)	2.1 (1.5–2.7)	1.5 (0.9–2.4)	3.9 (2.4–6.3)*
BDE 47	14.2 (9.4–21.3)*	16.5 (13.6–20.0)*	20.5 (17.6–23.9)*	28.2 (24.6–32.3)	36.2 (25.0–47.4)	43.5 (26.8–70.5)	91.7 (54.9–153)*
BDE 85	NR	NR	NR	NR	NR	1.4 (0.9–2.2)	2.7 (1.6–4.5)
BDE 99	2.5 (1.6–3.7)*	4.7 (3.7–5.9)	<MDL	6.9 (6.1–7.7)	7.4 (5.2–9.6)	11.9 (4.0–20.4)	27.1 (15.8–46.4)*
BDE 100	2.7 (1.7–4.3)*	4.2 (3.5–5.0)*	3.9 (3.4–4.5)*	5.2 (4.5–6.0)*	6.0 (4.2–7.8)	10.9 (6.8–17.4)	20.8 (12.7–34.0)
BDE 153	5.0 (3.1–8.1)*	5.9 (5.1–6.9)*	5.7 (5.1–6.3)*	8.1 (6.7–9.7)*	6.8 (5.2–8.4)*	32.5 (20.5–51.5)	27.4 (18.4–40.9)
ΣPentaBDE[a]	28.3 (19.1–42.0)*	36.6[b]	38.6 (335–43.7)*[c]	NA	62.0 (44.6–79.4)[c]	109 (74.1–160)	178 (112–282)
Other POPs							
DDE	NA	NA	238 (195–292)*	105 (84.7–129)*	NA	56.8 (44.6–72.3)	NA
PCB 74	NA	NA	4.8 (4.6–5.0)*	2.2 (2.0–2.4)	NA	<MDL	NA
PCB 118	NA	NA	6.0 (5.5–6.5)*	3.0 (2.8–3.4)	NA	<MDL	NA
PCB 138/158	NA	NA	15 (14.1–16.1)*	5 (4.5–5.6)	NA	3.0 (1.6–5.5)	NA
PCB 153	NA	NA	19.8 (18.8–20.9)*	5.8 (5.3–6.6)	NA	5.3 (2.9–9.2)	NA
PCB 170	NA	NA	5.4 (5.2–5.7)*	1.2 (0.97–1.3)	NA	1.7 (0.91–3.0)	NA
PCB 180	NA	NA	15 (14.5–15.7)*	3 (2.7–3.5)	NA	3.6 (1.9–6.8)	NA

*GM is significantly different from GM of gymnasts at the α=0.05 level.

[1]Watkins et al. 2011; [2]Stapleton et al. 2011; [3]Sjodin et al. (2008) and Patterson et al. (2009); [4]Zota et al. (2008); [5]Stapleton et al. 2008.

[a]ΣPentaBDE=Sum(BDEs 28, 47, 99, 100, 153).

[b]Median value, 95% CI not reported.

[c]ΣPentaBDE=Sum(BDEs 28, 47, 99, 100, 153, 154).

NR: Not reported due to low detection frequency (<50%).

<MDL: Geometric mean is less than the method detection limit.

NA: Data not available.

Table S3. Flame retardants in gym dust collected using a) vacuum cleaner and b) surface wipe.

a) Vacuumed	Gym 1					Gym 2		
Analyte (µg/g)	**LFP, within**	**Beam[1]**	**Vault**	**Uneven Bars**	**Floor Exercise**	**LFP, within**	**LFP, beside**	**VB**
PBDEs								
BDE 28, 83	2.35	3.44	0.91	0.42	0.15	48.5	5.66	1.43
BDE 47	*169*	*453*	*98.8*	*88.3*	20.4	390	247	146
BDE 85, 155	23.1	*50.3*	11.2	7.81	2.39	258	79.1	26.7
BDE 99	*225*	*870*	*208*	*159*	51.3	518	336	222
BDE 100	*51.0*	*194*	*32.5*	*29.2*	7.92	353	145	72.3
BDE 153	*32.8*	*89.4*	19.5	14.1	5.21	367	138	56.1
ΣPentaBDE	503	1660	371	299	87.4	1935	951	525
BDE 209	3.40	13.4	19.5	0.90	5.21	1.72	2.50	41.6
Firemaster 550								
TBB	85.6	36.6	28.9	20.8	23.5	<0.001	<0.001	0.35
TBPH	32.0	44.9	30.0	17.3	21.0	0.06	<0.001	0.21
Organophosphates								
TPP	NM	NM	NM	NM	NM	25.0	20.7	22.9
TDCPP	3.71	22.7	8.42	2.72	5.05	38.2	13.0	3.19
TCPP	3.06	2.60	1.85	2.48	0.75	NM	NM	NM

[1]Beam near uneven bars; LFP: Loose foam pit; VB: Vacuum cleaner bag; NM: Not measured
Italic font: May be less exact due to extrapolation from the end of a calibration curve.

b) Surface Wipe	Gym 1							Gym 2
Analyte (ng/wipe)	**Near LFP**	**Away from LFP**	**Beam[2]**	**Vault**	**Uneven Bars**	**Floor Exercise**	**Median**	**Near LFP**
PBDEs								
BDE 28, 83	0.34	0.33	0.12	0.01	0.04	<0.001	**0.08**	1.05
BDE 47	17.2	26.88	30.2	0.53	3.23	0.15	**10.2**	141
BDE 85, 155	3.37	1.66	2.69	0.03	0.13	0.02	**0.90**	44.0
BDE 99	42.9	36.05	38.0	0.76	2.64	0.36	**19.3**	262
BDE 100	0.11	7.29	9.65	0.16	0.53	0.08	**0.34**	98.0
BDE 153	6.46	1.81	4.61	0.06	0.18	0.03	**1.00**	101
ΣPentaBDE	70.3	74.04	85.3	1.55	6.75	0.63	**38.5**	647
BDE 209	0.23	1.24	0.02	0.12	<0.02	0.03	**0.12**	1.02
Firemaster 550								
TBB	8.05	1.74	3.90	1.46	2.04	0.18	**1.89**	0.03
TBPH	5.94	0.66	1.67	0.61	0.51	0.03	**0.63**	0.04
Organophosphates								
TPP	NM	NM	NM	NM	NM	NM	**NM**	15.36
TDCPP	1.83	<0.14	0.78	<0.14	0.21	0.07	**0.21**	5.15
TCPP	0.19	0.19	<0.17	<0.17	0.09	0.09	**0.09**	NM

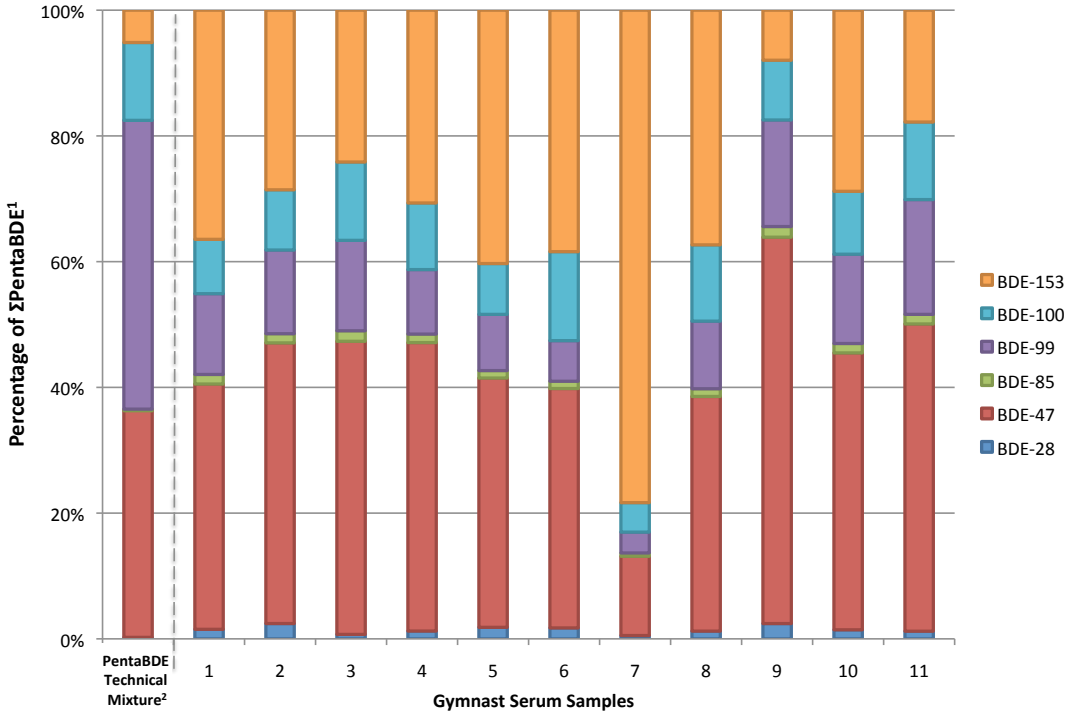
[2]Beam near vault runway; LFP: Loose foam pit; NM: Not measured

Table S4. Percentage (%, by weight) levels of bromine in gym equipment measured by XRF

	Gym 1		Gym 2	
Gym Equipment	n	Average (Range)	n	Average (Range)
Pit Cube	2	4.66 (3.16–6.16)	4	4.01 (0.483–5.60)
Landing Mat	15	1.41 (0.005–3.61)	0	NM
Sting Mat	7	0.020 (0.081–1.99)	1	0.532 (NA)
Vault Runway Carpet	2	0.621 (0.549–0.690)	1	0.903 (NA)
Vault Runway Foam	2	0.014 (0.007–0.021)	0	NM
Above-ground Pit	3	0.001 (0.003–0.047)	1	0.017 (NA)
Spring Board	1	0.005 (NA)	2	0.006 (0.002–0.010)
Floor Foam	1	0.003 (NA)	1	0.619 (NA)
Floor Carpet	1	0.001 (NA)	1	0.036 (NA)

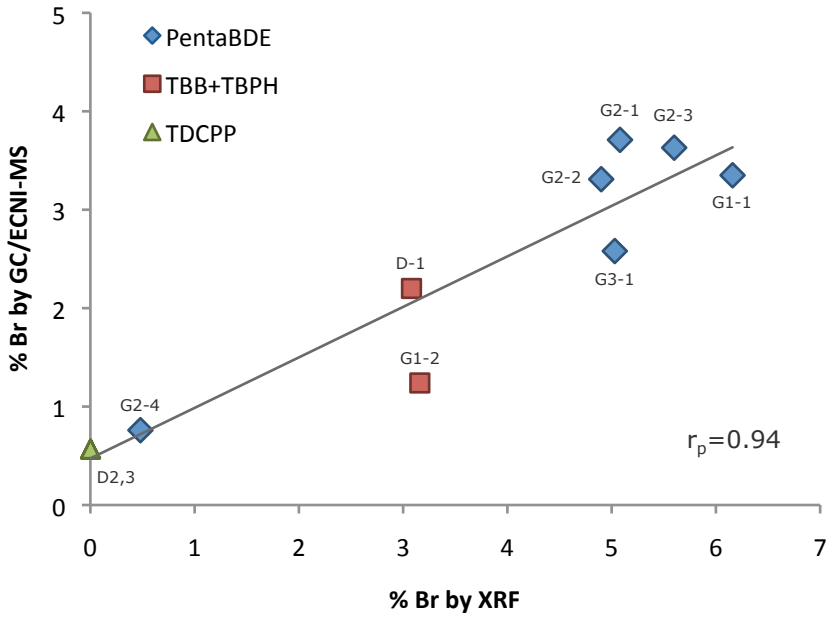
NM: not measured
NA: not applicable, only one item measured.

Figure S1. Percentages of PentaBDE[1] in the technical mixture and gymnast serum



[1]ΣPentaBDE includes BDEs 28, 47, 85, 99, 100 and 153.
[2]The U.S. Penta mixture DE-71 as reported by Laguardia et al. (2006).

Figure S2: Percent levels of bromine (by weight) in pit cubes as measured by GC/ECNI-MS and XRF (r_p=0.94)



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