

Does flying in commercial airliners present a threat of PBDE exposure?

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Introduction

Polybrominated diphenyl ether (PBDE) exposure can lead to increased body burden of this class of brominated flame retardant, especially in highly exposed workers (Stapleton et al. 2008, Bi et al. 2007, BLS 2009). One published article suggests that passengers flying in airplanes might have increased exposure to PBDEs reflected by elevated blood levels of PBDEs (Christiansson et al. 2008). Possible PBDE exposure in airplane cabins might originate from PBDEs in carpet liners, seat cushions, plastics used for luggage storage or in electronics, each of which is sometimes contaminated with PBDEs (Stapleton et al. 2005, 2008). In order to expand on the Christiansson et al. study, we organized a study of potentially highly exposed airline workers, either flight attendants or pilots.

Materials and Methods

The Institutional Review Committees of the University of Texas Health Science Center at Houston and the University of Texas Southwestern Medical Center in Dallas approved the research protocol. Informed consent was obtained from each volunteer prior to enrollment in the study. Recruitment was by word of mouth initially by members of the research team and then by airline workers themselves. Most volunteers were living in or around Dallas, Texas at the time of participation and usually for many years prior to entry in the study. Volunteers had to be in good health and between the ages of 18 and 70 years; there were no gender, ethnic or religious exclusions. All participants were healthy and worked for at least the previous 5 consecutive years in these positions. None were sampled after time off from their work. All had blood taken a short time after their last flight. Blood was collected at the Southwestern Medical Center in Dallas, Texas. A questionnaire including age, residence, present and past occupational status, known exposure to toxic chemicals was filled out by each volunteer. Approximately 50 ml of whole blood was collected; serum was extracted by centrifugation and used for analysis. Blood was stored at -80 degrees C, was sent by express delivery to Eurofins laboratory on dry ice and kept in a deep freezer until analyzed. Methods used by Eurofins laboratory for analysis of PBDEs in blood have been described elsewhere (Paepke et al. 2004). PBDE congeners BDE 17, 28, 47, 66, 77, 85, 99, 100, 138, 153, 154, 183, and 209 were measured.

Results and Discussion

The initial volunteers' occupational and demographic characteristics are summarized in Table 1. The first volunteers, 20 % male and 80 % female, varied in age from 35-60 years. The first group had 480-1500 hours or more of time worked in aircraft the past year and 3,000 to 7,000 hours over the previous five years. Table 2 provides the levels of individual BDE congeners by volunteer number. With the exception of two individuals, no elevation of any congener was found and total PBDE elevation was not noted in

any of this first batch of volunteers, all of whom had the potential for very high exposure to PBDEs from their work on commercial airlines.

Table 1. Occupational history of study participants

Subject ID	Gender	Age (in years)	Race/ Ethnicity	Total Hours	Total Hours	Profession
				Flown in Past Year	Flown in Past Five Years	
1	Male	NA	Caucasian	733	3000	Pilot
2	Female	35	Caucasian	700	3500	F.A.
3	Female	60	Caucasian	720	3600	F.A.
4	Female	43	Caucasian	480	4200	F.A.
5	Female	52	Caucasian	900	4500	F.A.
6	Male	60	Caucasian	1200	5000	F.A.
7	Female	45	Caucasian	1080	5400	F.A.
8	Female	53	Caucasian	1104	5520	F.A.
9	Female	45	Caucasian	1500	6000	F.A.
10	Female	48	Caucasian	1200	7000	F.A.

F.A. = Flight Attendant

Table 2. Levels of PBDE congeners detected in serum samples taken from U.S. airline workers (ng g⁻¹ lipid)

Sample Number	1	2	3	4	5	6	7	8	9	10
Lipid content (%)	0.6	0.44	0.54	0.47	0.46	0.35	0.4	0.53	0.5	0.55
BDE #17	(0.03)	(0.03)	(0.02)	0.15	0.65	0.13	(0.03)	0.065	0.14	0.33
BDE #28	0.52	0.29	1	1.2	5	0.8	0.67	0.25	0.96	5.9
BDE #47	5.8	2.5	16	13	80	13	7.3	3.5	13	95
BDE #66	0.055	0.051	0.15	0.13	0.68	0.12	0.065	0.052	0.14	0.93
BDE #77	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
BDE #85	0.12	0.054	0.17	0.3	1.5	0.36	0.13	0.089	0.24	2
BDE #99	1.3	0.64	2.4	2.5	26	2.9	1.1	0.93	2.6	25
BDE #100	1.1	0.37	2.2	4.7	10	2.5	1.4	0.84	2.1	12
BDE #138	(0.03)	(0.05)	(0.04)	0.059	0.16	(0.06)	(0.05)	(0.04)	0.039	0.16
BDE #153	3.2	6.3	7.9	6	4.6	2.7	8.8	13	5.2	5.6
BDE #154	0.13	0.07	0.21	0.32	1.3	0.29	0.097	0.08	0.18	1.1
BDE #183	0.15	0.19	0.1	0.25	0.4	0.26	0.21	0.21	0.31	0.22
BDE #209	1.8	1.2	1.9	2	2.4	2.8	1.9	(2)	3	(1)
Total BDE	14	12	32	31	133	26	22	20	28	150

Values below the limit of detection are denoted with the detection limit in parentheses.

While the study is still underway, the initial results are not consistent with the hypothesis that flying in commercial aircraft leads to elevated PBDEs exposure and body burden. The differences in our results from those presented in the prior study by Christiannson et al. 2008 might possibly be explained in several ways. There might be a difference in the chemical composition with respect to PBDEs in the European airliners reported as compared to US airplanes in the first published study. There may be dietary differences where elevated PBDEs in US food overwhelmed the relatively small differences described in the European study where PBDE levels are much lower than US human levels. Dust containing PBDEs might have differed in the American versus the European study. Chance might have played a role in the elevations of PBDE congeners sometimes but not always noted after flying in the

relatively small European study. Given the very large number of hours flown by the U.S. volunteers, it seems to us more likely that there may not usually be a danger of elevated PBDE exposure and hence body burden in those flying in commercial airlines. However, public health prudence suggests a larger and more representative sampling be obtained before coming to a firm conclusion regarding the potential health hazard of commercial airline travel due to the large number of individuals who fly on commercial airlines.

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