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Exposure to indoor and airborne food allergens in commercial airplanes

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To the Editor,

Exposure to indoor allergens has been associated to the development and exacerbation of asthma and allergy.¹ Therefore, thresholds for sensitization and asthma symptoms have been suggested for different indoor allergens. According to previous studies, the threshold values for sensitization of 2.0 µg/g Der p 1, 2.0 µg/g Can f 1, 1.0 µg/g Fel d 1, and 0.08 µg/g Bla g 2 as well as 10.0 µg/g Can f 1, 10.0 µg/g Der p 1 and 8.0 µg/g Fel d 1 for asthma symptoms have been proposed.³⁻⁶ Exposure to food allergens has also been related to the development of respiratory symptoms.⁷ Although much focus has been given to reactions following oral ingestion, non-ingesting route such as inhalation and cross-contact has been recognized.⁷ For allergic individuals air travelling can be a risk factor for accidental allergen exposure, which put them at risk of an in-flight medical emergency. Thus, this study aimed to assess the concentration of common indoor and airborne food allergens in commercial airplanes.

Dust was vacuumed from floor carpets and seats on 10 short-and medium-haul commercial airplanes, during each airplane's cleaning routine. One settled dust sample was collected in each commercial airplane (n=10). The sample processing and measurement of indoor and airborne food allergens have been described previously.⁸ Concentrations of common indoor and airborne food allergens, including mites (*Dermatophagoides pteronissinus*, Derp 1), molds (*Alternaria alternata*, Alt a 1), cockroach (*Blattella germanica*, Bla g 2), dog (*Canis familiaris*, Can f 1), cat (*Felis domesticus*, Fel d 1), grass (*Phleum pratense*, Phl p 5), peanut (*Arachis hypogaea*, Ara h 3, Ara h 6), and hazelnut (*Corylus avellana*, Cor a 9) were

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determined using a multiplex array for allergens (MARIA™, Indoor Biotechnologies). The concentration of allergens was determined based on the result of median fluorescent intensities for each allergen and airplane. The study was conducted according to the Declaration of Helsinki and was approved by the University and Hospital Health Ethics Committee.

Feld 1, Ara h 3, Ara h 6, and Cor a 9 were the most commonly detected allergens (100% of the samples), followed by Can f 1 (90%), Derp 1 (70%), Phl p 5 (30%), Bla g 2 (20%), and Alt a 1 (0%) (Table 1, Table S1). In addition, all the concentrations of Der p 1 and Can f 1 were above the described concentrations associated with sensitization and asthma symptoms, ranging from 12.1 µg/g to 422.6 µg/g and from 15.1 µg/g to 157.6 µg/g, respectively. All the concentrations of Fel d 1 and Bla g 2 were also above the values associated with sensitization (1.0 and 1.6 µg/g, respectively) and Fel d 1 for asthma symptoms (8.0 µg/g).

Table 1 Concentration of indoor and food allergens in 10 commercial airplanes

	Indoor allergens (µg/g)						Food allergens (µg/g)		
	Mites Derp 1	Molds Alt a 1	Cockroach Bla g 2	Dog Can f 1	Cat Fel d 1	Grass Phl p 5	Peanut Ara h 3	Peanut Ara h 6	Hazelnut Cor a 9
Median	15.2	NA	47.2	84.6	102.3	8.8	935.3	294.0	318.8
Minimum	12.1	NA	21.2	15.1	14.4	8.8	251.1	38.3	55.9
Maximum	422.6	NA	73.3	157.6	471.0	12.4	121725.2	35629.4	8304.4

NA: concentration below the limit of detection (<4.0 µg/g)

Indoor and airborne food allergens were found in dust samples collected in commercial airplanes, being the concentration of Der p 1, Can f 1, Fel d 1, and Bla g 2 higher than the values associated with an increased risk of acute symptoms of asthma.³⁻⁶ Load samples are usually used to provide estimates of exposure levels and samples have been collected from floor carpets and seats, which may be considered a proxy of exposure.⁹ In these reservoirs, particles deposit instead of remaining airborne, improving the accuracy of measuring allergen exposure in commercial airplanes.^{9, 10} The concentrations of Can f 1, Fel d 1 and Der p 1 allergens observed in our study were higher than concentrations previously reported in airplanes.^{11, 12} Ara h 2 concentrations were also previously quantified in commercial airplanes, but small amounts were detected in surface samples compared to our results.¹⁰ These results were also consistent with other studies suggesting that exposure to allergens may also occur in non-domestic environment,¹³ such as in commercial airplanes. Comparisons between our results and previous studies, namely the proposed thresholds associated to sensitization and asthma symptoms, may be limited by the different methodologies used to quantify the allergens indoors¹⁴ and the results should be

interpreted with caution. Although there are no threshold levels for food allergens, our study showed that on average the concentrations of food allergens were higher than indoor aeroallergens, suggesting that exposure to these allergens may induce respiratory symptoms, such as rhinorrhea, sneezing, nasal congestion, cough, and wheeze, skin manifestations and even, although much more rarely, anaphylaxis⁷ in allergic individuals during the flight.

Our results suggest that strategies to reduce the risk of an allergic reaction to indoor and food allergens while traveling should begin before the flight, decreasing the risk of in-flight allergic reaction, the discomfort for some passengers, and also the costs related to allergic emergencies and aircraft diversions.

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Keywords

Airplanes, dust, exposure, food allergens, indoor allergens

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Conflicts of interest

Authors declare no conflicts of interest.

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Supporting Information

Table S1 Individual concentration of indoor and food allergens in 10 commercial airplanes

	Indoor allergens (µg/g)						Food allergens (µg/g)		
	Mites Der p 1	Molds Alt a 1	Cockroach Bla g 2	Dog Can f 1	Cat Fel d 1	Grass Phl p 5	Peanut Ara h 3	Peanut Ara h 6	Hazelnut Cor a 9
1	57.8	<4.0	<12.0	72.8	214.7	8.8	3229.6	513.2	55.9
2	422.6	<4.0	21.2	30.0	105.4	12.4	121725.2	35629.4	57.8
3	15.2	<4.0	<12.0	15.1	14.4	<10.0	251.1	38.3	58.9
4	13.9	<4.0	73.3	157.6	155.1	8.8	37349.1	938.4	185.1
5	12.1	<4.0	<12.0	105.3	99.3	<10.0	1270.9	302.1	500.6
6	14.6	<4.0	<12.0	22.5	69.5	<10.0	3708.3	17659.9	413.3
7	20.9	<4.0	<12.0	116.0	471.0	<10.0	431.4	285.9	8304.4
8	<12.0	<4.0	<12.0	133.9	127.2	<10.0	546.6	192.2	743.5
9	<12.0	<4.0	<12.0	<4.0	69.2	<10.0	599.8	78.7	224.4
10	<12.0	<4.0	<12.0	84.6	58.9	<10.0	357.9	195.1	1696.3

NA: concentration below the limit of detection (<4.0 µg/g)