Original Article

Taxis but not private cars are mite allergen reservoirs in Brazil

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Summary. Indoor allergens are major causative agents in allergic disease development. Besides homes, public transport vehicles have been considered important mite and pet allergen reservoirs. Our recent studies on allergen exposure in automobiles showed that different allergen levels are found in private cars *versus* taxis. We quantified group 1 *Dermatophagoides* spp. (Der 1), *Felis domesticus* (Fel d 1), and *Canis familiaris* (Can f 1) allergen levels by ELISA in dust samples from 60 taxi and 60 private car upholstered seats. Mean levels of Der 1 and Fel d 1 were significantly higher in taxis than private cars. A significantly higher percentage of taxis (42%) harboring sensitizing levels of Der 1 compared to private cars (5%) was also found. In spite of the low mean Fel d 1 levels, comparison of the percentage of vehicles with moderate Fel d 1 levels showed a significant difference between taxis and private cars (43% *vs* 20%). On the other hand, mean Can f 1 levels were significantly higher in private cars compared to taxis concomitant with a significantly higher percentage of private cars containing moderate Can f 1 levels than taxis (53% *vs* 28%). We conclude that upholstered seats from Brazilian taxis but not private cars constitute an important mite allergen reservoir. Thus, additional effective measures for the reduction of allergen exposure in vehicles within the global allergen avoidance strategy should also be routinely accomplished to minimize the induction of sensitization and symptoms in allergic patients.

Key words: Allergen exposure, car, mite allergen, pet allergen, taxi.

Resumen. Los alérgenos de interior son los principales agentes causales del desarrollo de una enfermedad alérgica. A parte de los hogares, los vehículos de transporte público también se han considerado importantes reservorios de alérgenos de animales domésticos y ácaros. En nuestros estudios recientes sobre la exposición a los alérgenos en automóviles se observó que se pueden distinguir diferentes niveles de alérgenos entre los coches privados y los taxis. Se cuantificaron los niveles de alérgenos del grupo 1 *Dermatophagoides* spp. (Der 1), *Felis domesticus* (Fel d 1) y *Canis familiaris* (Can f 1) mediante ELISA en muestras de polvo de la tapicería de los asientos de 60 taxis y 60 coches particulares. Los niveles medios de Der 1 y Fel d 1 fueron significativamente superiores en los taxis que en los coches particulares. También se halló un porcentaje de taxis significativamente superior (42%) que contenían niveles sensibilizantes de Der 1, en comparación con los coches particulares (5%). A pesar de los niveles medios de Fel d 1 reducidos, la comparación del porcentaje de vehículos con niveles de Fel d 1 moderados mostró una diferencia significativa entre los taxis y los coches particulares (43% frente a 20%). Por otro lado, los niveles medios de Can f 1 fueron significativamente superiores en los coches particulares que en los taxis, junto con un porcentaje significativamente más elevado de coches particulares que contenían niveles de Can f 1 moderados que los taxis (53% frente a 28%). Se concluyó que la tapicería de los asientos de los taxis de Brasil, pero no de los coches particulares, constituye un reservorio importante de alérgenos de los ácaros. Por lo tanto, deberían implementarse de forma rutinaria medidas eficaces adicionales para reducir la exposición a alérgenos en los vehículos, de acuerdo con la estrategia global de evitación de alérgenos, y así minimizar la inducción de la sensibilización y los síntomas en los pacientes alérgicos.

Palabras clave: Exposición a alérgenos, coche, alérgeno de los ácaros, alérgeno de animales domésticos, taxi.

Introduction

Indoor allergens are major causative agents in allergic disease development. Besides homes, public transport vehicles have been considered important mite and pet allergen reservoirs [1]. The presence of allergens in public places is mainly related to passive allergen transport on clothing [2], even though environmental factors such as temperature and relative humidity can influence mite allergen levels. Several major indoor allergens such as group 1 *Dermatophagoides farinae* (Der f 1), *D. pteronyssinus* (Der p 1) and pet allergens can reach levels (≥ 2 μg/g of dust for mite and ≥ 1 μg/g of dust for pet allergens) that are considered significant risk factors for sensitization in susceptible individuals [3]. However, a recent review article has demonstrated that values > 2 μg of mite allergens/g of dust, > 8 μg of Fel d 1/g of dust and > 10 μg of Can f 1/g of dust have now been considered risk factors for allergic sensitization of genetically susceptible individuals in the home environments, although there are other alternative levels of interest depending on the environment considered [4]. Thus, moderate levels of Fel d 1 (1-8 μg/g of dust) and Can f 1 (1-10 μg/g of dust) allergens have been considered in the school environment [4]. The aim of this study was to determine the levels of Der 1 (Der p 1 + Der f 1), Fel d 1, and Can f 1 allergens in private cars and taxis and to evaluate the predominant allergen in each vehicle type.

Material and Methods

Car and dust sampling

Sixty taxis and 60 private cars were randomly selected for a mite and pet allergen study in the city of Uberlândia, Brazil, and their usage time was 5 years or less. Composite dust samples were collected from all the seats using a portable vacuum cleaner (Car Vac™ Plus, Black & Decker Inc., Hunt Valley, MD, USA) adapted with a paper filter for dust retention during about 3 minutes for each vehicle (0.5-1.0 g of dust). All sampled seats were upholstered, and their surfaces were lined by cushion and woven fabrics. Two investigators performed all the dust sampling that was stored at 4ºC until further allergen extraction.

ELISA for measuring levels of mite and pet allergens

Group 1 *Dermatophagoides* (Der 1), cat (Fel d 1), and dog (Can f 1) allergens were measured by enzyme-linked immunosorbent assays (ELISA) as described elsewhere [1,5] using their respective capture monoclonal antibodies: anti-Der p 1 (clone 5H8), anti-Der f 1 (6A8), anti-Fel d 1 (6F9), or anti-Can f 1 (6E9F9). The detection antibodies consisted of biotinylated anti-group 1 *Dermatophagoides* allergens (4C1) or anti-Fel d 1 (3E4C4) monoclonal antibodies or polyclonal rabbit serum against Can f 1. Absorbance results were expressed in micrograms per gram of dust as described previously [1], and the detection limit of ELISA was 0.04 μg/g for mite, 0.01 μg/g for Fel d 1 and 0.08 μg/g for Can f 1 allergens. The coefficient of variation of the inter-assays was less than 9% for any allergen.

Statistical analysis

Geometric means (GMs) with 95% confidence intervals (CIs) were obtained for the allergen levels, and the differences between the means were analyzed using the Mann-Whitney and Chi-square tests in statistical analysis.

Results and Discussion

Levels of Der 1 were significantly higher in taxis than private cars (GM: 1.92 μg/g; 95% CI: 1.56-2.35 μg/g *vs* GM: 0.57 μg/g; 95% CI: 0.47-0.70 μg/g of dust; $P < .0001$). Significantly higher percentage of taxis (42%) harboring sensitizing levels of Der 1 compared to private cars (5%) were also found ($P < .0001$) (Fig. 1A,B).

There were interesting differences in pet allergen levels between taxis and private cars. Mean Fel d 1 levels were also higher in taxis than private cars (GM: 0.95 μg/g; 95% CI: 0.70-1.27 μg/g *vs* GM: 0.41; 95% CI: 0.30-0.57 μg/g of dust; $P < .0001$). In spite of the low mean Fel d 1 levels, comparison of the percentage of vehicles with moderate Fel d 1 levels showed significant difference between taxis and private cars (43% *vs* 20%; $P = .0005$). On the other hand, mean Can f 1 levels were significantly higher in private cars compared to taxis (GM: 1.51 μg/g; 95% CI: 0.99-2.31 μg/g *vs* GM: 0.39 μg/g; 95% CI: 0.09-0.43 μg/g of dust; $P < .0001$) concomitant with a significantly higher percentage of private cars containing moderate Can f 1 levels than taxis (53% *vs* 28%; $P = .0003$) (Fig. 1A,B).

In modern society, people spend an increasingly greater part of their time indoors and more than 5% of their time inside transport vehicles [6]. In addition to mite and pet allergen exposure at home, the presence of these allergens in vehicles can contribute to sensitization in susceptible individuals or exacerbation of symptoms in patients with allergic respiratory diseases.

In this study, mean levels of mite allergens detected were close to sensitizing levels in taxis, while levels of cat allergens in private cars and dog allergens in taxis were low. These data showed differences in allergen levels between private cars and public transportation vehicles such as taxis. In our previous study, pet allergens were detected in public transport vehicles, but no comparison of allergen occurrence between public and private vehicles was made [7].

The higher levels of mite allergens in taxis can be explained by the common practice of stationing taxis in shadowy places with windows opened, thus providing more favorable conditions for mite breeding [1]. On the

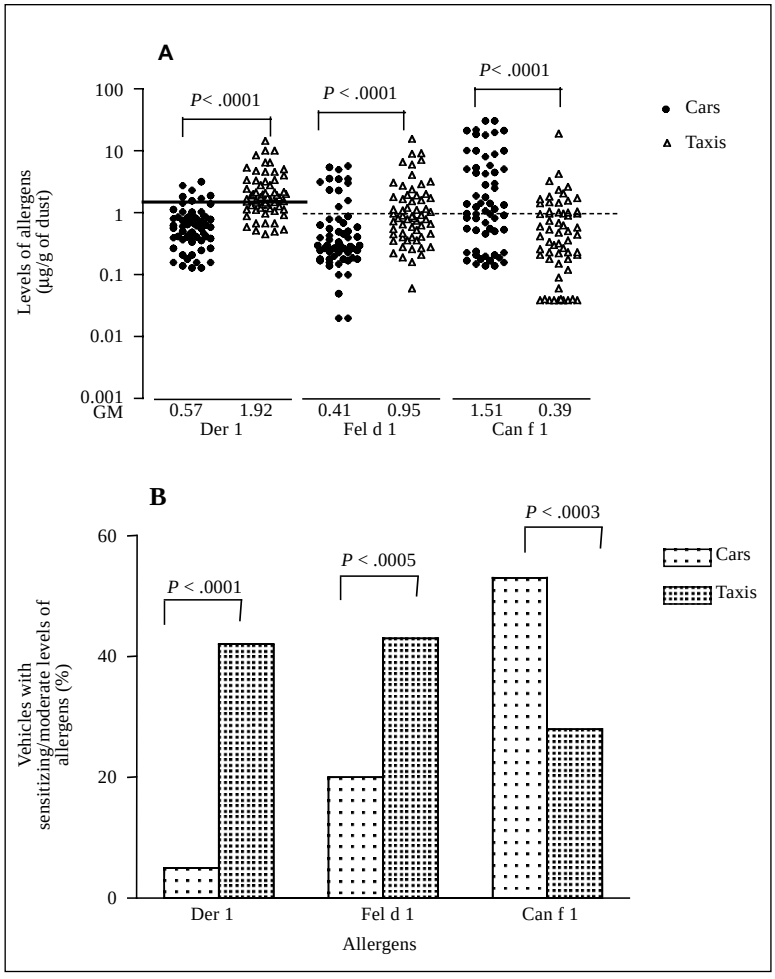

Figure 1. A) Levels of Der 1, Fel d 1 and Can f 1 allergens in dust samples from seats of private cars and taxis. The lines indicate risk factors for sensitization to mite allergens (bold line) and exposure to pet allergens (dashed line). B) Percentage of vehicles with sensitizing levels of group 1 mite (Der 1) and moderate levels of pet (Fel d 1 and Can f 1) allergens in private cars and taxis. GM = geometric mean.

other hand, private cars are commonly stationed in sunny places with windows closed, resulting in excessively high temperatures in the passenger compartment for mite propagation. The presence of moderate levels of cat allergens in taxis may be accounted for by their singular feature of efficient spreading through passive transport on clothing or shoes associated with the high passenger flow in these vehicles. Moderate levels of dog allergens in private cars are likely due to the presence of these pets in homes. As recently reported by Tranter [4] in the school environment, the moderate levels found in our study for pet allergens could represent alternative levels of interest in the transport vehicle environments.

We conclude that upholstered seats from Brazilian taxis but not private cars constitute an important mite allergen reservoir. Thus, additional effective measures for the reduction of mite and pet allergen exposure in vehicles within the global allergen avoidance strategy should also be routinely accomplished to minimize the induction of sensitization and symptoms in allergic patients.

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