Levels of house dust mite allergen in cars

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This small study investigated house dust mite (HDM) allergen levels in cars and their owners’ homes in north-east Scotland. Dust samples from twelve households and cars were collected in a standardised manner. The dust samples were extracted and measured for the Dermatophagoides group 2 allergens (Der p 2 and Der f 2) and total soluble protein. Allergen levels at homes tended to be higher than in the cars, but not significantly. However, they significantly correlated with paired car dust samples expressed either per unit weight of dust or soluble protein (rho=0.657; p=0.02 and 0.769; p=0.003, respectively). This points to house-to-car allergen transfer, with the car allergen levels largely reflecting levels in the owner’s home. Car HDM allergen levels were lower than those reported in Brazil and the USA. Twenty-five percent of the houses and none of the cars had allergen levels in dust greater than 2000 ng g⁻¹. This value is often quoted as a threshold for the risk of sensitisation, although a number of studies report increased risk of sensitisation at lower levels. This small study does not allow for characterisation of the distribution of HDM allergen in vehicles in this geographic area, or of the likely levels in other warmer and more humid areas of the UK. Cars and other vehicles are an under-investigated micro-environment for exposure to allergenic material.

KEY WORDS: Der f 2; Dermatophagoides; Der p 2; Scotland; vehicles
sampling techniques has been fully reported (7), but essentially all household samples were obtained by vacuuming the seat of a well-used lounge chair and nearby floor area for approximately 5 minutes. Car dust samples were obtained by vacuuming the driver’s seat and foot-well.

Dust samples were weighed and extracted for 2 hours by mixing them with 0.1 % Tween 20 (Sigma-Aldrich, Poole, UK) in phosphate buffered saline at 10 % weight/volume ratio. Extracts were centrifuged and the supernatant analysed for Dermatophagoides species group 2 allergens (Der p 2 + Der f 2) using the ELISA kit (Indoor Biotechnology, Cardiff, UK) and total soluble protein using the standard bicinchoninic acid colorimetric assay (Sigma-Aldrich, Poole, UK). The batch-to-batch method imprecision for the allergen and protein methods are 14 % and 10 % respectively. The lower limit of quantification calculated for the allergen assay using ProQuant software (QIVX Inc. Fort Collins, CO, USA) was 2 ng g⁻¹ dust. We measured Der group 2 allergens rather than the more usual Der p 1, as the latter can be underestimated in the presence of bakery/wheat components (9).

RESULTS AND DISCUSSION

The levels of HDM in the 12 bakery households matching the cars were not different from the larger data set of 24 bakery homes.

Measurable levels of the Der group 2 allergens were detected in all dust samples collected from the twelve houses and the matching cars. Their medians (and ranges) were 55 (5-12,863) ng g⁻¹ and 23 (3-454) ng g⁻¹ dust, respectively, or 6.48 (0.28-740.1) and 2.93 (0.14-65.11) when expressed as ng mg⁻¹ soluble protein (Figure 1).

Although allergen levels were higher in house samples expressed either way, these differences did not achieve statistical significance (Friedman test; \( p = 0.082 \) and 0.586, respectively). However, allergen levels correlated significantly between the paired dust samples from cars and houses; Spearman’s coefficients of correlation (rho) were 0.657, \( p = 0.02 \) for the results expressed per gram of dust and 0.769, \( p = 0.0034 \) when expressed per mg of soluble protein (Figure 2).

For the reason noted earlier, we measured Der group 2 rather than the more usual Der p 1. Attempting to convert our results to likely Der p 1 levels can only yield approximate values. Custovic (10) showed good correlation in UK field samples between Der p 1 and p 2, whereby 1 ng of Der p 2 was equivalent to 1.9 ng of Der p 1. Our group 2 measurement also theoretically includes any Der f 2 present, but in the UK D. pteronyssinus is predominant over D. farina. Thus we assume that likely Der p 1 levels are somewhere between the same as, or require doubling of, our measurements.

Justino et al. (6) measured Der group 1 allergens in car dust samples from Brazilian university staff and students, reporting a geometric mean [Der p 1 + Der f 1] of 540 ng g⁻¹ dust. Car allergen levels in our study are lower than these. Neal et al. (5) conducted a study of paired vehicles and homes in Ohio, USA. Their overall means of Der group 1 in houses and vehicles were 25,600 and 1,300 ng g⁻¹ dust, respectively. While Neal et al. (5) presents arithmetic means without any indication of the distribution of allergen data, which were very non-normal in both Justino’s and our study, their results suggest much higher vehicle and household levels of HDM allergens than we report. Interestingly, Neal et al. (5) also found a positive association between house and vehicle allergen levels.
The value of 2000 ng g\(^{-1}\) of Der p 1 in settled dust is often quoted as the threshold for the risk of sensitisation (11). Our data suggest that 25% of the matched households would exceed this. No allergen levels in the cars exceed it, and therefore suggest no risk of sensitisation. However, a number of studies (12-14) show that exposure to allergen levels of less than 2000 ng g\(^{-1}\) can still be a significant sensitisation risk. Dose-response relationships for other outcomes (rhinitis, upper and lower respiratory symptoms) in sensitised individuals are unclear. Therefore, while the health risk in this small vehicle group is probably small, their HDM levels deserve further investigation in a larger UK cohort, particularly if focussed on households that are likely to have high HDM levels. What also deserves further investigation is the use of allergen levels in settled dust as the inhalation exposure metrics for health outcomes (15).

Levels of house dust allergen in a car may reflect the levels of the allergen in the house and the extent of house-to-car transfer. While HDM allergen levels measured in this study in north-east Scotland indicate low risk (18), the small sample size can hardly serve to predict the distribution of HDM allergen, especially the levels that might constitute a health risk. Further investigations of HDM levels (including Der p 1 measurements) in UK households and vehicle dust are warranted, especially where high household HDM levels are likely to be found (i.e. higher ambient temperatures and humidity). Given that the major health risks are due to inhalation rather than indirectly from settled dust content and that airborne HDM allergen derives largely from human activity and disturbance of settled dust, we suggest measuring vehicle airborne allergen levels during real-life use of vehicles. We also hope this study will raise further interest in exposure to allergens and their possible health risks in all forms of transport.

REFERENCES


Figure 2 Correlation between car and house levels of HDM allergens


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Razine alergena prašinskih grinja u automobilima

U ovome smo preliminarnom istraživanju izmjerili razine alergena prašinskih grinja u automobilima i domovima njihovih vlasnika u sjevernoistočnoj Škotskoj. Uzorci prašine uzeti su na standardiziran način iz dvanaest domova i dvanaest uzorka. Nakon ekstrakcije izmjerene su razine 2. skupine alergena grinja (Der f 2 i Der p 2) te njihove ukupne topljive bjelančevine. Razine alergena u kućama bile su niže od onih u automobilima, ali ne značajno. Uočena je međutim značajna korelacija njihovih razina s razinama u automobilima, bez obzira na to jesu li iskazane udjelom težine po gramu prašine ili topljivim bjelančevinama (rho=0,657; p=0,02 odnosno rho=0,003; p=0,005). To upućuje na prijenos alergena iz kuće u auto tj. pokazuje da razine alergena u automobilima odražavaju razine u domovima njihovih vlasnika. Razine alergena kućnih prašinskih grinja u automobilima u Škotskoj bile su niže od onih izmjerjenih u Brazilu i SAD-u. U 25 % domova razina alergena bila je viša od 2000 ng g⁻¹, a u nijem uzorku nije izmjerena razina viša od te. Tu se vrijednost često smatra graničnom za rizik od senzitizacije, premda neka istraživanja govore o povišenom riziku od senzitizacije i prilikom nižim razinama alergena. Rezultati ovog istraživanja ne daju uvid u stvarnu prisutnost alergena kućnih prašinskih grinja u vozilima u sjeveroistočnoj Škotskoj niti upućuju na to koliko bi mogle biti njihove razine u toplijim i vlažnijim krajevima Ujedinjenog Kraljevstva. Automobili i ostala vozila zanemareni su kao izvori izloženosti alergenima.

KLJUČNE RIJEČI: Der f 2; Dermatophagoides; Der p 2; Škotska; vozila