

Airborne exposures to allergen and particles with and without carpeting. (#341)

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RATIONALE:

Health bodies and physicians advising on home allergen avoidance measures for asthmatics recommend removal of fitted carpets. Is this necessarily correct?

METHODS:

Allergen Test Dust (ATD) of known composition was aerosolised into an AC-1 (28.5m³) chamber under controlled conditions. During natural decay, room disturbance and vacuuming, serial airborne particle counts, surface and airborne allergen measurements (augmented ELISA), were undertaken for six different carpets and one hard floor.

RESULTS:

Following ATD introduction and during room disturbance the greatest airborne particle counts (x10⁴/m³) were identified with the hard floor (1.0µm=157.4, >3.0µm=36.6), by comparison with (lowest) Carpet 3 (1.0µm=3.2; >3.0µm=0.50, p<0.01) and (highest) Carpet 2 (1.0µm=44.3; >3.0µm=4.5, p<0.05).

Airborne allergen (*Derp1*) measurements (pg/l) were also greater during room disturbance for the hard floor (74.7) than for Carpet 3 and 2 (55.5; 43.2). Vacuuming exaggerated these differences, hard floor (252.7) versus Carpet 3 (55.5) and Carpet 2 (212.0). By contrast, surface allergen measurement (µg/m²) for the hard floor was reduced by vacuuming (14.4-0.16) while only moderately reduced for Carpet 3 (24.0-11.35) and Carpet 2 (22.5-8.33). Relevant particle counts and airborne allergen levels remained higher for the hard floor than for the carpets post vacuuming. Repeated vacuuming resulted in reduced airborne particles for hard floor and Carpet 2, whereas Carpet 3 was low throughout.

CONCLUSION:

This study raises significant doubts about the assumed relationship between surface and airborne allergen levels. Some carpets act as a reservoir for allergen resulting in increased surface allergen levels, yet reduced airborne exposures during room disturbance. Are such carpets acceptable ?

ABSTRACT

METHODOLOGY

Day 0: Test Carpet (1-6) or HF is laid in AC-1 Chamber. Equilibrated overnight under controlled conditions of 21°C, 55% RH and 1 air change/hour

Day 1 & 2: ATD Introduction x 4 followed by Natural Decay

Day 3 Room Disturbance x 3

Day 3 & 4 Vacuuming x 3 & Room Disturbance x3

Sampling performed at each test stage:

Airborne Particle Counts



Airborne Allergen



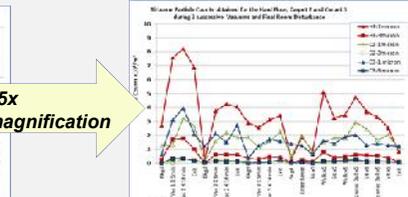
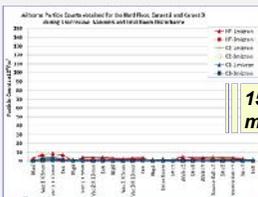
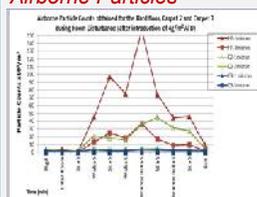
Surface Allergen



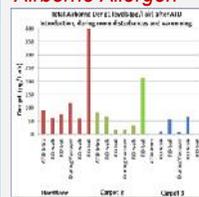
Measure dust mite, cat and pollen allergens via Standard ELISA (Indoor Biotechnologies) or Augmented ELISA (modified in-house)

RESULTS

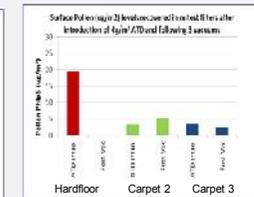
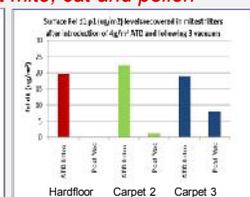
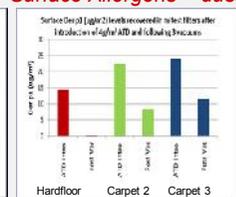
Airborne Particles



Airborne Allergen

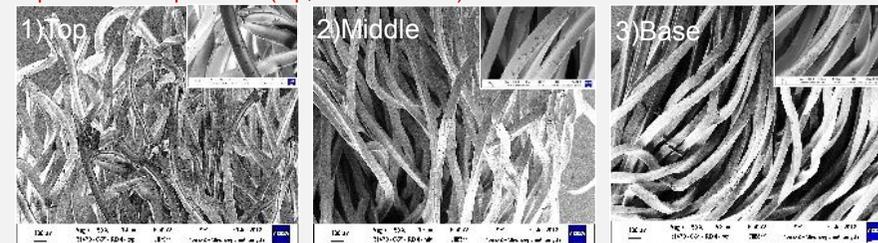


Surface Allergens – dust mite, cat and pollen

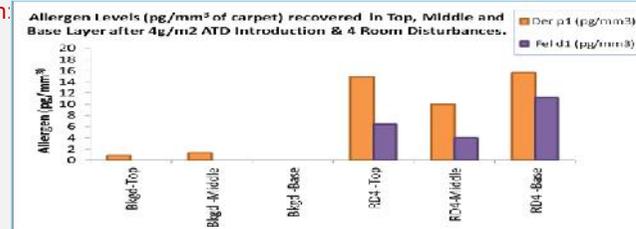


Scanning Electron Microscopy Images (Mag 50x & inset 200x) and Allergen Levels obtained for Carpet 3 at top, middle and base of carpet fibres.

Method: The carpet was loaded with 4g/m² ATD. Images 1-3 were taken at different depths in the carpet fibres (top, middle & base) after 4 room disturbances:



Dust mite and Cat Allergen (pg/mm³carpet) was measured at each carpet depth as shown:



SUMMARY

- This study indicates that different floor coverings have a significant impact on airborne exposure to allergens and particles. These airborne contaminants were consistently lower for the carpets tested compared to the hard floor.
- A carpet's pile height, density and fibre composition influences its particle retention capacity, according to Lewis et al, Causer et al. Carpet 3, a 100% nylon cut pile carpet, performed best during all test stages of this study, with the lowest levels of airborne allergen and particles detected.
- Foarde et al. detected lower airborne bio-pollutants in rooms with carpet compared to hard floors in two schools in North Carolina. In parallel, he obtained higher concentrations of settled dust and allergens in rooms with carpets than with hard floors. This is reportedly due to the trapping and retention characteristics of carpets which keep contaminants and allergens out of the air (Foarde et al, Lewis et al).
- Similarly, we found that Carpet 2 and 3 acted as reservoirs for allergen, leading to increased surface allergen levels detected even after vacuuming. Airborne allergen and particle levels during room disturbance and during vacuuming were reduced for these carpets compared to the hard floor. In support of this, a review by Luedtke cites a number of studies showing that although carpets typically carry higher burdens of contaminants, they do not release significant levels into the air.
- The SEM images of Carpet 3, taken at 3 depths show the effect of room disturbance on the dust distribution (4g/m²) in the carpet fibres. Penetration of particles down to the base of the carpet was observed. The corresponding allergen graph shows that similar concentrations of dust mite and cat allergen were distributed between the top, middle and base of the carpet, following 4 consecutive room disturbances.
- This study raises doubts about the assumed relationship between surface and airborne allergen levels in rooms with carpets and therefore respiratory exposure.

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