

EDITORIAL

On carpets, construction and covers

In my teaching, I sometimes use quotes from two handbooks on hygiene that were published in the early part of the century [1,2]. Both contain rather extensive sections on housing, describing how homes should be constructed, furnished and operated in order to make or keep their inhabitants healthy. The explicit instructions to keep homes dry, well ventilated, and to avoid carpets and heavy curtains one finds in these texts all sound surprisingly modern in view of the current discussions about the influence of housing construction and decoration on the development of allergy. Admittedly, these early worries about housing tended to stem more from concerns about infectious disease and comfort than from concerns about allergy, although Cooke already in 1922 reported the presence of inhalant allergens in house dust [3]. In the same decade, Storm van Leeuwen published his first accounts of the relationship between climatic factors and asthma [4]. Interestingly, one of the specific organisms identified by him as producing triggers for asthma was a mite growing on grain. This was most likely a storage mite, sensitization to which has been shown to be related not only to occupational exposures but also to living in damp homes [5]. In 1928, the German physician Dekker then reported to have observed large numbers of mites in dust collected from mattresses, furniture and carpets, which he clearly associated with asthma and other allergic reactions [6]. Unfortunately, a long period of not-so-benign neglect followed, and the role of dust mites in house dust allergy and asthma was only recognized fully in the 1960s when Voorhorst and coworkers first showed that allergic asthma was more common in damp homes than in dry ones [7], and then that a relatively unknown mite of the genus *Dermatophagoides* was, in fact, responsible for many cases of house dust allergy and asthma [8,9]. Since then, many investigators have tried to find out how exposure to dust mite allergens can be reduced. It is clear that complete avoidance is difficult if not impossible, given that dust mites feed on human skin scales, and prefer temperatures and air humidities that human beings also feel comfortable with. It is also clear that mite allergen levels are much lower at high altitude and in regions with cold winter climates, because the associated extended periods of low outdoor temperatures ensure equally long periods of low indoor humidity in heated homes. Nevertheless, conditions in individual homes within the same climatic region vary sufficiently to produce huge differences in mite infestation. As it is not generally feasible to move to another climate for prophylactic or therapeutic reasons, these variations between homes have generated

hopes for identification of housing factors that could be modified to create houses less conducive to mite growth.

In this issue, Dharmage and colleagues [10] present results of a study conducted in Melbourne, Australia. Mite allergen levels were determined in dust samples collected from bedroom floors and beds from a large number of homes, and then related to residential factors. From a multivariate analysis, the authors conclude that bedrooms with carpets, wooden floors on stumps and weather-board walls had higher mite allergen levels in floor dust and/or mattress dust, and they suggest that it would be useful to construct homes without these characteristics.

To what extent can such recommendations be supported? For mite allergen levels in *floor dust*, the importance of carpets seems clear. Dust from carpets was shown to have far higher mite allergen levels than dust from smooth floors, and this is in line with findings from several other investigators [11–14]. The relatively recent habit of decorating our homes with the efficient dirt (and mite) collectors otherwise known as ‘carpets’ should be opposed far more seriously than we have done so far. Smooth floors are a logical and cost-effective alternative. No changes in building codes or practices are needed for this measure to be implemented. Compared with the effect of carpets on the mite allergen content of floor dust, the effects of other factors were modest at best, rarely giving rise to a difference of more than a factor of two. It is unfortunate that no stratified data were presented by Dharmage *et al.* because now we have no way of knowing whether factors such as home age, home dampness, etc. would have any residual influence on mite allergen levels in dust collected from smooth floors. Data reported from The Netherlands [11] suggest that the influence of residential characteristics on mite allergen levels in dust from smooth floors is limited at best, and this raises the question whether a much stronger emphasis should not be placed on removing carpets rather than suggesting that changes in building practices would have an equally important effect. The second largest effect in the Dharmage *et al.* study was found for observed dampness. Damp or mouldy patches occur in homes that have leaks or water damage, or in homes that are not well ventilated or insulated. A similar relationship between observed dampness and mite allergen levels was noted by several other investigators [11,13,15]. To prevent damp and mouldy patches from developing, the shell of a house needs to be sufficiently insulated to avoid cold spots or ‘bridges’ that attract condensation. The observation of Dharmage *et al.* that homes with timber walls or wooden floors had higher mite allergen levels could be

related to poorer thermal insulation provided by these materials. One could then recommend, as the authors do, to avoid such walls or floors, but an alternative and more mechanistically sound recommendation seems to be that wall and floor structures should be properly insulated — irrespective of the material from which they're made. In our own studies, we found that dust from an insulated wooden floor contained less mite allergen than dust from uninsulated floors [11]. Thermal insulation may inadvertently reduce ventilation, which in turn may increase indoor humidity. Adequate ventilation is therefore needed to ensure removal of the inevitable water vapour produced in homes. Indeed, the rise in mite allergen levels in Swedish homes has been linked to the strong emphasis on energy conservation in that country, and equipment of energy-efficient homes with mechanical ventilation systems was shown to be effective in reducing mite allergen levels [15–17]. Other studies from cool climates have also suggested that mechanical ventilation, probably by providing a larger over-all ventilation rate than natural ventilation, reduces mite allergens [11,18] and may lead to clinical improvement in house dust mite-sensitive patients in the process [19]. However, the effect of increasing ventilation on indoor humidity and, eventually, mite allergen levels depends critically on differences between indoor and outdoor absolute humidity. If these differences are small, as they are in mild or warm, damp climates, increased ventilation does not help [20].

For dust from *mattresses*, the story is slightly different than it is for dust from floors. First of all, we create optimal living conditions for dust mites in mattresses because sleeping on them increases temperature, humidity and food supply. As a consequence, mite allergen levels on dust from mattresses are usually even higher than in dust from carpets, as was observed also by Dharmage *et al.* In the multivariate analysis, relations were found between mite allergen levels in mattress dust and floor construction, age of mattress, having a doona on the bed (a doona is a bed cover filled with feather, down, wool or synthetic fibres), observed mold, and age of the home. The absence of a doona on the bed was the only factor capable of increasing mite allergen levels by a factor of more than two in the multivariate analysis, but this could also have been related to the fact that the investigators vacuumed all bedding items (including doonas) for a total of one minute, which raises the possibility that from beds without doonas, relatively more mattress dust was collected. These findings illustrate the relatively modest effect of all factors investigated. Again, the modest amount of variation in mite allergen levels in mattress dust explained by residential characteristics is in line with observations from other investigators [10,21–23]. It is useful to keep in mind that the seasonal variation in mite allergen levels may easily exceed a factor of two to three when winters are relatively cold [21]. Within most

published studies, mite allergen levels in mattress dust easily varied over two to three orders of magnitude between homes, and one needs to ask whether the small reductions that seem achievable by changing the associated residential factors are worth the bother. In their discussion, Dharmage *et al.* briefly point to the importance of entirely *encasing* mattresses and other bedding with mite-impermeable covers. From the recent literature, this seems to be the one factor capable of reducing mite allergen exposure in the bed dramatically [24,25]. As other recent studies have shown that the risk of sensitization to mite allergen is already increased at very low concentrations [26,27], it seems that we should aim for large reductions of exposure rather than small ones. Given the modest effects that most residential characteristics seem to have on mite allergen levels in floor or mattress dust, one could argue that we need to focus first of all on removing carpets, and on covering mattresses, pillows and bedding. Additional benefits may be expected from adequate ventilation although this depends on the outdoor climate. Ultimately, recommendations to change the construction, decoration or operation of houses to combat allergy should be based on sound, randomized intervention trials. These trials should document clear reductions in exposure to mites, and clinical benefits either in studies among patients or in studies aimed at *preventing* allergy and asthma from developing. Several such trials among patients have been conducted [e.g. 24], and birth cohort studies have started to look into the issue of primary prevention [28]. It seems that cross-sectional studies such as the one presented by Dharmage *et al.* should be looked at primarily as a source of hypotheses to be rigorously tested in such trials, to separate the recommendations that work from the ones that do not.

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