

EDITORIAL

Feather or synthetic? That is the question

The indoor environment of modern homes contains many antigens that can cause allergic disease in susceptible individuals. The major biological sources of allergens in homes are house dust mites, insects (e.g. cockroaches), domestic animals (cats and dogs) and fungi. The term house dust mite usually refers to the mites of the family *Pyroglyphidae*, while domestic mites includes all mite taxa which can be found in homes (this includes *Pyroglyphidae* and storage mites) [1]. Although many different mite species occur in household dust, in most homes pyroglyphid mites constitute more than 90% of the mite population in mattresses and 70% to 95% of the mite population in carpets and upholstered furniture [2].

Dust mites feed on human skin scales, fungi, bacteria and various organic detritus. Van Bronswijk suggested that certain fungi which are present in house dust partially digest human skin scales making them more palatable for mites [3]. However, Douglas and Hart found that enhanced mite population growth after fungi were added to skin scales is not a consequence of fungal predigestion of skin scales, but occurs because fungi are the food source for mites [4].

The abundance of house dust mites in domestic dwellings has been related to a number of environmental factors. Among them, only the effects of temperature and humidity have been studied in detail (summarized in [1]). Even in the regions where climate is conducive for mite population growth there is a great diversity in the mite density between different homes, and between different areas within the same home [5,6]. The reasons for these variations in mite density and species diversity within any geographical area are not fully understood, as no apparent differences in the level of humidity, nor adequacy of food, were found between homes with high and low mite densities (there are suggestions that the protein content of dust may determine the success of mites) [6].

The exact number of house dust mite allergens that are clinically significant has not yet been determined. Seven mite allergens have been included in the 1994 revision of the allergen nomenclature [7], and several others have been reported since then [8,9]. Mite allergens are mainly contained on large particles which are greater than 20 microns in diameter, and which only become airborne during artificial disturbance (e.g. cleaning/vacuuming). In the absence of disturbance, airborne mite allergen is undetectable in most houses [10]. Large amounts of mite allergens are present in bedding, and it is likely that exposure mainly occurs at night in bed in a continuous low dose fashion. This concept is supported by a recent experimental study in

which non-specific bronchial reactivity in mite-allergic patients with asthma deteriorated, and other features of asthma developed, following repeated aerosol exposure to small doses of allergen [11].

House dust mites and asthma

In 1992 Richard Sporik *et al.* [12] wrote an excellent review article in this journal on the subject of the causal relationship between house dust mites and asthma. Since then, sensitization to house dust mites has been confirmed to be a major independent risk factor for asthma in areas where climate is conducive to support mite population growth [13–19]. Furthermore, the relationship between the level of exposure to mite allergens, sensitization and asthma has been investigated with respect to: (1) exposure and development of allergic sensitization; (2) exposure of sensitized individuals and the development of asthma; and (3) exposure and asthma severity in sensitized patients with established disease.

Both prospective [20–22] and cross-sectional studies [23,24] provided a strong epidemiological evidence of a simple dose–response relationship between level of exposure to mite allergens and allergic sensitization. Moreover, some indicated that being exposed to mite allergens puts sensitized individuals at the increased risk of developing asthma [25]. However, there does not appear to be a simple dose–response relationship between exposure to mites, symptoms and objective indices of asthma severity. Most asthmatics are sensitized (and exposed) to more than one allergen, and the relative contribution of each to the airway inflammation and asthma symptoms is unclear. Nevertheless, mite-sensitized asthmatic children have more severe bronchial reactivity when they are living in the areas with the high mite allergen levels, compared with areas where exposure to mites is lower [25]. We have found a modest, but significant correlation between the concentration of mite allergens Der p 1 and Der p 2 in the bed and objective indices of asthma severity (non-specific bronchial hyper-reactivity, lung function (FEV₁) and peak expiratory flow variability) in mite-sensitized adult asthmatics [26].

The increase in asthma prevalence

During the last few decades, many countries in the developed and developing world have experienced an increase in asthma prevalence, and probably atopic sensitization, which cannot be genetic in origin. Over the same period, many

aspects of modern life have changed and many theories advanced to explain this time-related trend in allergies. For example, although factory pollution has declined, motor vehicle pollution has increased. Diet, and in particular food preservation and freshness have changed. Broad-spectrum antibiotics are used throughout life, and are present in much of the food we eat. Extensive vaccination programmes have changed immunity, with fewer natural infections. Our homes have become better insulated and more energy efficient (resulting in a warm and humid environment with low ventilation rates, ideal for house dust mite population growth). Wall-to-wall fitted carpets and vacuum cleaners have become essential components of modern living and provided expanded reservoirs for mite growth. Older vacuum cleaners are one of the very few ways of producing an aerosol of mite allergens (for direct inhalation by the adult doing the cleaning and the child taking the ride on top). The change in asthma prevalence trend can be linked to a possible increase in exposure to allergens in indoor environment. Whilst there is no direct evidence to confirm an increase in dust mite allergen exposure, the indirect evidence is compelling that this could be one of several important cofactors.

Feather versus synthetic

Over the last decade, sales of pillows using synthetic fillings have increased enormously based on the concept that they are non-allergenic (as opposed to feather pillows). Recent data suggest that this is a myth, and that the converse is true.

Allergen levels

Kemp *et al.* [27] have recently compared nine pairs of pillows (one feather and one polyester) which had been used on a same adult bed for more than 6 months, and found an approximately eightfold higher level of total recovered Der p 1 in polyester than feather filled pillows. This finding challenged the wisdom of advising asthmatic patients to avoid using the feather pillows and to replace them with the synthetic ones. A study by Rains *et al.* [28] in this issue of the journal is the logical next step in which the Wellington group investigated the rate of accumulation of Der p 1 on new synthetic and new feather pillow over a 1-year period [28]. Synthetic pillows accumulated mite allergen significantly faster than those filled with feather, and after a 12-month period contained approximately fivefold more Der p 1. This is very similar to our finding in the north-west of England, where although the concentration of Der p 1 in pillows may be 20-fold lower than in New Zealand, non-feather pillows still contained almost five times more allergen than feather pillows [29].

Asthma prevalence

What do feather and synthetic pillows have to do with the increasing asthma prevalence? This is where epidemiology has provided some interesting findings. Butland *et al.* [30] investigated the relationship between changes in the home environment and the increase in childhood wheeze between 1978 and 1991 in 7.5–8.5-year-old children in two population-based case control studies in the London Borough of Croydon [30]. They found a moderate, but significant increase by 20% in the ratio of current wheezers to never wheezers, and an increase of 16% in the 12-month period prevalence of wheezing attacks. The prevalence of wheeze was positively associated with maternal smoking, absence of a father figure and gas cooking, and strongly negatively associated with the use of feather pillows. After adjustment for other variables, gas cooking and the absence of father figure lost significance, whilst the significant inverse association between wheeze and feather pillows persisted. The use of feather pillows appeared to be associated with a reduction in the odds of 36% for infrequent wheeze and 61% for frequent wheeze. Furthermore, when changes in potential risk factors over time were investigated, an observed rise in the use of non-feather pillows from 44% to 67% was estimated to be large enough to explain more than half of the 20% increase in the ratio of current wheezers to never wheezers between 1978 and 1991. We can therefore speculate that the increase in the use of non-feather pillows contributed to the increasing exposure to mites, which in turn could have been partly responsible for the increase in childhood wheezing.

Asthma severity

Until now, there has been little epidemiological evidence of the risks for asthma symptoms associated with high allergen exposure. Strachan and Carey have recently conducted a questionnaire-based case-control study to investigate the effect of the home environment on the risk of severe asthma in 11–16-year-old children in Sheffield [31]. The most powerful risk factors for severe asthma (defined as 12 or more wheezy episodes or a speech-limiting wheeze over the previous 12 months) were pet ownership and non-feather bedding, with a little or no effect of parental smoking, gas cooking and mould growth. Furthermore, the reduction in risk associated with feather pillows increased in strength with increasing severity of wheeze. The authors estimated that if the association between non-feather pillows and severe asthma was causal, it could account for 53% of the severe asthma in the studied population. There is no doubt that pet ownership is a marker for high exposure to pet allergens (homes with pets contain approximately 250-fold higher concentrations

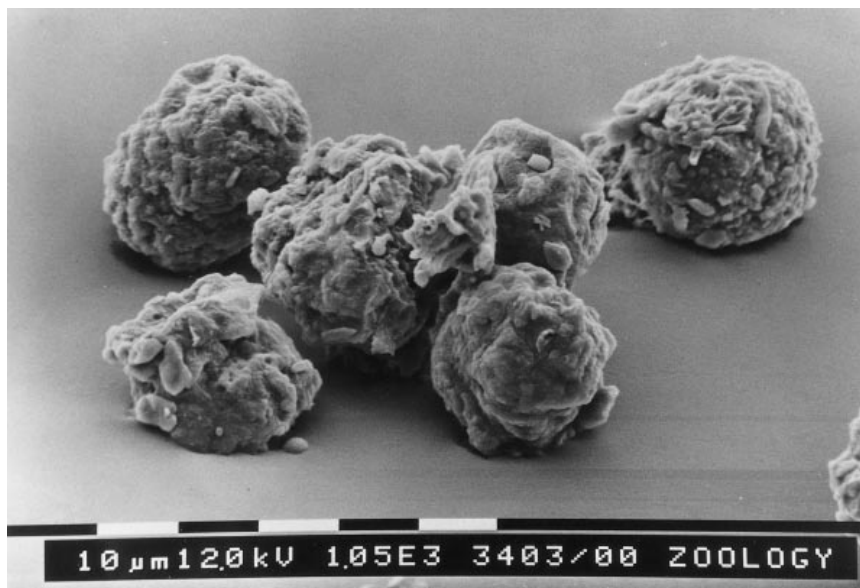


Fig. 1. Mite faecal pellets — the most important source of allergens. (Photograph: B. Hart.)

of pet allergens than those without pets) and, from the allergen data, that non-feather pillows may be a marker for high exposure to mite allergens. Thus the majority of severe childhood asthma can be explained by the high allergen exposure.

Feather or synthetic?

The authors of the article in this month's issue of the journal discuss the possible reasons for the difference in the accumulation and content of mite allergen in feather and synthetic pillows [28]. It is likely that the encasement rather than filling of pillows may be largely responsible for the observed phenomenon. Feather pillows are encased in a tightly woven fabrics to prevent the feathers protruding out, which is not essential for polyester-filled pillows. Thus, such encasements may act as a barrier to prevent house dust mites getting into the pillow and colonizing it, and also to keep the allergen inside the pillow. It has recently been suggested that fine woven fabrics were effective in blocking cat and mite allergen, and that they could be an effective alternative to semipermeable or impermeable materials as allergen barriers [32].

What advice should we be giving to asthmatic patients: feather or synthetic? First, do not spend a fortune on new 'hypoallergenic' synthetic pillows and quilts — they are not. For house dust mite sensitive patients, covering the pillows (along with the mattress and quilt) in mite impermeable covers may prove beneficial. However, for the size of benefit and the type of patient who benefits, we must await the results of large, randomized trials which are currently in progress. As for the increase in the prevalence and severity

of asthma, an increase in house dust mite allergen exposure may still prove important.

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