Principles for concepts of mite-allergen avoidance

Introduction
The prevalence of asthma has increased over the past three decades in industrialised countries (Gaffin and Phipatanakul, 2009). A majority of allergic patients are sensitized to house dust mite-allergens. Avoidance of airborne allergens and irritant triggers (where possible) should be included for management of asthma (Bacharier et al., 2008).

The meta-analysis of Gøtzsche and Johansen (2010) on partial avoidance aimed at reducing exposure to house dust mite-allergen is possible the most referred study on mite-allergen avoidance at EAACI 2010. Gøtzsche and Johansen concluded the interventions being ineffective. Total avoidance is known for its clinical effect (Platts-Mills et al., 1982), however is barely feasible for achieving long-term results (Lynden-van Nes, 1999).

The recently update by Gøtzsche and Johansen comprised only the amendment of the lead author contact details, marking the sparseness of new studies in the field of mite-allergen avoidance. A call is made for new trials including the use of broad in stead of single interventions (Gerth van Wijk, 2010). From environmental viewpoint, conceptual avoidance is the first line design of choice in the field of environmental interventions. Conceptual avoidance is defined as a compilation of interventions aimed at substantial avoidance of exposure from limited textiles of relevance (figure 1). Combinations of partial interventions have been recommended before (e.g. Jooma et al., 1995; Tovey and Marks, 1993), however quantified results on clinical effects are missing.

Figure 1. Chain from indoor environmental quality to allergic symptoms
Conceptual avoidance aims at substantial elimination of the major sources and reservoirs contributing to local exposure.

This report will summarize the results of new studies regarding principles for conceptual interventions and also the introduction of a novel treatment, and speculate on promising opportunities for future research.
**Strategy for avoidance**

A proposed strategy for mite-allergen avoidance comprises: 1. testing of possible sensitizations; 2. assessing of exposure and; 3. exterminating mites by long-term interventions and removing allergenic dust by short-term interventions (Bronswijk, 1993). Total avoidance aims to apply this strategy on all humid pockets available for mites.

**Long-term interventions**

Long-term interventions comprise building construction and humidity management by tenants. A novel development is the application of clean room technology limited to the breathing zone during sleep.

It is well accepted that dry microenvironments limit survival and development of mites. Numerous studies correlated allergen load to single building characteristics or ambient humidity conditions. While a study by Korsgaard (1983) dominates findings in this field, the results are disputable (Cunningham, 1996; Crowther, 2006). The debate regarding Korsgaard’s theory should be considered a call for a shift in theory. This call would include controlling the relative humidity from the microenvironment, which is determined by multiple interacting building characteristics, including heating, thermal quality of the building envelope, air permeability of the ground floor, production of humidity by occupants and ventilation. The findings from two correlation studies on multiple characteristics (Boven, 2010a and Boven 2010b) favour the call for a shift by Cunningham and Crowther. A recent trial (Wright, 2009) on the clinical effect of singular improved ventilation reflects the urge to address this call.

Airsonett developed a temperature controlled laminar airflow (Protexo) aiming to control airborne allergen exposure in the breathing zone during sleep. The principle of Protexo is to displace upward body heat convection by a stable laminar flow of filtered, slightly cooled air in the patient’s breathing zone. Airborne allergen exposure during sleep is mainly emitted from the bedding. After mechanical activation, one may expect that the allergen emissions will not be reduced by Protexo (Freihaut, 2010). Indeed Sigsgaard (2010) presented those emissions from duvet movements were not reduced by Protexo. Dahl and Wickman (2010) presented preliminary clinical results from a one year multi-centre study including around 200 patients with allergic asthma. Although many clinical variables improved, particularly in severe cases, lung function parameters did not improve significant. In a small sample study Ragazzo (2010) found the Protexo treatment to prolong the beneficial effects of a long-term, high-altitude stay in asthmatic children. In addition, Ragazzo did not find differences in lung function.

Another recently developed intervention aiming the control of the breathing zone during sleep is the Purezone Pillow (Stillerman, 2009). The principle of the Purezone Pillow is that HEPA filtered air passes through a mite impermeable pillow case, resulting in a purified breathing zone. In a small sample trial of Purezone Pillow there was a reduction in nasal and ocular symptoms and improvement of quality of life in patients with perennial allergic rhinoconjunctivitis. However, when analyzed from an environmental standpoint, the use of a singular Purezone Pillow neglects allergen emissions from other bed sheets.
Short-term interventions

Short-term interventions comprise intensive special cleaning, removal of textiles and application of impermeable covers, although the latter two could also be noticed long-term-interventions. The meta-analysis of Götzsche and Johansen (2010) looks at short-term interventions in the homes of patients with allergic asthma. Twenty-six trials included the use of impermeable covers. In a preliminary revisit different experimental designs on applying bedding interventions were identified by causal analysis (Boven, 2010c). Preliminary analysis of six trials indicate that natural variation in mite allergen load masks the significance of differences in reduction of mite allergen load by use of a singular bedding intervention. However and not (yet) clinically relevant, when peak flow was partitioned around 3%, a high reduction of mite load was found associated with an increase of peak flow in the morning. The results suggest that when reviewing trials on bedding interventions, clinical benefits have to be evaluated by use of a meta-regression in stead of a meta-analysis because of the different experimental designs.

Discussion

Beddings are an important source of exposure (Platts-Mills et al., 1997). Substantial avoidance of exposure from beddings can only be achieved by conceptual interventions. A load reduction of approximately 80 percent in mite load hypothetically may be achieved by a compilation of three barriers (impermeable cover, regularly vacuuming of cover and frequent hot washing of sheets). When adding a fourth barrier (removal or intensive special cleaning of all other textiles in the bedroom), the load reduction hypothetically may be 90 to 100 percent, which could result in an expected increase of PEFR of more then 3%. Building construction and humidity management play an important role in the long-term contribution of the fourth barrier. With regards to the limitations in feasibility of long-term total avoidance by patients, combining the three-barrier approach with either Protexo or the Purezone Pillow seems most interesting for future research.

Rotterdam, July 20, 2010

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