Taming Indoor Allergy and Asthma Triggers

Beth Israel and Children's Hospital Medical Care Center

Lexington, MA 3/11/01

First presented 3/17/95 as "Couch Potato Asthma," Children's Hospital, Boston

Building occupants in a "sick building" experience symptoms that include respiratory problems, sinus congestion, headaches, mucous membrane irritation, allergies, and asthma. These symptoms can be caused by a variety of bioaerosols.

Cat allergen has been detected in offices and schools as well as in homes. The allergen is usually highest in concentration on clothing and furniture associated with cat owners. Individuals with a high level of sensitivity to cat or mite allergen can react very strongly to students or co-workers carrying allergens in their hair or clothing. Building occupants themselves are the source of other contaminants, including volatile organic compounds (VOCs), carbon dioxide, bacteria, viruses, and skin scales.

Skin scales (and pet dander, if pets are present) often make up the bulk of visible dust in the air and on surfaces, as well as concealed particulates in carpets, ducts, and "fleecy" furniture. Skin scales are the primary food source for a complex indoor ecosystem whose inhabitants include numerous organisms such as mold, bacteria and insects.

The single most important additional and necessary component of the indoor ecosystem is water, either from human sweat, leaks, or extracted directly or condensed from atmospheric moisture. Without water, the ecosystem does not develop; with an abundance of moisture, mold, bacteria and insects flourish in their appropriate niches and become the source of odors, irritants, allergens, and asthma triggers. A child sitting endless hours in a stuffed chair playing TV/video games incubates crumbs and skin scales, possibly creating conditions within the cushions which foster the growth of microbiological organisms and dust mites. These are the children who are vulnerable to "couch potato asthma," as are parents who may still be sleeping on the same pillow since childhood. The asthma population has almost doubled in the last decade, and over 50% of asthmatics are allergic to dust mites; exposure to dust mite fecal pellets may actually be a cause of asthma. Dust mite allergen has been detected in office settings and schools as well as in homes, and it is probable that the fecal pellets and body parts (such as hairs) of other insects that abound in the indoor ecosystem are also allergens and/or irritants.

The mixture of moisture and dust, whether present in a pillow, a couch, a damp basement, a room humidifier, or on walls and ceilings, will most likely result in the development of a microscopic ecosystem. And in conditions of high relative humidity and in the absence of any liquid water, accumulated skin scales on basement baseboard convectors or in unit ventilators, as well as in water reservoirs of HVAC (heating, ventilation, and air conditioning) equipment and refrigeration

equipment, can supply the nutrients for mold. Contrary to common belief, the mite diet includes more than skin scales. Not surprisingly, wherever I find mold growing in a house, even on a bathroom ceilings or a basement wall, I find mites foraging. Booklice and carpet beetles also feed on the mold spores and/or directly on the skin scales. These insects are consumed by spiders which, like mites, may be associated with potent, allergenic fecal material.

The long-term effects of low exposures to most mold toxins are not known for certain, though recent studies in office settings have associated chronic fatigue syndrome (CFS) with exposure to mold metabolites and mycotoxins. Other office worker symptoms include adverse central nervous system effects, eye and skin irritation, and upper or lower respiratory irritation. A recent outbreak of mold-related illness after Midwest flooding may have resulted in acute symptoms in 20 children, and in one death. The presence of mold growth on building surfaces should be taken seriously, as it may be a source of spores containing potent mycotoxins.

The problem areas in homes and buildings most likely to be bioaerosol sources are:

1. humidifiers, (HVAC) equipment, and associated air ducts
2. basement floor and wall surfaces near the foundation walls
3. parts of exhaust-only systems, such as those associated with bath or clothing dryer hoses
4. carpeting, particularly in basements and entry areas subject to wetting from foot traffic or repeated washing.

Carpeting and associated pads (particularly jute) that have been wet from flooding or washing more than once can be a source of severe building contamination. (Seemingly new or clean carpeting can have padding contaminated with mold or bacteria which is aerosolized during carpet disturbances from normal activity.) If the humidity is adequately high, even carpeting that has never been wet can be overgrown with mold that is digesting clumps of skin scales in the carpet. In a contaminated carpet, normal activities such as walking and play may kill microscopic insects. But insect body parts and fecal pellets, along with mold spores and bacteria if present, can still become airborne and settle on other surfaces which can act as additional reservoirs and sources. In addition to housing biological growth, some types of carpet pads and tightly-woven, worn wool carpeting may be a source of respirable irritants from frayed and fractured fiber-ends. Since the likelihood is so significant that carpet particulates will be allergens or irritants, it is my opinion that in the homes of asthmatics, only high efficiency particulate arrestance (HEPA) vacuum cleaners should be used. In an ideal world, all fleecy-surface cleaning, particularly in hospitals and buildings with carpeting, would be done with HEPA vacuums.

Occupants with building-related symptoms may be reactive to any number of a host of airborne particulates or allergens, few if any of which are detectable by any means other than the exposed individual's own immune system. The air sampler that I find most useful is the Burkard Personal Air

Sampler. This palm-sized unit takes in air at about 10 liters per minute and deposits airborne particulates onto a thin film of grease on a microscope slide. The sample is stained and observed under a microscope. Another useful sampler, the Andersen, collects particulates on a petri dish but only detects culturable mold spores and may underestimate spore concentrations by a factor of 10 to 100, depending on how old the spores are.

Visual microscopy of air and bulk samples provides many clues but cannot detect sub-micron fragments of partially degraded materials that may be coated with allergenic proteins, such as microbe-produced waste products, exocellular enzymes and adhesion proteins. The proteinase allergen present on mite fecal pellets can only be detected with an immunoassay (available from DACI: 1-800-344-3224) of a collected dust sample; gram-negative bacterial endotoxin can only be detected by a more costly assay. Fractured particulates that appear to have originated from dried-out solids in water reservoirs appear in air samples, but their actual source, allergenicity or identity cannot be determined with any certainty.