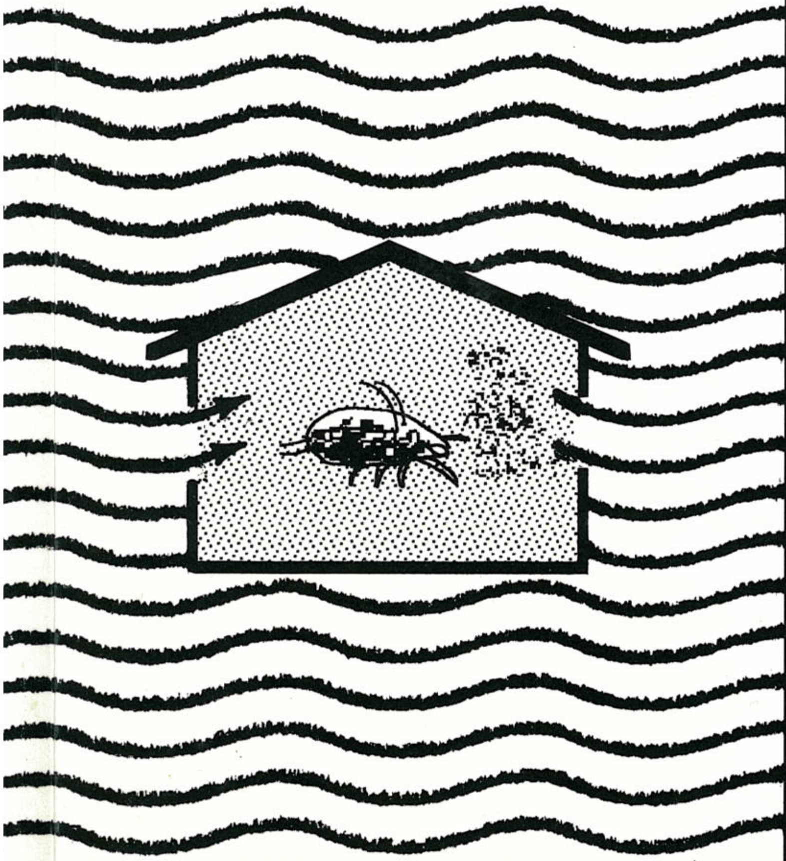


MITES, ASTHMA AND DOMESTIC DESIGN

A conference to explore the potential of domestic design to reduce the prevalence and severity of asthma in Australia.

Sydney, March 1993

ALLERGEN FREE HOUSING IN DENMARK

Jens Korsgaard

Bronchial asthma is a chronic airway disease which runs over years with relapses and remissions and differs in severity from patient to patient, from a few attacks every month to daily debilitating attacks. The group most affected by bronchial asthma is mainly young and middle-aged people, in other words, people in active employment, so the costs of sick leave etc. makes bronchial asthma a very expensive disease for society.

Let's look at the environment and bronchial asthma caused by exposure to house-dust mites in dwellings. In one way it is a very simple problem we are facing, as shown by a survey carried out in a Canadian study (Murray et al. 1984) where a group of asthmatic children living in Vancouver were compared with another group of asthmatic children living in a town on the other side of the Rocky Mountains. The two populations were identical with respect to racial composition, age etc. When allergy tested these two groups were very different with a prevalence of mite allergy in Vancouver of 50% compared to only 3% on the other side of the Rocky Mountains. So the Rocky Mountains imply a 20-fold decrease in the occurrence of house-dust mite allergy. The most likely explanation for this very large difference in disease incidence is the climatic conditions at the two sites. In Vancouver you have the western wind coming in from the Pacific Ocean, this is humid and leaves the Vancouver area with the humid outdoor air. When the wind rises over the the Rocky Mountains it cools off and gives off its humidity as rain or snow with a resulting low humidity to the east of the mountains.

This is only one of more than 100 studies describing differences in mite allergy in relation to differences in climate. These studies illustrate the crucial importance of climate and humidity with respect to the resulting exposure to house-dust mites and frequency of mite allergy in the population.

We can define low housing risk levels of mite exposure. This is done by case control studies, typically comparing a group of patients with mite allergy and a group of healthy control persons. One such study of 25 asthmatic patients assessed their exposure to house-dust mites in their own homes. The asthmatics exposure to house-dust mites in mattress dust, in dust from bedroom floor and in dust from living room floor was very much higher than the healthy controls. This shows that it is not a genetic phenomenon that you develop dust mite asthma - it is an environmental phenomenon. It is the high exposure of patients in dwellings that leads to the occurrence of mite asthma. To put it more clearly, we can from these exposure data calculate the relevant disease risk associated with different exposure levels in houses - if you are exposed to a concentration of house-dust mites of 10 or below per 0.10 gram mattress dust this implies a relative disease risk of 1.0. This means that you have no increased disease risk in your present dwelling. If you live in a house with a moderate (11 to 100 house-dust mites per 0.10 gram mattress dust) exposure, your disease risk in that household is increased fivefold. And lastly, if you live in the highest exposure group, your disease risk for developing mite asthma is increased over eightfold. The magnitude of the latter compares directly to the increased relative disease risk in tobacco smokers with respect to the risk of developing lung cancer.

From these exposure data we can define a Threshold Limit Value of the maximum exposure to house-dust mites in dwellings, and if you want to avoid an increased disease risk, this TLV is a maximum exposure of 10 mites per 0.10 gram dust.

In the 1990's four studies have elaborated on the association of exposure to house-dust mites and the risk of developing asthma. Five other studies have associated mite exposure with the risk of developing a positive allergy test towards extracts of mites. And lastly, there are three different

Jens Korsgaard is a Chest Physician who has pioneered studies of allergen avoidance, the role of mite allergy in asthma and of low mite -allergy housing.

studies where, through environmental changes, people have achieved a dramatic decrease in asthmatic symptoms in mite allergy patients. From these three studies we can make a guess at the levels of exposure that would imply a sick person to become healthy.

The message from all these studies is that the value to aim at, when you want to prevent disease or you want to cure already existing disease, is 100 mites per gram dust (10 mites per 0.10 g), which is equivalent to an antigen level in dust of 2 micrograms per gram. This TLV is internationally accepted in World Health Organisation (WHO).

There is only one factor in modern housing which associates with the number of mites found, and that is the absolute indoor air humidity in three critical dry winter months.

If, in the northern hemisphere, in January and February there is a low indoor air humidity, there will be a concentration of mites in mattress dust below the TLV of 100 mites per gram dust. If there is a moderate high indoor air humidity, there will be a moderate exposure to house-dust mites. the highest humidity will mean the highest exposure.

It is now possible to transform the TLV of mite exposure of 100 per gram dust to a maximum allowable indoor air absolute humidity in winter of 7.0 g water vapour per kg dry air. This humidity limit is internationally recognised and has been tested in several studies. So the conclusion on mites and humidity is to aim for a maximum indoor air humidity of 7.0 g/kg which corresponds to a maximum relative humidity of 45% at indoor temperatures of 20-22 oC.

The most important construction factor of modern housing leading to high indoor air humidity is tightness of the building envelope. If we take a closer look at the relation between building tightness and indoor air humidity we are dealing with a situation where the net result of humidity production by the inhabitants themselves and their indoor activities and humidity removal by ventilation determines the resulting level of indoor air humidity.

To take an example, a family of four have an average water vapour production of 12 litres per 24 hours in their home. Water vapour produced indoors is removed by ventilation, humid indoor air is exchanged with dry outdoor air. If you know the average water vapour content of the outdoor air in winter you can calculate, provided steady state conditions, the resulting indoor air humidity with different levels of ventilation. You can transform your maximum indoor air humidity in winter to a minimum ventilation rate for a family to have an indoor humidity below 7 g/kg. In Denmark with an average outdoor humidity of 4 g/kg a family of four in a house of 100 m2 will need a minimum ventilation in the range of 0.7 air changes per hour, so, with security limits, we would advocate a minimum ventilation of 1.0 ach.

In practice, charts have been constructed to estimate the needed minimum ventilation in a given family from known information about number of inhabitants in the family and the size of the individual dwelling. The charts are geographic specific in dependence of the average outdoor air humidity in a given area.

As to the effects of ventilation in relation to mite allergy this has been assessed by the investigation of 13 patients with mite asthma in comparison with a control group of 13 patients. The study group was moved into new houses equipped with mechanical ventilation, and the ventilation rate, occurrence of house-dust mites and disease activity were measured.

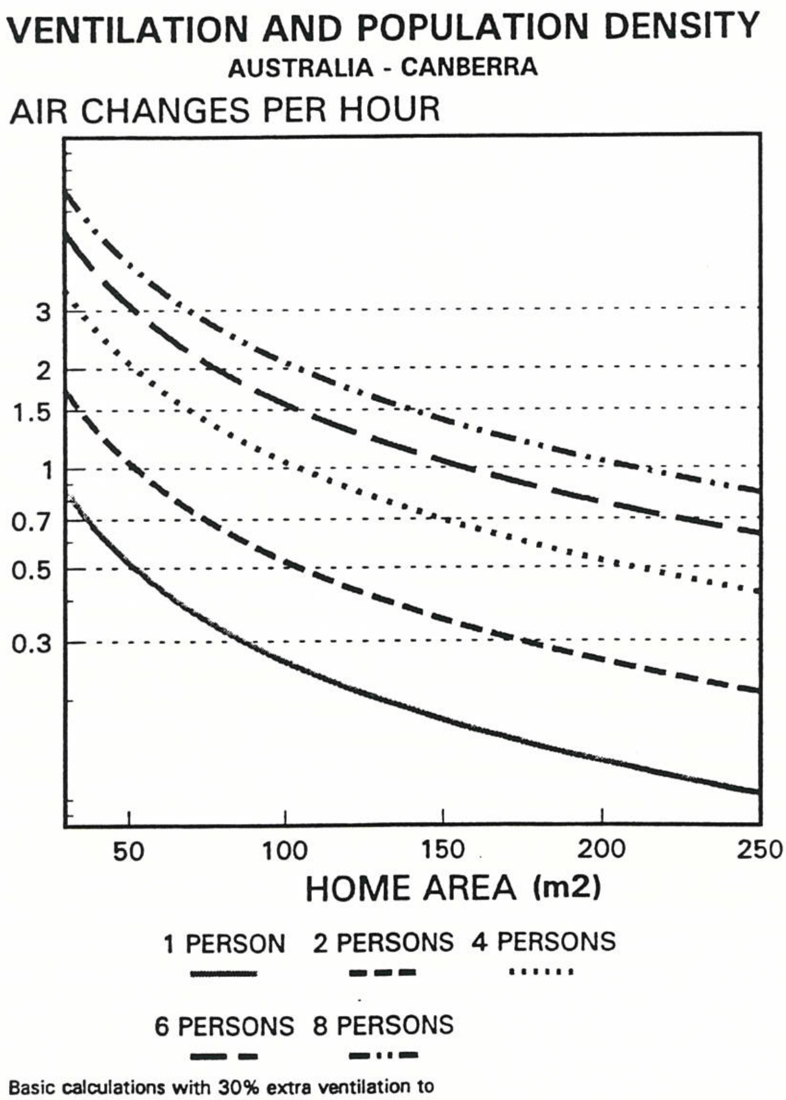
To summarize the results, the expected increase in ventilation rate occurred in the study group from 1984-85 where the mean ventilation rate in the study group increased to 1.25 and no one in the study group had an air exchange below 1.0. Secondly, the mite concentrations in the study group decreased from an average of 20 to around 2, which means that the concentration of mites after ventilation was reduced to 10% of the starting value. The key clinical results documented an increase in basic lung function of 30% when the study and control group were compared. This was paralleled by a decrease in the use of medicine of 60% - a dramatic effect of environmental treatment of mite allergy.

Conclusion.
A maximum indoor air humidity of 7 g/kg (45% relative humidity) in winter corresponds to a minimum ventilation defined in relation to size of dwelling, family size and outdoor humidity. It also depends on where you are located in the world. If you want a weather stable increased ventilation with low heating energy costs, and no thermal side effects ie. draughts, this implies the need for mechanical ventilation with heat exchange.

The outdoor climate in Australia is in most areas much more humid than corresponding conditions in the north of Europe. This implies that a sufficient low indoor air humidity in winter is not obtainable by ventilation alone. A relevant climate therapy in Australia would thus require some sort of dehumidification in combination with increased ventilation. In Canberra, with an average outdoor absolute humidity of 4,5 g/kg in the three dry winter months, ventilation alone could decrease indoor humidity below 7,0 g/kg while the Sydney area with an average outdoor absolute humidity of 6.0 in June, July and August is borderline (shown below).

....

The figure below shows estimated rates of ventilation required to maintain microclimates which are not conducive to mite proliferation for the driest portion of the year. These calculations have been made on the basis of outdoor meteorological data for Canberra and Sydney for dwellings with different floor areas and numbers of occupants.



Basic calculations with 30% extra ventilation to achieve sufficient ventilation with varying habits with relation to humidity production

Dr Derek Maelzer
Department of Crop Protection
Waige Agricultural Research Institute
University of Adelaide
Glen Osmond SA 5064
Ph. 08 372-2269 Fx. 08 379-4095
Area of interest
Biological control, integrated pest management and population dynamics of scale insects&aphids

Miss Ajsa Mahmic
Department of Medicine
University of Sydney, D06
Sydney NSW 2006
Ph. 692-2093 Fx.
Area of interest
Mites and asthma

Mr Paul McGregor
Australian Inst. Refrig. & Air Con. Engineering
Suite 5, 110 Willoughby Rd
Lane Cove N.S.W. 2065
Ph. 906-4177 Fx. 906-7984
Area of interest
Air conditioning, ventilation & indoor air quality

Dr Craig Mellis
Dept of Respiratory Medicine
Royal Prince Alfred Hospital
Missenden Rd
Camperdown NSW 2050
Ph. 692-6827 Fx. 519-6986
Area of interest
Paediatric asthma and epidemiology, costs.

Prof Peter Miller
Bioscience Unit
UTS
PO BOX 123
Broadway NSW 2007
Ph. 3302229 Fx. (02) 330-2228
Area of interest
Urban entomology

Mr Dieter Mylius
Advisory Services
The Building Centre/Sydney Building Inf. Centre
P.O. BOX 33
Strawberry Hills N.S.W. 2012
Ph. 319-1333 Fx. 698-8081
Area of interest
Humidity in houses

Mr Stuart Nicolson
SANDOZ Australia PTY LTD
P.O. BOX 23
Chadstone Victoria 3148
Ph. (03) 254-1000 Fx. (03) 254-1010
Area of interest
Textile treatment for mite prevention

Dr Stephen Nogrady
Dept. of Thoracic Medicine
Woden Valley Hospital
Woden
Canberra ACT 2606
Ph. (062) 44-2066 Fx. (062) 44--2604
Area of interest
Clinical asthma, primary sensitisation- home design

Mr Henry Okraglik
Centre for Design
R. M.I.T.
Swanson St GPO BOX 2476V'
Melbourne Vic. 3000
Ph. 03 660-3482 Fx. 03 663-2891
Area of interest
Building and interior design

Ms Jenny Peat
Department of Medicine
University of Sydney, D06
Sydney NSW 2006
Ph. 516 8631 Fx. 516 8528
Area of interest
Epidemiology- asthma prevalence and aetiology

Mr Bryce Peters
Bioscience Unit
UTS
PO BOX 123 Broadway
Sydney NSW 2007
Ph. 330-2233 Fx. 330-2228
Area of interest
Urban entomology

Mr Paul Pholeros
Healthabitat
PO BOX 495
Newport Beach Sydney 2106
Ph. 973-1316 Fx. 973-1316
Area of interest
Health and housing

* **About 1 million Australians have non-trivial asthma**

* **There is increasing evidence of a causal link between increased exposure to mite allergens and the prevalence and severity of asthma**

* **Large reductions in allergens can reduce symptoms in people with asthma**

* **"Hygiene" methods of allergen control have generally not been effective at producing large reductions in mite allergens**

* **Coastal Australia has the highest levels of mite allergens recorded anywhere so far**

* **These high levels are likely to be a consequence of the way we build, furnish and live in houses**

* **Appropriate design of houses and furnishings has the potential to massively reduce our exposure to mite allergens**

"A concerted research effort is needed... [to understand the part played by domestic mites in allergic diseases] ... also to continue efforts designed to reduce the levels of mite allergens to which the population is exposed. This will be one of the greatest challenges of environmental medicine in the coming decade, but if effective one that is likely to yield great benefits."

Editorial, Thorax 48:5-9. (1993).