

Seasonal asthma and the house-dust mite in tropical Africa

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Summary

The relationship between seasonal asthma and sensitivity to the house-dust mite has been investigated in a country with large seasonal variations in relative humidity.

Of seventy-eight African asthmatics, 64.1% gave a history probably suggestive of sensitivity to house-dust, and 55.1% a history strongly suggestive of such sensitivity. On skin testing, 35.9% had strong reactions to the house-dust mite *Dermatophagoides pteronyssinus*, compared with 1.9% of fifty-one matched controls without symptoms of chest disease. Few had either a history or skin tests suggestive of pollen or mould sensitivity. Most of the asthmatics were worse during the hot, wet season when the humidity is highest. This is also the time when in-patient asthmatics are most numerous.

D. pteronyssinus grows well in warm, damp conditions and it is suggested that sensitivity to this mite may play a significant role in the marked seasonal changes seen in our asthmatic patients.

Introduction

Sensitivity to the house-dust mite *Dermatophagoides pteronyssinus* is an important cause of asthma in many parts of the world (*British Medical Journal*, 1971). Growth of this mite is known to be mainly dependent on changes in relative humidity, but also to a lesser extent on changes in temperature. Spieksma, Zuidema & Leupen (1971) found that the mite grows best at high humidity levels and at a temperature of about 25°C. They found a correlation between mite counts and the degree of dampness of houses in the Netherlands and low counts in the mountains of Switzerland, attributable to the low humidity in the air at that altitude. This last fact is thought to explain the symptomatic improvement in many asthmatics while living in the Swiss Alps. Findings were similar in houses in Finland (Stenius & Cunningham, 1972), but not in the U.K. (Maunsell, Wraith & Cunningham, 1968).

In Rhodesia nearly all the rainfall occurs from November to March, which is also the hot season. During this time, therefore, conditions for mite growth should be ideal. Consequently we thought it worthwhile to investigate the relationship between atmos-

pheric humidity, a history of seasonal asthma, and allergy to *D. pteronyssinus* in a group of African asthmatics.

Patients and methods

Asthmatics were selected from patients attending a respiratory disease clinic at Harare Hospital* during the period October 1973 to September 1974. Referral to this clinic occurs from a variety of sources; hospital doctors, municipal and industrial clinics, rural clinics and private practitioners.

An historical questionnaire in use at the Brompton Hospital, London, with minor modifications for local conditions, was used. To ensure uniformity one of us (J.B.C.) conducted all the interviews. An interpreter was needed for about half the patients, but the same one was used throughout.

A patient was diagnosed as asthmatic if there was a history of wheezy breathlessness varying either spontaneously or as a result of treatment, and if significant variability of airways obstruction was demonstrated on lung function testing. This was done by measuring the vital capacity (VC) and forced expiratory volume in 1 s (FEV₁) using a Vitalograph spirometer (Vitalograph Ltd). Each test was performed before and after inhalation of salbutamol and at each follow-up visit. The maximal change in the FEV₁ in each patient was calculated and expressed as a percentage of the first of the two recordings used in the calculation. If this was 15% or greater, or failing this, if the FEV₁ came within 2 s.d. of the predicted value for that patient (indicating that no further change could be expected), he was included in the study. Prediction values used were those drawn up for this population (Cookson, Blake & Faranisi, 1974). In most patients the diagnosis was supported by a clinical record of wheeze and breathlessness responding to specific therapy.

Skin tests against various substances were carried out by the prick method, using commercially available antigens (Bencard Ltd). Selection of antigens was based on the history, but always included the house-dust mite *D. pteronyssinus* and usually house dust, and a variety of pollens, animal danders, foods and moulds. Pollen antigens were from grasses, trees, shrubs and flowers, found commonly in South Africa and Rhodesia. Weals produced were measured in millimetres and the size of the control weals subtracted. A matched control series of fifty-one subjects, without symptoms of chest disease, was taken from patients attending the outpatient department of the hospital, and was similarly tested.

Other investigations performed in all the asthmatics were chest X-ray and blood eosinophil counts.

Monthly mean relative humidity levels for the Salisbury area were obtained from the Department of Meteorological Services for the period October 1969 to September 1974, and the average values for each month of the year calculated.

The number of in-patients discharged from the hospital each month with a diagnosis of asthma, for the period October 1969 to September 1974, were obtained from the hospital records. The average number for each month of the year was then calculated.

Results

A total of seventy-eight African asthmatics (forty-five males and thirty-three females) were identified and fully investigated. Their age range was from 9–60 years with an average of 34.8 years. The age of onset of symptoms varied from under 1 to 56 years

* The community hospital for the African population of Salisbury (altitude 1524 m), and the referral hospital for most of the northern half of the country.

with a mean of 26.8 years. In 80.8% of the patients a change in the FEV₁ of 15% or more was demonstrated.

On history taking, forty-three patients (55.1%) claimed that their asthma was worse when their house was swept or dusted, fifty (64.1%) were worse inside their house rather than outside, and seventy-four (94.8%) were worse at night. Only ten patients (12.8%) thought they were sensitive to grass pollens and only five to shrub and flower pollens. Very few patients were sensitive to other allergens.

When questioned about seasonal changes in their symptoms, sixty-three patients (80.8%) thought they were worse during certain times of the year. The remainder considered either that their symptoms were similar all the year round (nine patients), or that the onset of their asthma was too recent for a seasonal incidence to be demonstrable (six patients). The results obtained when the sixty-three patients with seasonal asthma were asked what time of the year they were worse, are shown in the lower part of Fig. 1. This shows the number of patients worse in each month, expressed as a percentage of all these seasonal asthmatics. The middle part of the figure shows the number of discharges from the hospital for asthma for each month, averaged for the

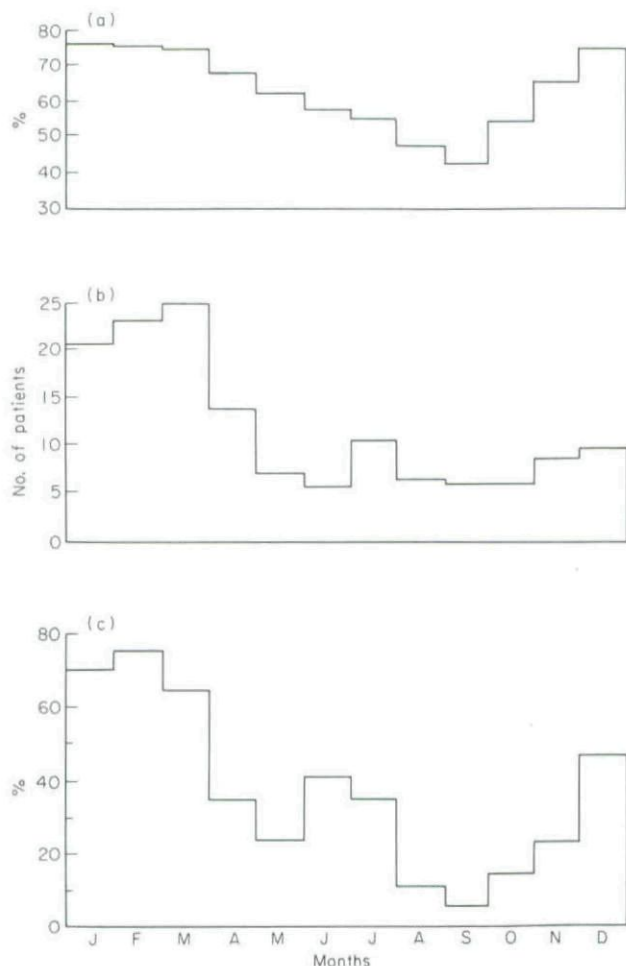


Fig. 1. Comparison of (a) relative humidity, (b) hospital discharge rates for asthma, and (c) the percentage of seasonal asthmatics worse in each month of the year.

period October 1969 to September 1974. The top part of the figure shows the relative humidity in Salisbury for each month, again averaged over the same period. It will be seen that there is a marked correlation between relative humidity, discharge rates from hospital, and the seasonal history obtained from our patients. Although several patients had symptoms when the humidity was both high and low, only two had symptoms only when it was low.

On skin testing, 35.9% of the seventy-eight patients tested had significant (more than 5 mm diam.) reactions to *D. pteronyssinus*, compared with 1.9% of the controls. This difference is highly significant statistically ($P < 0.0005$). Of the sixty-nine patients tested with house-dust allergen 14.4% had significant reactions compared with 3.9% of the controls. This, however, is not significant ($P < 0.1$). The only other significant reactions were in five patients who reacted to cat or dog dander.

None of the patients, or the controls, had significant reactions to grass, tree, shrub or flower pollens, to moulds or to any of the other antigens. Many patients had positive skin reactions between 1 and 4 mm in diam. to these antigens; however, only in the case of shrub and flower pollens and *Alternaria* were these statistically significantly more common than in the controls. In the case of *D. pteronyssinus* however, reactions of this size occurred in all but seven of the fifty patients who did not have significant reactions—a highly significant difference from the controls.

There was no statistical correlation between a history of attacks during sweeping or dusting and a significant reaction to *D. pteronyssinus*. However, when the six patients with recent onset of asthma were excluded, there was a significant relationship between symptoms during months of high humidity and both precipitation of attacks by sweeping and dusting ($P < 0.005$) and positive reactions (≥ 1 mm) to *D. pteronyssinus* ($P < 0.01$). There was no relationship between a significant skin reaction and seasonal symptoms.

Blood eosinophil counts of greater than 500/mm³ were present in thirty-four asthmatics.

Discussion

These results suggest, firstly, that sensitivity to the house-dust mite is a major feature in the asthmatic patients examined. Although on history taking only 53% said they were worse when their house was being swept and dusted, this is a difficult question for some patients, especially men, to answer and more (64%) were worse inside the house and almost all (94%) were worse at night. This latter symptom is said to indicate sensitivity to the house-dust mite, which feeds on human skin scales and therefore lives predominantly in bedding. The other striking feature in the history was the small number of patients sensitive to pollens and other allergens.

On skin testing, the only allergens producing significant weals in more than a few patients were *D. pteronyssinus* and house-dust, with a striking absence of reactions to pollens or moulds.

The lack of correlation between significant reactions to *D. pteronyssinus* and a history of attacks during sweeping and dusting, may indeed mean that there is no such relationship, but more probably indicates both that smaller skin reactions are important, and that this particular question is inadequate.

Although *D. culinae* (identical with, or related to, *D. farinae*) seems to be the predominant mite in some parts of the world, Pepys, Chan & Hargreave (1968) have shown marked cross reactivity between it and *D. pteronyssinus*. We are therefore unlikely to have missed sensitivity to this mite.

That our patients' symptoms are worse during the rains, when humidity is high, suggests that either pollens or moulds might be responsible. Pollen counts have not been carried out in Salisbury but they have been done by Ordman (1972) in Bulawayo, about 300 miles south of Salisbury. He found that pollen counts (mainly grasses, cypress and pine), and fungi (mainly *Cladosporium*, *Rusts*, *Smuts* and *Alternaria*) were, in general, indeed higher during the rains. However, the negative histories and skin tests make these unlikely causes in our patients.

Alternatively, the house-dust mite could be the principal allergen and cause seasonal symptoms because it is more common when the humidity is high. Spieksma *et al.* (1971) found that the mite grows best at a temperature of 25°C and a relative humidity of between 70 and 80%. It stops growing and dies out when the humidity falls below 60%.

In Rhodesia the rains fall almost entirely from November to March. The hot season runs from October to April with average maximum temperatures between 22 and 27°C. The figure shows that the months when the humidity is between 70 and 80% and the temperature is high, coincide with the months when asthmatic symptoms are most common and asthmatic in-patients most numerous.

The lack of correlation between significant skin reactions to *D. pteronyssinus* and seasonal symptoms, again suggests that weals smaller than 5 mm are important. It is also possible that enough mites remain, even in times of low humidity, to precipitate asthma in very sensitive individuals.

It would have been of interest to demonstrate a rise in the mite count during these wet months, but there can be no doubt that they do at least exist, as our patients would not otherwise show skin reactivity.

Many aspects of mite sensitivity in Europe and America have been reviewed recently (*British Medical Journal*, 1971). In the U.K., Smith (1970) found that asthma due to the mite tends to be perennial, probably because of a high humidity throughout the year and heating of houses to maintain an even temperature. In the Netherlands, however, Voorhorst *et al.* (1967) found moderate increases in mite counts in September and October, paralleled by an increase in asthmatic symptoms. Domrow (1970) from Australia, however, found no such relationship.

In Africa, several studies have implicated the mite in causing asthma. Ordman (1971), in South Africa, found in coastal regions, both that mites were more common, and that more asthmatics were sensitive to them. These patients tended to improve on moving away from the coast to where the air was drier. However some inland places had high humidity levels and high mite counts.

Buchanan & Jones (1974) from Zambia, skin tested 100 asthmatics against both *D. pteronyssinus* and *D. farinae* and examined dust from their homes for mites. They found that skin reactions were significantly more common with both allergens in their patients than in the controls and also more mites from the homes of patients than controls. Mite counts were higher during months of high humidity. However, their studies were carried out only during the rainy season and may have included more seasonal asthmatics. They also do not mention allergy to other substances.

From Accra in Ghana, Commey & Haddock (1973) found that 32.5% of forty asthmatics had significant (more than 5 mm diam.) skin reactions to *D. farinae* and that this was significantly more than the controls. They do not report a seasonal incidence but state that temperature and humidity are high all the year round. However, another report from Accra (Anim & Edoo, 1972) suggested an association with the wet-hot season.

From Nairobi, Kenya, which has a similar altitude to Salisbury, Gitoko and Rees (1971) report finding large numbers of mites in house-dust, though they give no details of any seasonal variations.

The factors precipitating asthma are multiple, and because our patients are sensitive to the house-dust mite, and are worse during periods of high humidity, it does not follow that the former causes the latter. Other unknown factors may be present during this time. On the other hand, obvious ones such as pollens and moulds do not seem to be important, and the biological properties of the mite support a relationship.

Since our patients are not necessarily representative of the total population, it is not possible to be certain that conclusions drawn from them are applicable to asthmatics as a whole. However, they do suggest that the majority of asthmatics, at least in an urban environment, are sensitive to the house-dust mite and that this might well account for the seasonal nature of their symptoms.

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