

'Barn allergy': asthma and rhinitis due to storage mites

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Summary

The differential diagnosis of asthma in farm workers is between a type I hypersensitivity to a pollen or dust allergen and a type III hypersensitivity to mould antigens.

We describe asthma and rhinitis, and not farmer's lung, in a farming population due to the non-pyroglyphid grain storage mite.

Before a diagnosis of farmers' lung due to mouldy hay is made in any patient whether or not precipitins to *Micropolyspora faeni* are present, skin tests for storage mite should be made. If these are positive a diagnosis of 'barn allergy' should be considered and a trial of sodium cromoglycate be given.

Introduction

In a recent survey of allergic respiratory disease in an Orkney farming community of 220 people about 15% were found to have asthma or allergic rhinitis, and many of these noticed that their symptoms were brought on or aggravated by exposure to hay, straw or grain dust in barns (Cuthbert, 1978). An obvious differential diagnosis lay between allergic asthma mediated by type I, immediate hypersensitivity and farmers' lung disease. We therefore decided to search for allergens responsible for these symptoms.

The agent responsible for farmers' lung disease has been identified (*Micropolyspora faeni*) and evidence for an immune response to this antigen was looked for in this community. However, it is also known that non-pyroglyphid storage mites are found in high numbers in hay, straw and stored grain (Griffiths *et al.*, 1976). We therefore skin tested the members of the farming community with extracts of four of the more frequently occurring of these species, as well as the house dust mite (*Dermatophagoides pteronyssinus*). Further evidence of exposure was obtained from serological tests, RAST, in particular. Dust samples from the houses and barns were examined for their mite content.

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The time course of the asthma, the skin test findings and the serology lead us to conclude that the farmers' respiratory symptoms are due to the non-pyroglyphid grain storage mite and not farmers' lung. We give the name 'barn allergy' to this new syndrome, which can be diagnosed from the history and by simple skin prick tests.

Patients, materials and methods

Patients

Thirty-eight subjects were studied; thirteen farmers, six farmers' wives, eighteen farmers' children and one farmer's father. There were twenty-nine males, mean age 28 years, range 8 to 58 years and nine females, mean age 36 years. Thirteen control subjects (town dwellers) were studied; eight male and five female, mean age 24 years, range 14 to 50 years. All the townspeople and two-thirds of the farming group had symptoms of asthma and/or rhinitis.

Skin test antigens

Extracts of four species of storage mite were kindly prepared by Bencards from cultures reared by A. M. Cunnington (Wraith & Cunnington, in preparation). They were *Lepidoglyphus destructor*, *Acarus siro* and *Tryophagus putrescentiae* and for skin-testing they were used at 1.0%, 0.1% and 0.01%. These extracts, as well as *D. pteronyssinus*, were coded and used for skin testing by the latin square method. All weals were read at 15 min. Prick tests were also performed with hay dust, grass pollen and a variety of moulds and animal danders. A weal diameter of 2 mm and over, greater than the control reaction (if any) was considered positive when read after an interval of 15 min.

Precipitins to M. faeni

Sera were tested by counter-current electrophoresis using *M. faeni* antigens prepared by the London School of Hygiene and Tropical Medicine Mycological Reference Laboratory.

On each occasion positive and negative sera were run with those of the test subjects. The results were read blind by two observers.

Radioallergosorbent test (RAST)

RAST profile analyses were performed as described by Ceska (1972).

Dust samples

Samples were taken from the surface of mattresses from seven houses and sixteen samples were taken from barn floors, stored hay and grain. These were examined by A. M. Cunnington of the Pest Infestation Laboratory, Slough, or I. G. Jeffrey of the Agricultural Scientific Services, Edinburgh.

Results

Symptoms

The symptoms of thirty-eight members of the farming community (representing 85% of the atopic subjects, and 17% of the total Orkney survey) are shown in Table 1. All these subjects gave positive prick tests to one or more of five species of mite (*D. pteronyssinus* and four species of storage mites). None complained of any symptoms

Table 1. Diagnosis and symptoms in 38 members of the farming community whose allergic symptoms only occur or become worse in barn or byre and who gave positive immediate skin tests to one or more mite extracts

Diagnosis	Symptoms			
	Perennial symptoms aggravated by exposure to farm dust	Symptoms present only on exposure to farm dust	Summer hay fever	Past symptoms only
Asthma	6	5	—	2
Rhinitis only	3	9	1	—

symptomatic subjects 26. Asymptomatic subjects 12. Total 38.

attributable to house dust. However, twenty-three out of twenty-six of those with symptoms (88%) did complain that their symptoms were caused or aggravated by contact with barn dust.

Of the thirteen town-dwellers, seven suffered from asthma and the remaining six from rhinitis only. All gave positive skin prick tests to *D. pteronyssinus* although only nine attributed their symptoms to house dust.

Skin tests

Apart from positive skin tests to the mite species, horse dander was the most frequent other single allergen to give a positive skin test. Interestingly, the incidence of positive skin tests to grass pollen is lower than expected in an atopic group, being only 11%.

The results of skin testing with three concentrations of house dust and storage

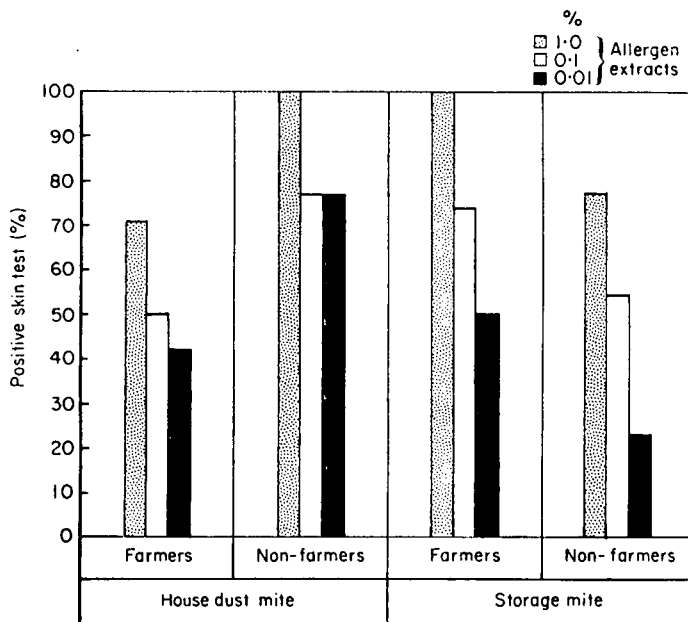


Fig. 1. Percentage of positive skin prick tests to house dust and storage mites in farmers and non-farmers.

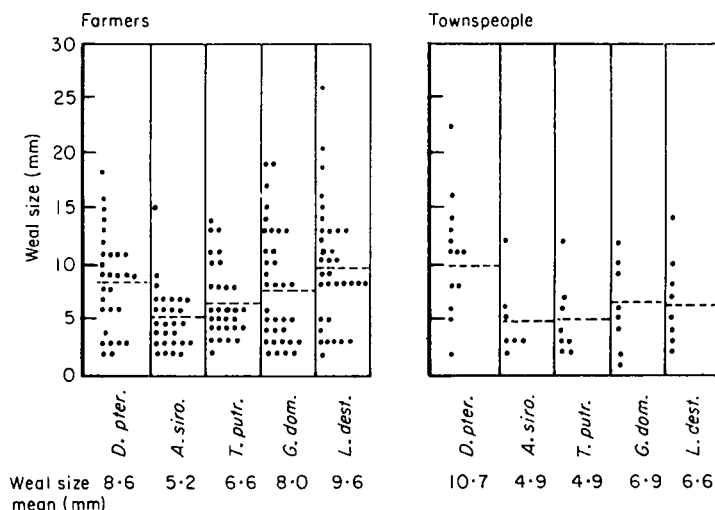


Fig. 2. Individual skin test weal areas to house dust and four storage mites in the farmers and townspeople of Orkney.

D. pter. = *Dermatophagoides pteronyssinus*

A. siro. = *Acarus siro*

T. putr. = *Tyrophagus putrescentiae*

G. dom. = *Glycyphagus domesticus*

L. dest. = *Lepidoglyphus destructor*

mite (1.0%, 0.1%, 0.01%) are shown in Fig. 1. There seems to be an inverse relationship between the two families of mite; the farmers being more responsive to the storage mite compared with house dust mite, with the reverse being found in the non-farmers. The individual weal areas are shown in Fig. 2. Here, although the farmers respond to storage mite, they also give positive responses to the house dust mite. Largest responses in the farming group, however, are the non-pyroglyphid storage mite. In the townspeople, response to the house dust mite is obviously greater than to the storage mite.

RAST

The positive RAST values for the house dust and four storage mites are shown in Table 2. A positive RAST is defined as twice the count of a normal negative serum run in the same assay. There was a higher percentage positive RAST to *G. domesticus* in farmers than to *D. pteronyssinus*, whereas the reverse held for the townspeople. It should be added that even the townspeople on Orkney are not totally unconnected with farming and possibly have become sensitized to the storage mite at some time.

Mite fauna

As can be seen from Table 3, all seven samples of mattress dust contained *D. pteronyssinus*, although it was present in only one of the sixteen farm dust samples. Low numbers of the non-pyroglyphid storage mite were found in the majority of mattress dust samples, but were plentiful in the farm dust samples.

Precipitins and RAST to *M. faeni*

No farmer gave a positive RAST to *M. faeni* although 4 gave precipitins, 2 of these being strongly positive.

Table 2. Percentage positive RAST assays to four species of mite in farmers and townspeople of Orkney

Mite	Patients			
	Farmers (n=38)		Townspeople (n=13)	
	No. positive	Percentage	No. positive	Percentage
<i>D. pteronyssinus</i>	11	28.9	7	53.8
<i>A. siro</i>	4	10.5	1	7.7
<i>T. putrescentiae</i>	6	15.8	0	—
<i>G. domesticus</i>	20	52.6	4	30.8

Table 3. The mite fauna of hay and grain dust and mattress dust from farms and farmhouses of the farming subjects studied

Species	Hay and grain dust (No. of samples = 16)		Mattress dust (No. of samples = 7)	
	No. of samples infested	Weighted mean and range (no. mites per 100 mg dust)	No. of samples infested	Weighted mean and range (no. mites per 100 mg dust)
Pyroglyphidae				
<i>D. pteronyssinus</i>	1	26.0	7	223 (38–686)
<i>Euroglyphus maynei</i>				
Acaridae				
<i>Acarus farris</i>	14	1535.4 (277.5–2260.9)	6	19.5 (8.5–32.0)
<i>Acarus siro</i>				
<i>Tyrophagus longior</i>	16	2120.8 (69.8–5144)	5	7.1 (2.6–14.5)
Glycyphagidae				
<i>Lepidoglyphus destructor</i>	9	438.6 (41.6–675.8)	7	15.8 (2.3–33.9)
<i>Glycyphagus domesticus</i>				
<i>Lepidoglyphus michaeli</i>				
<i>Goheira fusca</i>	—	—	6	38.0 (2.6–141.9)
<i>Ctenoglyphus canestrini</i>	1	15.4	—	—
Chortoglyphidae				
<i>Chortoglyphus arcuatus</i>	—	—	2	144.3 (4.5–284.1)
Tarsonemidae				
<i>Tarsonemus</i> spp.	3	few	1	7.1
Cheyletidae				
<i>Cheyletus</i> spp.	7	68.9 (28.8–155.8)	5	6.5 (2.3–14.4)
Tydeidae				
<i>Tydeus</i> spp.	6	37.6 (1.1–68)	—	—

Other species, recorded mainly from farm dust: Hypopi (heteromorphic deutonymphs), Saprogllyphidae, Nycteriglyphidae, Labidophorinae (Glycyphagidae); various Mesostigmatid mites not identified at species level and the Cryptostigmatid mites not identified at species level and the Cryptostigmatid species *Scheloribates laevigatus*.

The two with strongly positive precipitins were, (a) a farmer who exhibited the classical symptoms of acute farmers' lung, followed by a more chronic condition, and whose X-ray appearances confirmed the condition, and, (b) a farmer whose symptoms were chiefly those of the immediate type except for an occasional night cough after working with hay, but without fever and with a normal X-ray. Both are atopic and also sensitive to the storage mites, with positive skin tests and RAST.

The other two with positive precipitins were a farmer's wife who suffers from rhinitis when in contact with farm dust and to a lesser degree house dust, and a dairy farmer who also suffers from perennial rhinitis mostly due to farm dust, but also from occasional attacks of nocturnal dyspnoea and malaise. It is difficult to associate these symptoms with mouldy hay or grain, since he only feeds his cattle silage. Neither of these two have X-ray evidence of disease.

Four of those with negative precipitin tests have been suspected of having farmers' lung at some time: (1) a farmer with chronic winter cough and breathlessness without wheeze, but with X-ray appearance suggestive of the condition; (2) one farmer who complained of breathlessness without wheeze after combine-harvesting, but of immediate type; (3) a semi-retired farmer who had suffered from asthma in the past, and now complains of occasional attacks of nocturnal dyspnoea after contact with dusty hay, with pyrexia at times, but without any radiological evidence of disease; and (4) a farmer's son who, with other members of his family, had fever, pains in the chest, and malaise some hours after threshing some very mouldy oats in a confined space (two other members of this family gave positive complement fixation tests to mouldy hay antigens). All of these also gave positive immediate skin tests to the storage mites.

Discussion

The condition of asthma in farm workers is important because some causes of airways obstruction will have a worse prognosis than others, the usual differential diagnosis being between a type I hypersensitivity to a pollen or dust allergen, and a type III hypersensitivity to mould antigens, e.g. *Micropolyspora faeni*.

Grant *et al.* (1972) maintained that farmers' lung occurs with greater frequency in Orkney than in many other parts of the British Isles. Our study has demonstrated that a type I allergy to storage mites is a considerably commoner occurrence than farmers' lung as a cause of allergic respiratory disease associated with hay. Although *D. pteronyssinus* has been found to be an important source of allergy in house dust, the non-pyroglyphid storage mites have been known to be the cause of respiratory allergy for many years, especially among those handling grain, and the relevant published records will be reviewed elsewhere (Wraith & Cunnington, in preparation). Very high numbers of the storage species of mite are known to occur in stored grain and hay (Griffiths *et al.*, 1976; Jeffrey, 1976).

This was confirmed in the samples examined in this study from sixteen farm locations. *Acarus farris* and *Tyrophagus longior* were species found in very high numbers on most of the farm sites and are very closely related to the species *A. siro* and *T. putrescentiae* extracts of which were used for skin tests. In fact nearly 80% of the farming community gave positive skin tests to these allergens. *Lepidoglyphus destructor* and *Glycyphagus domesticus* were also found in considerable numbers in many of the sites and these gave over 90% of the positive skin tests, and the latter was also associated with a positive RAST in over half the subjects studied.

As can be seen from Fig. 1, the farmers gave a greater percent response to the storage mite compared with non-farmers, the reverse being true of the non-farmers—i.e. the townspeople gave a greater response to the house dust compared with the storage mite. The relationship of the occurrence of symptoms on exposure to farm dust known to contain storage mites and confirmation of sensitivity to these species by skin test and RAST leads us to conclude that they are an important source of allergy in farmers and their families.

Orkney is a relatively isolated group of islands off the north coast of Scotland, with a population of only 18,000, being a farming community consisting of small family farms, principally of beef cattle. The majority of the farmers and their families with symptoms of asthma and rhinitis in this study noticed that their symptoms were worse, or only occurred when exposed to farm dust, and not after an interval as is the case in typical farmers' lung. In most cases their symptoms occurred whilst actually working in the barn or byre, or immediately afterwards. Farmers complain of their symptoms mostly during the winter months. At this time the cattle are housed and feeding them may occupy 1–2 hours on two occasions during the day. Rhinitis is more likely to occur at these times than asthma, possibly as a result of the fairly short exposure. Threshing and bruising of grain also takes place indoors during the winter, and may occupy half or a full day at a time. Asthma is more likely to occur than rhinitis at these times, with the greater exposure. Only one person gave a positive skin test to cow dander, several gave positive skin tests to horse dander, but horses are no longer employed on farm work. In summer, when the cattle are out to grass and the work is carried out in the open, symptoms are much less common. Only a very few positive skin tests to grass pollen were found among the farming families.

It is important that there should be a clear distinction between the two allergens, and the different hypersensitivity reactions that they engender. We have shown that it is rare for farmers to develop a type I hypersensitivity to *M. faeni* (we did not have one case) compared with their liability to become sensitized to storage mites.

Before a diagnosis of farmers' lung due to mouldy hay is made in any patient, whether or not he has precipitins to *M. faeni*, skin tests for storage mite should be undertaken, the test material to include the commoner species of *Glycyphagus*, *Tyrophagus* and *Acarus*. In the event of these tests being positive, a diagnosis of 'barn allergy' should be considered and a trial of sodium cromoglycate be given. However, it may only be by the use of bronchial provocation tests and gas transfer studies that a final diagnosis can be reached.

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