

The incidence and causative factors of atopic asthma and rhinitis in an Orkney farming community

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Summary

Fifty farming families on the mainland (the largest island) of Orkney were surveyed to assess the amount of allergic respiratory disease and the principal causative factor. This account deals with only type I allergy and demonstrates a prevalence of asthma and rhinitis of 17.3% and of extrinsic asthma and rhinitis, in which definite allergic causes can be identified, of 12.7%. In addition it is shown that over one-fifth of the farming community are 'atopic' in that they demonstrate positive prick tests to one or more allergens. Less than 50% of those with allergic respiratory disease have attended the doctor with their complaint, a fact which calls in question the validity of epidemiological studies of allergic disease based on hospital and clinic attendances. Sex distribution confirms the finding that males suffer from asthma more frequently than females, however more females than males give positive skin tests without exhibiting symptoms of allergy.

Pollens, animal danders and fungi all have a part to play in the aetiology of asthma and rhinitis among Orkney farmers, although the incidence of grass pollenosis is well below average. The two commonest allergens are hay dust and *Dermatophagoides pteronyssinus* which are found frequently to affect the same subject.

Introduction

Grant *et al.* (1972) have drawn attention to the high incidence of farmer's lung in certain areas of Scotland including Orkney. This report presents some of the findings of a survey of allergic respiratory disease in a small farming community on the main island of Orkney, into the prevalence of type I Allergy (Gell & Coombs, 1968), asthma and rhinitis, and with the amount of 'atopy' in the farming community.

Orcadian economy is based on the rearing and export of beef cattle. The main crop, therefore, is grass for pasture and for storage as hay and silage. The cattle are housed

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for 6 months of the year, from November to April, when they are fed the stored foodstuffs, and it is during this time that the greatest number of people complain of allergic symptoms.

Definition of terms used

Atopy. This term is here applied to the exhibition by a subject of one or more positive skin test reactions to a common allergen.

Asthma. Intermittent airways obstruction that is reversible spontaneously or with treatment, and evidenced by a history of wheeze and/or tightness of the chest unassociated with any obvious infectious condition and occurring on more than one occasion either seasonally or perennially and usually accompanying or following exposure to some precipitating allergen.

Atopic asthma. As above where a positive skin test is present to one or more allergens.

Rhinitis. Intermittent bouts of sneezing and/or irritation of the nose and/or blocked nose; that is to say two or more such symptoms occurring on frequent occasions either seasonally or perennially.

Atopic rhinitis. As above where a positive skin test is present to one or more allergens

The diagnoses made on these definitions as a result of the analysis of the questionnaire have been confirmed by either direct knowledge of the patient or further investigation and examination. When there was a doubtful diagnosis the patient was excluded.

Atopic respiratory disease. Atopic asthma and/or atopic rhinitis (the description 'asthma and/or rhinitis' alone, includes both atopic and non-atopic patients).

Materials and methods

Fifty farming families in a single general practice in farms adjacent to one another on the mainland of Orkney were chosen for study. For each family three questionnaires were filled in at personal visits to the house. For each member a questionnaire concerning general matters, e.g. age, sex and medical history, was completed, and secondly, one concerning any allergic conditions such as asthma, rhinitis, eczema, etc., then, thirdly, a specific questionnaire about allergic disease.

In all, 220 subjects were included, 113 males and 107 females. Their ages and sexes are shown in Table 1. The sex ratios were very evenly distributed throughout the age

Table 1. Ages and sexes of members of fifty farming families in the mainland, Orkney

Sex	Age (years)					Total
	0-5	6-15	16-25	26-50	over 50	
Male	6	32	16	31	28	113
Female	7	25	15	32	28	107
Total	13	57	31	63	56	220

groups. Of the 121 engaged in farm work the majority of those doing full-time work—78 in all—were men (62 men to 16 women) whilst the majority of the remainder were women working part-time on the farm, either because they had other jobs, were retired or were looking after the house (12 men to 31 women).

Of the 220 subjects included in the survey 205 were willing to be skin-tested with a range of allergens, concentrating on those most likely to be found in the farming environment (Table 2). Prick tests only were used.

Weals of over 2 mm in diameter in the presence of a negative control test were regarded as positive.

Results

Skin tests

The results of skin-testing 205 subjects reveal a prevalence of atopy in forty-four (21.5%), or twenty-seven of 109 males (24.8%) and seventeen of ninety-six females (17.7%), a ratio of approximately three males to two females. The frequency of positive tests with the allergens used is shown in Table 2. In Table 3 the number of subjects who were skin-test positive to the different categories of allergens are shown, indicating that the house-dust mite (*Dermatophagoides pteronyssinus*) and house dust are the cause of most sensitization, with farm dusts (hay and straw dust) and animal danders second.

More men than women are sensitized to dusts and to animals in a ratio of two men to one woman (an exception is chicken feathers, to which only women gave positive skin tests). The reverse is true of fungi to which twice as many women as men give positive skin tests and pollens with which the ratio of men to women is 1:1.3.

Whereas positive skin tests to animals, pollen and fungi were distributed at random among the sensitized subjects, in seventeen instances positive tests to farm dusts (hay and straw) and to the house-dust mite (*D. pteronyssinus*) occurred in the same subject, and all of these complained of farm dust in the barns and byres as the principal cause of their symptoms.

Questionnaires

The result of the questionnaires directed to 220 subjects showed a total of twenty-three sufferers from asthma (10.5%) of whom sixteen had atopic asthma (7.3%), twenty-eight from rhinitis (12.7%) of whom twenty-four had atopic rhinitis (10.9%) and a total of 38 with asthma and/or rhinitis (17.3%) of whom twenty-eight had atopic respiratory disease (12.7%). The sex distribution showed a marked preponderance of male sufferers, especially in respect of atopic asthma, where there were six male to every one female sufferer (Table 4).

Of the forty-four who were atopic, only twenty-eight (63.6%) actually had symptoms of allergic respiratory disease. Of these, twenty-three blamed the farm dust (either of hay or straw or both) as the primary cause of their symptoms and twenty of these were skin-test positive to the house-dust mite (*D. pteronyssinus*). Five of the twenty-three blamed farm dust and house dust and of these four were skin-test positive to house-dust mite. Only five complained of house-dust as the chief or only cause of their symptoms and none of these gave positive skin tests to the house-dust mite!

Children under 16 years of age

Children below school-leaving age, showed a very similar pattern of distribution of

Table 2. Number of positive skin tests to a battery of twenty-five allergens giving also the percentage of positive results for each of the commonest allergens among the atopic subjects and the total survey population

Allergen	<i>n</i>	Atopic subjects (%)	Total survey population (%)
House dust	33	76.7	16.1
<i>D. pteronyssinus</i>	35	79.5	17.1
Hay dust	27	62.8	13.2
Straw dust	12		
Mixed threshings	11		
Mouldy hay	5		
Grass pollen	9	20.5	4.4
Nettle	1		
Plantain	4		
Milk	5	11.6	2.4
Eggs	5	11.6	2.4
Fish	2		
Nuts	4		
Cereals (mixed)	4		
Sheep	11	25.6	5.4
Cow	4	9.3	1.95
Horse	17	38.6	8.3
Cat	12	27.3	5.0
Dog	7		
Chicken feathers	4		
Alternaria	5	11.6	2.4
<i>A. fumigatus</i>	10	23.3	4.9
Cladosporium	2		
Dry rot	2		
Ustilage	4		

Tested: 205 (109 males, 96 females); positive: 44 (27 males, 17 females).

Table 3. Summary of skin test results. The number of subjects skin-test positive to the different categories of allergens

Allergen	<i>n</i>
House dust and/or mite	37
All farm dusts	28
Pollens	8
Foods	11
Animals and birds	27
Fungi	13

disease if the results of skin testing were disregarded. However, the role of atopy in the symptom group was of greater significance in these younger subjects than in the adults, there being only one of the 70 subjects under 16 years, a sufferer from rhinitis, who was not skin-test positive to one or more of the allergens used. Whereas the percentage of adults with asthma and/or rhinitis was the same as the percentage of those under 16 years of age, the percentage of adults with atopic respiratory disease was 11.3% compared with 15.7% of the younger age group. Comparisons of the two age groups for each condition and the distribution of the conditions between the sexes is shown in Tables 4 and 5.

Age on onset

Thirty-six per cent of those with asthma and/or rhinitis from whatever cause and 39.3% of those with atopic respiratory disease experienced their first symptoms before the age

Table 4. Sex distribution of asthma and rhinitis as a whole and asthma and rhinitis of atopic origin in the farming population of Orkney

Diagnosis	Number			Percentage of population			M:F ratio
	Male	Female	Total	Male	Female	Total	
Asthma and/or rhinitis	26	12	38	23.0	11.2	17.3	2:1
Asthma	16	7	23	14.2	6.5	10.5	2:1
Rhinitis	20	8	28	17.7	7.5	12.7	2.4:1
Atopic respiratory disease	21	7	28	18.6	6.5	12.7	3:1
Atopic asthma	14	2	16	12.4	1.9	7.3	6:1
Atopic rhinitis	17	7	24	15.0	6.5	10.9	2.3:1

Numbers: male 113; female 107; total 220.

Table 5. Sex distribution of asthma and rhinitis as a whole and asthma and rhinitis of atopic origin in children under 16 years of age in the Orkney farming population

Diagnosis	Number			Percentage of population			M:F ratio
	Male	Female	Total	Male	Female	Total	
Asthma and/or rhinitis	11	1	12	19.3	7.7	17.1	2.5:1
Asthma	7	0	7	12.3	—	10.0	—
Rhinitis	9	1	10	15.8	7.7	14.3	2:1
Atopic respiratory disease	10	1	11	17.5	7.7	15.7	2.3:1
Atopic asthma	7	0	7	12.3	—	10.0	—
Atopic rhinitis	8	1	9	14.0	7.7	12.9	2:1

Numbers: male 57; female 13 (ratio M:F=4.4:1).

of 5 years. A further 21.1% of the former and 25% of the latter first experienced symptoms between the ages of 5 and 16 years and 42.1 and 35.7% respectively first suffered when 16 years of age or over. Only two of the twenty-eight with atopic disease (7.1%) first developed symptoms after the age of 25, whilst a further four of thirty-eight (10.5%) developed asthma and/or rhinitis that was not atopic after this age.

Attendance at surgery

Finally, an analysis of those attending the doctor for their complaint of asthma or rhinitis is shown in Table 6. Less than 50% of all asthmatics and a little over 10% of those with rhinitis had complained of their condition prior to this survey.

Table 6. Surgery attendances for asthma and rhinitis compared with the numbers found to be suffering from these complaints during the course of the survey of an Orkney farming community

Disease	Number		Percentage
	From survey	Attending surgery	
Asthma	23	11	47.8
Atopic asthma	16	9	56.25
Rhinitis	28	3	10.7
Atopic rhinitis	24	3	12.5
Atopics for asthma or rhinitis	44	12	27.3
Atopic respiratory disease	28	13	46.4

Discussion

Most epidemiological studies of allergic respiratory disease have been concerned with special groups, such as children (Morrison Smith, Harding & Cummings, 1971; Williams & McNicol, 1969), those living in isolated communities (Mantle & Pepys, 1974; Anderson, 1974; Turner, Baldo & Anderson, 1975), distinct racial groups (Godfrey, 1975; Merrett, Merrett & Cookson, 1976; van Niekerk *et al.*, 1979) etc. The present study is concerned with a community of small farmers on a group of Scottish islands. However, it relates to the whole community, not just those attending hospital or clinic. A contrasting group, although on a different scale, is that studied by Blair (1974), who looked at a urban population in an East London suburb. He found an overall incidence of 7.2% atopic disease (3.5% with asthma, 2.2% with 'hay fever' and 1.5% with eczema), whereas among the Orkney farming population there is an incidence of 11.9% of respiratory allergy only (6.5% with asthma and 10.4% with rhinitis), suggesting that there is a greater exposure to sensitizing allergens in this rural environment, or that the Orkney population is genetically more prone to atopy. This latter is a possibility, since the population of the islands is still relatively isolated and in-bred of Norse-Scots descent.

Instances of genetically determined prevalence of such conditions is shown in the study by Mantle & Pepys (1974) of asthma in the Tristan da Cunha islanders and possibly also in those of Anderson (1974) and Turner *et al.* (1975) and others among

the natives of the Papua new Guinea Highlands, Godfrey (1975) in the Gambia and van Niekerk *et al.* (1979) in South Africa among the Xhosa children. In the latter, it is shown that the incidence of asthma is higher among the town-bred children than among the country-bred where it is almost non-existent, whereas in the present study the rural population of Orkney has an incidence of asthma of 6.5% compared with the 3.5% of Blair's East Londoners. Further studies on comparable rural and urban communities would be of interest.

Blair (1974), studying large numbers (9145 subjects), did no skin tests but Godfrey & Griffiths (1976) found in their survey of school children in Southampton that among the 33.7% who were skin-test positive to mite and/or grass pollen, one half were symptomless. In the present study sixteen of forty-four atopics were symptomless (36.4%). Whether this reflects a greater degree of contact with the allergens among the rural population or a higher concentration of allergen in the environment (effectively the same thing) or some other factor is not determined.

The ratio of males to females (29.6% of males to 58.8% of females) bears out the findings of Davies (1976) that more women than men are atopic without symptoms of disease. In this instance, however, the explanation may lie in the greater contact that the men have with the farm dusts.

The finding that at least 50% of those with asthma and about 90% of those with allergic rhinitis have not attended their doctor with their complaint can be explained by (a) the mild nature of some symptoms, (b) the short duration of symptoms during limited exposure to allergens and their relief on leaving the affected environment, (c) the reluctance of farmers to complain and the necessity of getting their work done regardless of disability and (d) the possibility that in some patients rhinitis is misdiagnosed as common cold, sinusitis, etc.

Environmental factors

The four main environmental factors productive of allergens in farming are pollens, animal danders (including birds and feathers), fungal spores and dusts.

Pollens. These appear to play only a very small part in the production of allergic symptoms in Orkney farmers. Although grass is the main crop for animal fodder, 'hay fever' as commonly understood is a rare complaint among native Orcadians and of forty-four atopic subjects only nine (0.5% of the population) actually complained of symptoms, compared with Blair's 2.2% of Londoners with 'hay fever'. Another seven sufferers alleged that their symptoms occurred chiefly in the fields and blamed grass cutting, but were skin-test negative to grass pollen. The reason may be genetic but could be accounted for by the climate which ensures that the pollen that is not washed down immediately by rain is blown off the islands into the sea. The pollen season moreover is relatively short, the grass ripening rapidly in the long summer days of June and July, in the high latitude of Orkney.

Animal danders. These also play a relatively minor role. The greatest number of positive skin tests to animals was to horse dander and horses are no longer used in working the farms. Although eleven subjects were skin-test positive to sheep's wool, only one farmer complained of symptoms of rhinitis when shearing sheep. Only four of the 205 tested were skin-test positive to cow dander, although many complained of symptoms from the feedstuffs (principally hay), whilst feeding them. Whereas men gave twice as many positive skin tests to dusts and animals than did women, only

women reacted to chicken feathers, and it is women who have a monopoly of the care and feeding of the poultry.

Fungi. The only fungus giving any number of skin-test-positive results (10) was *Aspergillus fumigatus*, which accounts for some type I allergies but there were no cases of broncho-pulmonary aspergillosis. But why more women than men should be sensitized to fungi is unclear.

Dust. Dust plays a major role in the aetiology of asthma and rhinitis among the Orkney farming community. The results (Tables 2 and 3) show that dust is a greater factor than any other, and that hay and grain dusts in barn and byre are of much greater significance than house dust. Both the results of the questionnaires and the investigations indicate that hay dust is a principal cause of symptoms and is frequently associated with sensitivity to the house-dust mite, whereas sensitivity to house dust is not only relatively uncommon but when present is less often found in association with sensitivity to the house-dust mite (*D. Pteronyssinus*). It seems reasonable, therefore, to suspect that the relevant allergen in the farm dust may be the house-dust mite or a related species. Investigations into this possibility are the subject of a report elsewhere (Cuthbert *et al.*, 1979).

Finally food allergy does not appear to play a significant role in respiratory or other diseases among the Orkney farmers.

Conclusions

- (i) Allergic respiratory disease occurs with rather more frequency in Orkney farming families than in most populations studied.
- (ii) Although the severity of the allergic symptoms is not often great, they affect the whole family whether working actively on the farm or not.
- (iii) Less than 50% (chiefly the asthmatics) of those affected visit the doctor on account of their allergic condition.
- (iv) Most allergic symptoms are associated with exposure to dust from hay or grain on entry into barn or byre.
- (v) Over one-fifth of the population show evidence of sensitivity, to one or more allergens likely to be encountered on the farm, whether or not they have experienced symptoms.
- (vi) It is probable that the conditions encountered in Orkney farming are sufficiently typical of those to be found in many other localities for the findings of this survey to be relevant to many other farming communities, but further studies need to be undertaken to verify this.

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