

Asthma amongst Tristan da Cunha islanders

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Summary

The incidence of asthma amongst Tristan da Cunha islanders was recorded over a period of 16 months. Thirty-two per cent of the islanders gave a history of asthma, and 22% had one or more attacks during the survey period. Three-quarters of the affected islanders had mild asthma. Both the incidence and severity of asthma on Tristan have declined since 1944.

Over half the asthmatics were allergic to house dust extracts on skin testing; so was a large proportion of non-asthmatic islanders. Large numbers of house dust mites are present in Tristan dust, but airborne allergens are scarce. Total IgE levels were greater than normal in the serum of twenty-three of sixty-seven islanders investigated. Allergy was thought to be the main cause of asthma in about a third of the active asthmatics.

The high incidence of asthma on Tristan derives from two or three asthmatics amongst the fifteen ancestors of this highly inbred community. Nevertheless, asthma on Tristan, as elsewhere, seems to have a multifactorial aetiology.

Introduction

Tristan da Cunha is a small island in the South Atlantic, roughly midway between South Africa and South America, and situated just north of the Roaring Forties. The population is highly inbred, and it is claimed that the present islanders are all descended from fifteen ancestors (Christopherson, 1946), although this estimate fails to include a few offspring probably resulting from temporary and irregular unions with non-islanders in the past.

In October 1961 a new volcanic vent erupted 300 yards from the only settlement on Tristan, and the 268 islanders were evacuated to the United Kingdom. The great majority returned within the next 2 years. During their exile in England they were intensively investigated under the auspices of the Tristan da Cunha Working Party of the MRC. One of the findings recorded by this investigation was the high incidence

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of bronchospasm amongst Tristan islanders. Asthma, apart from the common cold, was their most common complaint.

The first mention of asthma amongst Tristan islanders was made by a missionary early in this century (Barrow, 1910), who noted a death attributed to asthma in a girl of 12, and two other non-fatal cases. Thirteen years later asthma was the most common disease found by a visiting ship's surgeon (Wild, 1923). By 1938 asthma was 'the only disease of any importance on Tristan' (Christopherson, 1946), and Woolley (1946) noted amongst the islanders 'twenty-seven severe asthmatics who continually suffer from the condition, and seventy who develop asthma only when suffering from an upper respiratory tract infection'. The Norwegian Scientific Expedition of 1937-38 claimed to have 'fairly convincing information' that three of the original fifteen ancestors suffered from asthma, while Woolley stated that 'the evidence seems to point to Glass and . . . Susannah Phillips as the originators of the condition'.

The present investigation was to determine the current incidence of asthma on Tristan da Cunha, and to attempt to elucidate the aetiology of this common disease in an exceptionally inbred and isolated population.

Table 1. Age and sex distribution of asthmatics

Age	Active Asthmatics		Latent Asthmatics	
	Male	Female	Male	Female
1-12	4	4	0	0
13-19	1	5	0	1
20-29	2	4	4	2
30-39	1	7	3	6
40-49	4	4	1	6
50-59	5	5	1	3
60-69	5	3	0	1
70 plus	5	3	0	2
Total	27	35	9	21
	62		30	

Patients and methods

The island population was 286 in June 1971. Two deaths and four births occurred in the next 16 months. The number of adults investigated during this period was 216, 108 males and 108 females. All but four of the adults were skin tested with a standard battery of allergens, and completed a questionnaire. The number of children (under 13 years of age) on the island during the period was seventy-two, thirty-one males and forty-one females. Twenty of the children were skin tested.

Blood was taken from eighty-three islanders for the determination of levels of IgE. Serum was separated on the island and transported frozen to the U.K. for the estimation. Samples of mattress dust from island houses were examined in the U.K. to find out the numbers and species of house dust mite present. Finally an assessment of the islanders' exposure to airborne allergens was attempted, using an automatic volumetric air sampler.

Results

Asthma

Fifty-four of the 216 adults (25%) were seen suffering from at least one attack of asthma during the period June 1971 to November 1972. Thirty-one of these were female (29% of the adult female population), and twenty-three of them were male (21% of the adult male population). Eight children (11%) were seen with asthma over the same period. These sixty-two individuals are subsequently referred to as active asthmatics.

In addition, another thirty adults gave a history of having been affected by asthma at some time in their lives, but were not seen suffering from it during the period of investigation. This group is referred to hereafter as latent asthmatics. Half of this group had not suffered from bronchospasm since their return to Tristan in 1962 or 1963.

Age and sex distribution of asthmatics

There were four times as many female active asthmatics as male active asthmatics between the ages of 13 to 39 (sixteen as opposed to four), a finding which is not merely a reflection of an excess of females over males in this age group in the general population (Table 1).

Severity of asthma

The sixty-two active asthmatics of all ages were separated into two groups by the single criterion of whether their asthma caused less or more than 1 week's interference with their normal activities. Forty-six had less, and sixteen had more, than 1 week's interference because of asthma. Thus three-quarters (74%) of the active asthmatics had clinically mild asthma over the period of the survey.

Family history of asthma

Table 2 shows the number of islanders in three groups: active asthmatics, latent asthmatics, and non-asthmatics who gave a history of asthma among parents, siblings, or children.

Other allergic diseases

Twenty-seven islanders gave a history of seasonal rhinitis. Seventeen of them had a positive reaction to grass, shrub or tree pollens on skin testing, eight were negative to pollens but positive to house dust or wheat, and two had no positive reactions on skin testing. One of the subjects with seasonal rhinitis also had atopic eczema (the only case on the island), three other islanders gave a history of urticaria, and one other islander developed pompholyx after contact with fibreglass.

In all, eighteen (20%) of the ninety-two islanders with a history of asthma also gave a history of rhinitis, eczema or urticaria.

In nearly all cases the seasonal rhinitis was mild, and only four islanders required treatment with antihistamines during the summer.

Age of onset of asthma

Most islanders reported onset of asthma in childhood.

Childhood up to 13 years	48
Adolescence 13–19 years	11
Adult 20–45	15
Adult over 45	11
Unknown	7
Total	92

Course of asthma in U.K. and on Tristan da Cunha

A third of those with a history of asthma had experienced bronchospasm only on Tristan. Almost equal numbers thought their asthma was worse, better or the same in either the U.K. or on Tristan.

Asthma only on Tristan	32
Asthma worse on Tristan than in U.K.	19
Asthma the same in U.K. and on Tristan	18
Asthma only in U.K.	2
Asthma worse in U.K. than on Tristan	21
Total	92

History of causal factors

All patients with a history of asthma were asked about possible causes for their attacks of wheezing. Many reported more than one cause. Nearly all patients mentioned a relationship to colds, which usually occur in epidemics following the arrival of a ship, affecting a variable number of islanders. Exercise was the next most commonly mentioned cause of asthma. House dust as a provoking agent was noticed chiefly by women in relation to household activities. Emotion as a cause of asthma included laughing, three patients said 'seedy' grass made them wheeze, and one patient always developed mild spasm when sleeping in one of the old wooden shacks on Nightingale Island, when he made an excursion there. In general, apart from five exceptions, the islanders noticed no seasonal difference in their asthma.

Cause of asthma

Colds and upper respiratory tract infections	76
Exercise	30
Emotion	15
House Dust	23
Grass	3
Other Allergens	2

Skin tests of allergic sensitivity

The skin of the forearms of 232 islanders was tested by the prick test technique. A standard battery of British allergens was used, and five extracts of allergens derived from Tristan da Cunha; namely, Tristan mattress dust and house dust, *Cladophora*, *Sporomia* and *Pithomyces chartarum*.

Fifty-nine out of sixty-two active asthmatics, twenty-nine out of thirty latent asthmatics, 111 of the 142 non-asthmatics with a positive family history of asthma (family history positive non-asthmatics), and thirty-three of the fifty-four non-asthmatics with a negative family history of asthma (family history negative non-

Table 2. Family history of asthma amongst asthmatics and non-asthmatics

Group	Positive family history	Negative family history	Total
Active asthmatics	56 (90%)	6 (10%)	62 (100%)
Latent asthmatics	26 (87%)	4 (15%)	30 (100%)
Non-asthmatics	142 (71%)	54 (29%)	196 (100%)

asthmatics), were skin tested. Fifty-two of the fifty-six islanders not skin tested were children under 13 years of age who had never had asthma. The results are summarized in Table 3.

Table 4 sets out the salient points from the results shown in Table 3. Figures are percentages of the number in each category actually skin tested who showed a positive reaction.

Tristan mattress dust and house dust, British house dust and *Dermatophagoides pteronyssinus* extracts were by far the most allergenic substances tested, followed by pollens. Over a third of non-asthmatics gave positive skin reactions to the dust related

Table 3. Numbers of positive skin reactions in each group

Allergen	Asthmatics		Non-asthmatics Family history	
	(62) Active	(30) Latent	(142) Positive	(54) Negative
<i>Alternaria</i>	0	0	0	0
<i>Aspergillus fumigatus</i>	4	0	2	0
<i>Aspergillus terreus</i>	1	0	1	0
<i>Cladosporium</i>	4	0	0	1
<i>Merulius lacrymans</i>	3	3	0	1
<i>Sporobolomyces</i>	3	1	0	1
Yeast	2	0	0	0
<i>Candida albicans</i>	4	3	9	0
Grass pollen	14	8	13	1
Shrub pollen	11	5	15	0
Tree pollen	10	5	7	0
Milk	4	1	1	0
Egg	2	0	2	0
Wheat	1	2	1	0
Fish	0	1	0	0
Nuts	4	0	2	1
Cat	2	2	4	0
Dog	0	1	0	0
Feathers	1	0	0	1
Horse	3	0	0	0
British house dust	37	12	35	8
<i>D. pteronyssinus</i>	32	8	27	5
<i>Cladophora</i>	1	0	3	0
<i>Pithomyces</i>	2	2	2	1
<i>Sporormia</i>	1	1	3	0
Tristan mattress dust	37	12	50	14
Tristan house dust	35	12	38	10

extracts, compared with over half the asthmatics. More striking differences, however, emerge from comparison of the active asthmatic group with the family history negative, non-asthmatic group. Sixty-three per cent and 54% of the former gave positive skin reactions to British house dust and *D. pteronyssinus* respectively, while in the latter group the same allergens provoked positive skin reactions in only 24% and 15% of the sample. Secondly, a quarter of the asthmatics as a whole reacted positively to grass pollen, compared with only one of the thirty-three family history negative non-asthmatics. Third, over half the family history negative non-asthmatics had no positive skin test reactions to any allergen, while under a quarter of the active asthmatics were non-reactors.

Despite these differences, it is clear that in any individual case positive skin reactions alone cannot be of much aetiological significance in the absence of other evidence of an allergic aetiology.

Table 4. Percentage showing positive reaction to certain allergens

Allergen	Asthmatic		Non-asthmatic Family history	
	Active	Latent	Positive	Negative
Grass pollen	24	28	12	3
Shrub pollen	19	17	14	0
Tree pollen	17	17	6	0
British house dust	63	41	32	24
Tristan mattress dust	63	41	45	42
Tristan house dust	59	41	34	30
<i>D. pteronyssinus</i>	54	28	24	15
% not showing any positive reactions	24	41	43	55

Correlation between skin tests and histories of sensitivity

Of the sixty-two active asthmatics, twenty gave a history of provocation of their asthma by exposure to house dust, of whom sixteen had a positive skin test reaction with British or Tristan house dust extracts. Two out of the three latent asthmatics who gave a history of house dust provoked asthma had positive reactions with house dust extracts. On the other hand, about a third of both the active and the latent asthmatics had positive reactions with house dust extracts, but did not think that house dust provoked their attacks of asthma.

Two of the three islanders who said 'seedy grass' made them wheeze gave positive reactions to pollens on skin testing. The islander who noticed provocation of spasm when sleeping in the wooden shacks on Nightingale Island gave positive reactions to dry rot, pollens and house dust extracts, all allergens present in the Nightingale Island shacks to an unusual degree.

Environmental allergens

Samples of mattress dust were collected from ten of the seventy-two families on the island. The dominant species of mite in the dust was *D. pteronyssinus*, amounting to

nearly 60% of the total mite population. The related pyroglyphid *Euroglyphus maynei* accounted for another 16%. These two species thus account for about 75% of all mites present.

Appreciable numbers of *Chlortoglyphus* were also present in all samples. *Chlortoglyphus* is a storage species which has been recorded damaging products in several countries, including clover seed in New Zealand. It is probable that the relatively high numbers present in Tristan mattress dust are due to the use of New Zealand flax as a roofing material, and it was interesting to note that there were significantly greater numbers of this species present in the dust from houses thatched with this material than in those roofed with corrugated iron. About half the island houses are now roofed with corrugated iron rather than the formerly ubiquitous New Zealand flax. All Tristan houses, however roofed, tended to be rather dusty inside.

The estimated density of *D. pteronyssinus* and *E. maynei* in Tristan mattress dust, calculated on the number/weight ratio for each sample, was 'fairly heavy', and particularly so in four of the samples.

Table 5. IgE levels in asthmatics and non-asthmatics

	No. of sera	IgE > 400	IgE < 400
Active asthmatics	34	14	20
Latent asthmatics	10	3	7
Non-asthmatics	23	6	17
Total	67	23	44

An automatic volumetric air sampler was set up on the western edge of the settlement to assess the extent and significance of airborne allergens. A full year's survey is not yet completed, but preliminary results appear to indicate that Tristan islanders breathe exceptionally pure air, and are not exposed to significant numbers of unusual airborne allergens (Gregory, personal communication).

The standard of living of Tristan islanders is rising with increasing affluence. Mattress interiors are filled with springs, and pillows are filled with foam rather than penguin feathers. Imported lumber rather than old ships' timbers full of dry rot is now used for domestic interiors. There was no evidence from the histories of those suffering from active asthma that contact with unusual potentially allergenic substances, such as sea bird guano or albatross feathers, played any significant part in provoking asthma.

Immunoglobulin E levels in Tristan sera

Eighty-three islanders were bled. Sixteen samples were damaged in transit. Total IgE levels in the remaining sixty-seven samples were measured in the Clinical Immunology laboratories of the Cardiothoracic Institute by the method of Rowe (1969), using the British Research Standard 68/341. The upper limit of normal by the method used is 400 units. Twenty-three of the sixty-seven sera showed a total IgE level above this figure (Table 5).

Of the twenty-three islanders with raised IgE levels, fourteen were active asthmatics, all of whom had showed positive skin reactions to one or more of the allergens tested.

Two of the three latent asthmatics with raised IgE levels suffered from seasonal rhinitis, and only one of the six had no positive skin reactions.

Thus two of the islanders with raised IgE levels showed no obvious cause for their high levels of reaginic antibodies.

Extrinsic and intrinsic asthma amongst Tristan islanders

Islanders with active asthma who gave a definite history of provocation of bronchospasm by a particular allergen, and who showed an immediate positive reaction to that allergen on skin testing, were classified as extrinsic asthmatics. Islanders whose asthma was not so provoked, and whose skin tests were all negative were classified as cryptogenic (intrinsic) asthmatics. The remainder were classified as indeterminate.

According to these polar criteria nineteen (31%) of the sixty-two active asthmatics were suffering from extrinsic asthma. Half of this extrinsic group gave a history of seasonal rhinitis or other allergic disorder, and all but one had a family history of asthma.

Eleven (18%) of the sixty-two were classified as having cryptogenic asthma. All but two had a positive family history; none gave a history of any other allergic disorder.

Table 6 shows the correlation of IgE levels with the above classification.

Table 6. Classification and IgE levels of active asthmatics

Group	Number (%)	IgE > 400	IgE < 400	IgE not estimated
Extrinsic	19 (31%)	8	7	4
Cryptogenic (intrinsic)	11 (18%)	0	2	9
Indeterminate	32 (51%)	6	11	15
Total	62 (100%)	14	20	28

Discussion

Incidence of asthma on Tristan da Cunha

Asthma is defined 'as that condition of wheezing and breathlessness characterized by airways obstruction which varies from time to time either spontaneously or as a result of treatment'. This investigation confirms the high incidence of this condition amongst Tristan islanders. Sixty-two out of 288 islanders (22%) had one or more attacks of asthma over a period of 16 months. This corresponds to a rate of 161/1000/year, and compares with figures of between 12.2 and 25.6/1000/year in British general practice (Hodgkin, 1973; Perkin, 1972). A further thirty islanders had been affected by asthma in the past, making a total of ninety-two (32%) who had suffered from asthma at some time in their lives. There is some evidence that both the incidence and severity of asthma on Tristan may be declining.

Between 1942 and 1944 the island medical officer noted ninety-seven patients with asthma. Twenty-seven of them (28%) were classified as severe asthmatics 'who continually suffer from the condition'. The other seventy usually developed the asthma when suffering from an upper respiratory tract infection (Woolley, 1946). This represented an incidence of active asthma of 49% in the population of 198, and compares with a current incidence of 22% amongst the islanders. Only eleven (18%) of these

could be described as severe asthmatics 'who continually suffer from the condition'. In 1961 the island medical officer noted that 'approximately 10% of the islanders' required medication for their asthma although the number of chronic sufferers who went about wheezing was much higher (Samuels, 1963).

This apparent decline in the incidence and severity of asthma on Tristan has taken place over a period of dramatically improving standard of living and hygiene, resulting in a major reduction of the load of intestinal parasites formerly endured by the islanders; and some additions to the therapeutic armamentarium available on the island, notably sodium cromoglycate and corticosteroids. Over the same period there has been no significant change in the genetic endowment of Tristan islanders, who have continued to intermarry.

Causes of asthma amongst Tristan islanders

Some, at least, of the remarkably few ancestors of the islanders suffered from asthma. It is therefore not surprising to find a high incidence of the disease in what has remained an inbred population. Pedigree analysis has shown that asthma runs in certain families (Roberts, 1969). Nevertheless, to attribute Tristan asthma merely to the Tristan islanders' genetic endowment is begging the aetiological question.

This survey showed a higher than expected number (twenty-seven) of islanders with seasonal or perennial rhinitis, of whom twenty-five showed positive skin reactions to pollen or house dust. This compares with the four islanders noted in 1938 to be suffering from hay fever, and the lone islander in 1961 who gave a history of hay fever (Black *et al.*, 1963). Twenty per cent of the present islanders who gave a history of asthma also gave a history of rhinitis, eczema or urticaria.

The Norwegian Expedition of 1937-38 concluded in rather general terms that Tristan asthma was allergic in origin. The validity of this conclusion has been questioned (Citron & Pepys, 1964) on the grounds that no skin tests were done, and few examples of definite causal relationships between the asthma and the allergens were given. Although the same authors detected allergic causes for asthma in the thirty-four islanders they investigated, they noted that in most of them infection was also an aggravating factor, and inferred from the rarity of eczema, urticaria and allergic rhinitis that their patients did not have a generally high degree of allergic hypersensitivity.

Virtually the whole adult population was skin tested in the present survey. The only significantly allergenic substances were pollens and house dust related extracts. Most of the active asthmatics showed positive reactions to one or other of these allergens, but so did many of the non-asthmatic islanders. Heavy concentrations of house dust mites were found to be present in Tristan dwellings. The significance of these results must be assessed in the light of the histories given by the patients, clinical observation over the period of the survey, and the levels of IgE in patients' serum. Most emphasis has been given to the histories and clinical observation since normal levels of IgE in the Tristan population have not been established.

About a third of Tristan islanders who had asthma over the period of the survey were thought to have a primarily allergic basis for their asthma. About a fifth of the active asthmatics were thought to have no allergic basis for their asthma, and in the rest the aetiology appeared mixed, although in some of these allergy seemed to play some part.

The role of infection in causing asthma on Tristan is also important. Colds and

upper respiratory tract infection come to Tristan on visiting ships, and occur usually in well defined epidemics. Experience on the island indicated that an epidemic invariably caused a markedly increased incidence of wheezing. During the survey period a severe epidemic of viral illness affected 96% of the islanders over a period of 8 weeks, which serological evidence suggested was due to Influenza A2 of the Hong Kong Serotype H₃N₂. This epidemic precipitated an attack of bronchospasm in 35% of the active asthmatics (Mantle & Tyrrell, 1973).

This marked effect of infection might suggest that the important aetiological factor on Tristan is a hereditary non-specific bronchial hyper-reactivity to a variety of stimuli, whether infective, allergic or emotional. Alternatively it can be argued that allergic mechanisms may be responsible for a chronic inflammatory reaction in the bronchi resulting in a state of bronchial hyper-reactivity to non-specific irritants such as infection (Howell, 1971). The data from the present survey would certainly bear such an interpretation, which would, however, be extremely difficult to prove.

The Tristan islanders comprise a small, genetically inbred, stable and isolated population. Despite these peculiarities, it is difficult to resist the conclusion that the asthma so widely prevalent in this community is as multifactorial in its aetiology as it is generally accepted to be elsewhere.

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