

INCIDENCE OF FUNGAL SPORES AT THE HOMES OF ALLERGIC PATIENTS IN AN AGRICULTURAL COMMUNITY. II. CORRELATIONS OF SKIN TESTS WITH MOLD FREQUENCY

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A mold survey in and out of the homes of 145 allergy patients was conducted over the course of a year and frequency of mold recovery was correlated with skin test reactivity in 131 of these patients. The highest percentage correlation with positive skin test and finding mold in the home was with *Cladosporium*, *Penicillium* and *Alternaria*, while *Helminthosporium*, *Fusarium*, *Aureobasidium* (*Pullularia*) and *Mucor* each had correlations of one percent or less. The 0-10 age group was the most skin test reactive to molds in general while the over-50 age group was the least reactive. The percentage of patients sensitive to *Alternaria* also responding to other mold antigens was the highest with *Helminthosporium*. Since *Helminthosporium* was rarely recovered in this survey the data suggest that cross reactivity and not dual reactivity between *Alternaria* and *Helminthosporium* is occurring.

IN A PREVIOUS PAPER we have shown the results of a 12-month indoor-outdoor mold survey at the homes of 145 allergy patients in an agricultural community.¹ We now present correlations between mold sensitivity of 131 of these patients reactive to mold antigen and the frequency of mold at the homes.

Reports in the literature vary in their conclusions regarding correlations between skin test results and home mold frequency. Goldfarb² and Schaeffer et al³ have stated that the highest percentage of positive skin tests almost always shows the highest frequency of spore counts and cultures when ambient air studies are made. On the other hand Sherman and Merksamer⁴ noted that the presence of mold in the home is of minimal importance in relation to sensitivity. Still others⁵ found it difficult to make correlations between skin test reactivity and presence of mold in the environment. However, it is generally accepted that exposure to high concentrations of mold spores, reactivity to more than one mold and antigenic cross reactivity between spores of different fungal genera are important factors leading to exacerbation of allergic symptoms in the mold sensitive patient. This paper will consider these factors in a community where a large variety of agricultural commodities grown year-round may contribute significantly to the frequency of numerous mold aeroallergens.

Materials and Methods

Experimental procedures for the collection of data in this investigation are described elsewhere.¹

Antigens: Mold extract antigens (1:20 W / V : 1:1000 W:V) were purchased from Hollister-Stier Laboratories (Livermore, California) and included *Alternaria*, *Aspergillus*, *Aureobasidium* (*Pullularia*), *Cladosporium* (*Hormodendrum*), *Fusarium*, *Helminthosporium* and *Mucor*. In order to compare our data with those of Jones and Gerson⁵ only 2+ or greater skin test reactions are reported. All skin tests were performed intradermally on the back using a Koss automatic scarifier.

Allergic Patients: All patients selected for this investigation presented with allergic rhinitis or seasonal or perennial asthma and included males and females of all age groups. A total of 145 patients were included; skin tests had not been performed on eight of these and their home mold data were excluded from this report. Six patients were skin test negative to all molds tested.

Results and Discussion

In almost all instances there is a greater percentage correlation of positive skin test with indoor colony forming units (CFU) compared with outdoor CFU (Table I). This is probably due to the higher frequency of indoor mold captures since four Petri plates were used compared with one for the outdoor sample. The highest percentage correlations are with Cladosporium, Penicillium and Alternaria, while the correlations relating the number of positive skin tests to catches of Helminthosporium, Fusarium, Aureobasidium and Mucor are one percent or less in each case.

Table I. Percentage Correlation of Positive Skin Test and Finding Mold In and Out of the Homes of 137 Allergic Patients.

Antigen	Percent Correlation	
	Indoor	Outdoor
Cladosporium	31	27
Penicillium	20	6
Alternaria	18	10
Aspergillus	8	3
Helminthosporium	1	1
Fusarium	1	1
Aureobasidium	1	1
Mucor	1	1

In Table II is listed the number of patients per age group with skin test reactions greater than I+ to a given mold antigen. All percentages are rounded to the nearest percentage point. As a group the 0-10 year olds demonstrated the greatest percentage of reactive patients (mean: 42%) while none of the other age groups had more than 29% of the patients reactive to mold antigens. There were no patients over 50 years of age who were reactive to Aspergillus, Cladosporium or Fusarium

The number of patients who were skin test positive to Helminthosporium is the greatest in each age group compared with the other fungal antigens tested.

The sensitivity of children to mold allergens has been treated in some detail by others^{2,5} and is substantiated by our data.

The lack of skin test reactivity in the over-50 age group to several of the fungal antigens tested suggests an immunological deficiency in these persons. Considering a reasonably large sample number¹⁰, 2+ reactivity in some of these patients would be expected. This apparent lack of sensitivity exists for Fusarium, Aspergillus and Cladosporium, which are molds with low, moderate and high frequency, respectively, in our study.

It is difficult to explain how Alternaria was found in 18% of the homes yet a higher percentage of persons was sensitive to this mold in most age groups. This phenomenon was noted by Jones and Gerson⁵ and has been discussed by them. It is also possible that development of sensitivity to the mold spores might have occurred at a different time period from when the sample was taken. The same phenomenon is even more pronounced with the low frequency molds. In the case of Aspergillus, a moderate frequency mold, cross-antigenicity has been shown to exist with Penicillium⁶ and this may help explain the high frequency of skin test positive persons who react to Aspergillus antigens.

Of the six patients who were skin test negative to mold all had Cladosporium in the home and Alternaria, Penicillium and Aureobasidium were each found in half of the homes. These six patients were between the ages of 14 and 47.

Table II. Number of Patients Per Age Group With Skin Test Reactions Greater Than 1 +.

Age group:	0-10	11-20	21-30	31-40	41-50	>50
Sample:	29	20	25	29	18	10
Antigen						
Alternaria	15 (52%)	6 (30%)	8 (32%)	13 (45%)	4 (22%)	2 (20%)
Aspergillus	9 (40%)	4 (20%)	7 (28%)	5 (17%)	3 (17%)	0 (0%)
Aureobasidium	9 (40%)	5 (25%)	10 (40%)	7 (24%)	6 (33%)	3 (30%)
Cladosporium	10 (35%)	2 (10%)	6 (24%)	8 (28%)	4 (22%)	0 (0%)
Fusarium	7 (24%)	3 (15%)	5 (20%)	7 (24%)	3 (17%)	0 (0%)
Helminthosporium	22 (75%)	12 (60%)	13 (52%)	17 (59%)	10 (56%)	9 (90%)
Mucor	8 (28%)	1 (5%)	2 (8%)	4 (14%)	2 (11%)	3 (30%)
Penicillium	9 (40%)	3 (15%)	2 (8%)	5 (17%)	4 (22%)	2 (20%)
Mean%:	42	23	27	29	25	24

The percentage of patients who had a 2+ or greater skin test reaction to Alternaria with concomitant 2+ or greater skin test reactions to the other mold antigens tested is presented in Table III. The 0-10 and 21-30 age groups had the highest dual reactivity in general as seen by the mean (44% and 46% respectively). Comparatively low incidence of dual reactivity was present in the 11-20 and 41-50 age groups (31% and 39% respectively). In the over-50 age group Helminthosporium was the only mold antigen that was skin test positive when Alternaria was also skin test positive. In all age groups Helminthosporium antigen consistently presented the highest incidence of reactivity with Alternaria compared with other antigens tested.

Since Helminthosporium positive skin tests were the most frequently encountered in this survey and this mold was found only on rare occasions¹ these data are in conflict with those of Goldfarb² and Schaeffer et al³ who have stated that the spores with the highest frequency are also the most important from the clinical standpoint. Our data suggest that cross-reactivity between Alternaria and Helminthosporium exists compared with dual sensitivity of Alternaria and the other fungal antigens tested. This evidence of cross-reactivity is supported by Sams and Smith,⁶ who reported definite cross-antigenicity between Alternaria and Helminthosporium by statistical analysis of skin test data and by tanned erythrocyte hemagglutination test and concluded that the skin test for immediate hypersensitivity was the only reliable tool for estimating cross-reactivity. They also reported cross-antigenicity between Helminthosporium and several other fungal antigens prepared from the same genera of fungi used in this study. Jones and Gerson⁵ suggest that cross-reactivity between Alternaria and Cladosporium may be occurring. Of 22 positive reactors to Alternaria, nine were also positive to Cladosporium. Our data yield somewhat higher frequency of concomitant 2+ reactions of Cladosporium and Alternaria for the same age group (47% vs. 41%) but cross-antigenicity between these fungal antigens is not evidenced by Sams and Smith.

Further evidence for cross-reactivity between Alternaria and Helminthosporium is presented in Table III, which indicates that Helminthosporium was the only mold antigen that was skin test positive when Alternaria was also skin test positive in the over-50 age group.

In conclusion, in virtually all age groups a relatively high percentage of allergic persons was skin test positive to molds that were recovered from their homes in low, moderate and high frequency. These patients may have become sensitized to that mold at a time other than when the sample was collected since one can expect a changing frequency of fungal genera inside and outside the home and in the patient's environment as a whole.

Dual reactivity between these aeroallergens is known to exist and cross-reactivity is strongly suggested.

Helminthosporium does not have to be present in the environment for skin test and probably respiratory reaction to this mold to occur, as long as Alternaria or other molds are present. This is true for up to a year prior to skin testing equal to the length of time of this survey.

Table III. Percentage of Patients Sensitive to Alternaria Also Sensitive to Other Mold Antigens

Antigen	Age Group					
	0-10	11-20	21-30	31-40	41-50	>50
Aspergillus	9/15 (60%)	3/6 (50%)	5/8 (63%)	4/13 (31%)	1/4 (25%)	0 (0%)
Aureobasidium 8/15	3/6 (53%)	6/8 (50%)	5/13 (75%)	2/4 (38%)	0 (50%)	0 (0%)
Cladosporium	7/15 (47%)	0/6 (0%)	4/8 (50%)	5/13 (38%)	1/4 (25%)	0 (0%)
Fusarium	7/15 (47%)	1/6 (17%)	3/8 (38%)	6/13 (46%)	0/4 (0%)	0 (0%)
Helminthosporium	13/15 (87%)	4/6 (67%)	6/8 (75%)	9/13 (69%)	2/4 (50%)	2/2 (100%)
Mucor	6/15 (40%)	0/6 (0%)	1/8 (12%)	4/13 (31%)	0/4 (0%)	0 (0%)
Penicillium	5/15 (33%)	2/6 (33%)	1/8 (12%)	3/13 (33%)	2/4 (50%)	0 (0%)
Mean%:	44	31	46	41	29	14

Summary

Allergic patients (137) were skin tested and 131 were found to be allergic to mold antigen. Children under 10 years were the most reactive; persons over 50 years were the least reactive. More persons were reactive to Helminthosporium than to any other mold antigen tested, despite its rare occurrence in the patients' environment.

References

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