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Mold Allergy is a Risk Factor for Persistent Cold-Like Symptoms in Children

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Summary: In winter, children with mold allergy may develop persistent cold-like symptoms (PCLS) that often defy conventional therapy. To investigate the cause of PCLS, we enrolled 44 children (25 with PCLS and 19 controls) in a 2-year study to compare their clinical symptoms and the mold count in their homes. Children with PCLS had a higher percent of eosinophils in nasal smears as compared with those without PCLS (32% vs 26%). On a scale of 0 to 3, the PCLS group had higher symptom scores ($P < 0.001$ for all symptoms): bloodshot eyes (2.92 vs 0.79), mouth breathing (2.04 vs 0.68), rhinorrhea (2.48 vs 0.89), nasal voice (2.68 vs 1.00), postnasal drip (2.64 vs 0.47), and headache (2.72 vs 0.53) than the non-PCLS group. The clinical scores also correlated significantly with the mold count in the home (the r value ranged from 0.6716 to 0.7450). We conclude that management of children with PCLS should include decreasing humidity and enforcing environmental control to eradicate mold from inside the homes. *Clin Pediatr.* 1997;36:695-700

Introduction

We studied a group of children with known mold allergy who develop persistent cold-like symptoms (PCLS) in the winter months. PCLS is the worsening of the combined symptoms of nasal congestion, cough, bloodshot eyes in the morning, postnasal drip during the night, frequent headache, and easy fatigability. These patients were frequently treated for season-related upper respiratory tract infections or si-

nusitis, in spite of the fact that they were lacking signs of infection. Repeated courses of antibiotic therapy were frequently prescribed with or without antihistamines, decongestants, or steroid nose sprays, even though these treatments were often ineffective. The patients' symptoms would resolve dramatically when the weather became warmer. Since these children were known to have mold allergy, we speculated that an increase in the mold count in the homes during the winter might be contributing to

the development of PCLS. In this report we demonstrate the results of a 2-year study in 41 children who were divided and compared based on the presence or absence of PCLS.

Materials and Methods

Patients

Forty-four children (ages 4 to 14) with perennial allergic rhinitis diagnosed in our allergy clinic and who were seen in the winter months were chosen on a consecutive basis for the study. Informed consent was obtained from their parents. All of the patients had been determined by skin test to have sensitivity ($\geq 2+$ on the scale of 0 to 4) to at least three mold allergens, but not to house dust mites, animal danders, or cockroaches. Of the 44 children, 25

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had had PCLS for at least the last 2 years and 19 had not. The clinical criteria of PCLS included the simultaneous presence of moderate to severe nasal congestion, cough, bloodshot eyes, postnasal drip, headache, and easy fatigability continuously for more than 2 weeks. The evidence of upper respiratory infection or sinusitis was carefully ruled out by observing clinical signs (family history, fever, clinical course) and radiographic findings (absence of opacity, air-fluid level, and mucosal thickening of greater than 4 mm in sinus cavities).

Parents were instructed to fill out the symptom score sheets during two visits in January and February using a scale of 0 to 3 (0 = no symptoms; 1 = mild symptoms; 2 = moderate symptoms; 3 = severe symptoms). The average of the scores from the two visits represents the final score on the following symptoms: bloodshot eyes, mouth breathing, rhinorrhea, heavy nasal voice, postnasal drip, and headache.

Mold Survey

The air inside the children's bedrooms and outside all 44 homes (including 40 to 50 feet around the perimeter of the homes) was sampled within 3 weeks after a clinic visit during the winter. Air samples were collected with an Anderson air sampler, which was stationed in the center of the children's bedrooms 30 inches above the floor. The flow rate was set at 1 cubic foot per minute and the machine was run for 2 minutes, which allowed the spores to impact directly on the culture media plate in the sampler after they went through 400 μ -sized pores. Colony counts were made as soon as they appeared on the culture plate, which usually took 48 to 72 hours. After 2 to 3

days to allow the colonies to sporulate, they were mounted and read microscopically with the use of current monographs to identify the species. Dual samples were taken at each site. The air was sampled in January–February and July–August for each home. The molds were identified under the microscope and their concentration in the air was expressed as colony-forming units per cubic meter of air (CFU/m³).

Nasal Smear for Eosinophils

We examined the nasal discharge collected after a deep nasal blowing from all the patients. The smears were air-dried, fixed in 95% alcohol, and stained with Hansel stain (Lide Laboratories, Florissant, MO). The number of eosinophils was expressed as a percentage of the total white blood cells in high-power fields under the microscope.

Statistical Analysis

Symptom scores were compared between the group with

PCLS (N=25) and the control group (N=19) with Student's *t*-test. The mold count from the homes was also compared between the groups and a correlation with symptom score was determined by regression analysis.

Results

Table 1 lists the symptom scores of children with and without PCLS in the winter months. A statistically significant difference ($P<0.001$) was observed for virtually all the symptoms listed. The mean of nasal eosinophilia was 32% in the PCLS group (range 15% to 43%) and 26% in the control group (range 15% to 35%), not a statistically significant difference ($P>0.1$). The fungal strains isolated from the homes are listed in order of frequency of isolation in Table 2. The top five strains listed accounted for 80% of the molds isolated. All the children were sensitive to at least three of the molds listed in the table. A

Table 1

COMPARISON OF SYMPTOM SCORES BETWEEN CHILDREN WITH PERSISTENT COLD-LIKE SYMPTOMS (PCLS) AND THOSE WITHOUT PCLS (0=NONE; 3=SEVERE)

	PCLS Group (N=25)	Non-PCLS Group (N=19)
Bloodshot eyes*	2.92	0.79
Mouth breathing*	2.04	0.68
Rhinorrhea*	2.48	0.89
Nasal voice*	2.68	1.00
Postnasal drip*	2.64	0.47
Headache*	2.72	0.53

* $P<0.001$.

Table 2

FUNGAL STRAINS COMMONLY ISOLATED FROM THE HOMES OF CHILDREN WITH PERSISTENT COLD-LIKE SYMPTOMS

Cladosporium
 Penicillium
 Curvularia
 Epicoccum
 Alternaria
 Paecilomyces
 Aureobasidium
 Botrytis
 Trichoderma

0.68), rhinorrhea (2.48 vs 0.89), nasal voice (2.68 vs 1.00), post-nasal drip (2.64 vs 0.47), and headache (2.72 vs 0.53) than the non-PCLS group. The symptom scores for all of the children enrolled in the study correlated positively with mold count in the homes during the winter months (Figure 1). The correlation coefficient (*r* value) ranged from 0.6716 to 0.7450.

Discussion

House dust mites, animal danders, cockroaches, and molds are the most important airborne allergens in the home environment. In contrast to seasonal allergens such as the pollens of trees, grasses, or weeds, the constant presence of indoor allergens has long been blamed for the development of perennial allergic rhinitis, even in younger children.¹⁻³ While house dust mites, animal danders, and cockroaches are easier to identify as household allergens, mold allergens, while ubiquitous, are invisible and their significance is therefore often overlooked.

There are at least 14 different mold allergens known to cause symptoms of respiratory allergy.⁴ Although the significance of mold allergy in northern Florida each year is not fully appreciated by clinicians, we have regularly observed a group of children with mold allergy who develop PCLS in the winter months. PCLS is not a new clinical entity. It represents a severe form of allergic rhinitis in the clinical spectrum of mold allergy. As outlined in Table 1, the symptoms of rhinitis in patients with PCLS are more intense and almost never respond to antibiotic therapy. Symptomatic treatment with antihistamines with or

Table 3

COMPARISON OF MOLD COUNT (CFU/m³) IN THE HOME BETWEEN CHILDREN WITH PERSISTENT COLD-LIKE SYMPTOMS (PCLS) AND THOSE WITHOUT PCLS

	PCLS Group (N=25)	Non-PCLS Group (N=19)
Summer		
Inside house	473 ±91*	383 ±96
Outside house	784 ±147	699 ±100
Winter		
Inside house†	1130 ±109	424 ±28
Outside house	668 ±94	694 ±135

*Mean ±SEM.

†*P*<0.001.

comparison of the mold count in the homes of children in the two groups is shown in Table 3. The only significant difference between the groups was observed in the mold count from the homes in the winter months. The average mold count in winter in the

homes of children with PCLS was nearly threefold greater than that in the homes of children without PCLS. On a scale of 0 to 3, the PCLS group had higher symptom scores (*P*<0.001 for all symptoms): bloodshot eyes (2.92 vs 0.79), mouth breathing (2.04 vs

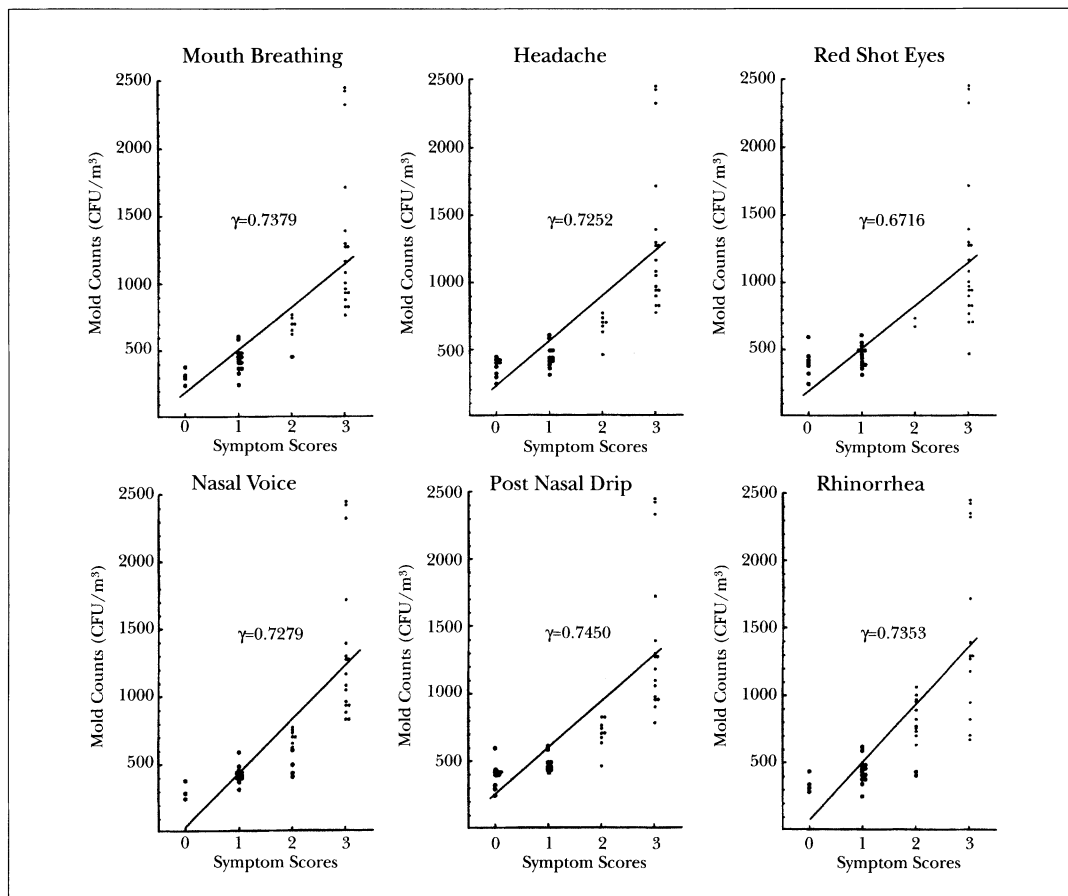


Figure 1. Correlation between mold count in the air and symptom scores of 44 children with or without PCLS.

without decongestants seldom achieves relief of symptoms. Even with the use of cromolyn or steroid nose sprays, patients continue to complain of the persistence of symptoms. In our earlier studies, we found PCLS the leading cause of morbidity and school absenteeism in this group of children.^{5,6} However, because of the seasonal coincidence and the known epidemiology of viral infections in the winter months,⁷ upper respiratory infection or sinusitis is often suspected, and the possibility of mold allergy is often overlooked by clinicians. Therefore, we suggest that there should be careful evaluation to distinguish between children with PCLS and those with respiratory

infections. In the clinical course of upper respiratory infections, there are always periods of remission between relapses of symptoms caused by infections. PCLS, on the other hand, lasts for months with sustained symptoms and is almost never accompanied by fever. Also, PCLS rarely presents with mucoid nasal discharge and is never associated with positive sinus radiography as in the case of sinusitis. Furthermore, bloodshot eyes in the morning and headache are common clinical features of PCLS, but not of viral upper respiratory infections (Table 1).

Our results suggest that PCLS is a severe form of mold allergy that occurs in the winter. This as-

sumption is based on two findings: (1) significantly higher mold counts in the air of homes of children with PCLS (Table 3) and (2) the positive correlation between indoor mold counts and symptom manifestation (Figure 1). Although we acknowledge that the airborne mold counts can vary from one time of the day to another, from room to room, and from day to day,^{8,9} the finding of significantly higher indoor mold counts in the winter months than in the summer months was not fully expected. Although we did not record the humidity in the homes, the weather report indicated that even in the winter months there was high humidity in our region. Therefore, in-

creased moisture in the homes, even in the winter, might be the critical factor for excessive mold growth. This increased humidity is in part the result of the common practice of installing elaborate insulation for energy savings in modern-day housing construction. In the summertime, air-conditioning helps to reduce both the room temperature and the humidity, which helps curtail mold growth. In winter, however, the furnace has little, if any, effect on humidity in the home. Our speculation was confirmed by the frequent reporting by parents of heavy condensation on the windows of their homes each morning in the winter. The reason the non-PCLS group appeared to have lower mold counts inside the home is not known. We speculate that there are several tangible factors that could be responsible: the number of people in the house, the presence of television sets or recreational machines in the children's bedrooms, the age of the carpets, and the age of the house itself.

In spite of finding a good correlation between mold counts and the symptoms of PCLS, we are unable to determine a critical threshold level of mold counts that would cause the development of symptoms. This difficulty was also reported in studies involving the measurement of the dust mite concentration^{10,11} or cat antigens indoors.¹² Perhaps, as has been suggested, the clinical threshold is also individually determined by mast cell releasability or the presence of specific epitopes of antigens at any given time.¹³

The results of this study have several important implications in the management of the symptoms

of PCLS. First, mold allergy cannot be overlooked as a cause, especially in children at high risk for developing PCLS. Second, PCLS should be suspected when initial treatment with antibiotic therapy, antihistamine/decongestants, or even steroid or cromolyn nose sprays fails to achieve the desired results. Third, the frequent occurrence of bloodshot eyes in the morning and persistent headache, in addition to being common clinical features of allergic rhinitis, should raise the concern that PCLS may be present. Fourth, PCLS can be effectively controlled only if an effort is made to reduce the humidity in the home environment.

Environmental control, including the removal of organic dusts, old carpets, and wallpaper from the home; the use of fungicidal detergents; or addition of an air cleaner to the house should be emphasized. Therefore, the practice of using a humidifier in the bedroom in the winter months, as is often recommended by clinicians for the relief of cold symptoms, should be discontinued if PCLS is suspected.

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