

Effect of evaporative coolers on skin test reactivity to dust mites and molds in a desert environment

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ABSTRACT

Dust mites and molds are usually not found in arid environments and have a lower prevalence in desert areas. Evaporative (swamp) coolers increase indoor humidity significantly. The purpose of this study is to determine whether evaporative coolers affect the skin test rate to dust mites and molds in patients. Patients with asthma or allergic rhinitis who were undergoing skin testing for molds, indoor allergens, grasses, weeds, and trees were asked about presence of central, window, and evaporative cooler air conditioning in their home. All were tested using the prick technique with controls. One hundred ninety patients between 1 and 42 years (mean, 5.4 years) were evaluated. Fifty-nine (31%) had an evaporative cooler in their home. Twenty-five (42%) of those with evaporative coolers had a positive skin test to at least one mold compared with 26 (19%) without coolers (chi-square, 10.5; $p = 0.001$). Twenty (34%) of those with evaporative coolers had a positive skin test to dust mites compared with 23 (17.5%) without coolers (chi-square, 6.2; $p = 0.013$). Children ≤ 6 years of age had the greatest skin test prevalence (chi-square, 4.3; $p = 0.03$). In the desert, children in homes using evaporative coolers are significantly more likely to have positive skin tests to molds or mites. This appears to be because of humidity caused by these devices. Patients with asthma in homes with evaporative coolers should be counseled about the risk for mold and dust-mite allergy. Humidity monitoring, cooler maintenance, and filter changes should be discussed.

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Key words: Allergic rhinitis, asthma, desert, dust mite, environment, evaporative cooler, humidity, indoor, mold, swamp cooler

Indoor allergens such as dust mites and molds have been well established as inducers and promoters of asthma.¹ Home damage or mold growth from dampness has been associated with an increase in early childhood asthma.^{2,3} Mold allergy is extremely prevalent in areas of the country with high humidity.⁴ However, dust mites and molds are generally not found in home environments with $<40\%$ humidity and as such have a low prevalence in desert areas. Evaporative coolers are only efficient when the relative humidity is low, thus restricting their effective use to very dry climates. Evaporative coolers are very popular in the desert because they are relatively inexpensive and conserve energy. Proper function of evaporative coolers leads to significantly increased indoor humidity and may permit growth of dust mites and molds in climates that are usually not conducive to their growth. Our study set out to determine whether there is a higher prevalence of skin test reactivity to dust mites

and molds in patients living in homes using evaporative coolers in a desert climate.

MATERIALS AND METHODS

Patients presenting to the University of Nevada School of Medicine Allergy and Asthma Clinic in Reno, NV, between August 2007 and June 2008 with a history of asthma and allergic rhinitis were evaluated. Data for age and presence of central, window, or evaporative coolers were collected from patients who were undergoing routine skin testing for molds, indoor allergens, grasses, weeds, and trees. Confounding factors such as frequent humidifier or vaporizer use were exclusion criteria because these devices also raise indoor humidity. Patients who had extensively lived outside the Reno, NV, area were excluded to avoid the possibility of previous sensitization from living in regions where there is a high incidence of dust mite and mold sensitization.

Each subject underwent allergy skin tests supervised by an allergist. Skin tests were performed using the prick-puncture method using a five-prong Greer Dermapik (Greer Laboratories, Lenoir, NC) as previously described.⁵ A 3-mm wheal was the minimum size of the histamine control to be considered adequate. To be considered positive, skin tests were required to be at least one-half the size of the histamine control. Patients were skin tested to a standard battery of extracts in-

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Table 1 Demographic data

<i>n</i>	190
Mean age (yr)	5.4
Age <6 yr	78
Swamp cooler in home	60
Central air conditioning	124
No air conditioning	6

Table 2 Results

Skin tests positive for molds	
Patients with evaporative coolers	42%*
Patients with air conditioning	25%
Skin tests positive for dust mites	
Patients with evaporative coolers	34%#
Patients with air conditioning	21%

* $p = 0.002$ chi-square; # $p = 0.013$ chi-square.

cluding various molds, inhaled allergens (molds and dust mites), weeds, grasses, trees, and animals. All molds tested included *Aspergillus*, *Alternaria*, *Cladosporium*, *Penicillium*, *Dreschlera*, *Curvularia*, Mold Mix II (*Curvularia*, *Fusarium*, *Aureobasidium*, *Mucor*, and *Rhizopus*), *Rhodotorula*, Smuts, *Dermatophagoides pteronyssinus*, and *Dermatophagoides farinae*. Extracts were obtained from Alk-Abello (Round Rock, TX). Statistical analyses (chi-square) were performed on the data obtained (Graph-Pad Software, San Diego, CA).

RESULTS

One hundred ninety patients between the age of 1 and 42 years with a mean age of 5.4 years with symptoms of asthma or allergic rhinitis were evaluated. Thirty-one percent of the patients reported using an evaporative cooler in their home. Sixty-five percent of patients used central air conditioning. The remainder of patients did not have any form of air conditioning. Demographic data is presented in Table 1. Three patients were excluded because of frequent vaporizer or humidifier use. Seven patients were excluded because of a history of having lived extensively in other areas of the country besides Reno, NV.

Evaluation of mold skin test reactivity was performed. Mold allergy was found in 42% of the patients with evaporative coolers when compared with only 25% of patients without evaporative coolers (Table 2). This correlation of evaporative coolers and mold sensitization was statistically significant. The most frequently identified molds were *Aspergillus*, *Cladosporium*, *Dreschlera*, and Smuts.

Evaluation was performed to evaluate skin test reactivity to dust mites also. Thirty-four percent of those with evaporative coolers had a positive skin test to at

least one dust mite compared with 21% without evaporative coolers (Table 2). The correlation of evaporative coolers to dust-mite sensitization was statically significant.

For all patients with skin test reactivity to dust mite or mold, skin test reactivity was also determined by age. Forty-four percent of the evaluated group (78 of 190) was in the age group of ≤ 6 years. Of these children 44 or 56% of this group had evaporative coolers. Most of the mold allergic patients were ≤ 6 years of age. Chi-square of 4.0 and $p = 0.046$ and were statistically significant. A significant number of the patients sensitized to dust mites were also ≤ 6 years of age (chi-square of 4.7 and $p = 0.03$). This was also determined to be statistically significant. Patients with evaporative coolers ≥ 7 years of age did not have significant sensitization to molds or dust mites ($p > 0.05$).

DISCUSSION

Studies evaluating the presence of aeroallergens in desert environments are relatively rare. Allergists face challenges in designing locally relevant skin test sheets for trees, grasses, and weeds. It has been generally thought that dust mite and mold sensitivity was uncommon in this area and many allergists do not routinely test for molds or dust mites. For the first time here, we show that the presence of evaporative coolers in desert homes increased the prevalence of skin test reactivity to molds and dust mites. This prevalence is increased in children < 6 years of age. This increased prevalence in young children is probably caused by the increased time they spend at home and indoors because of increased nap and sleep time compared with older children and adults.

Evaporative coolers are devices that cool air through the simple evaporation of water. They differ from refrigeration or absorption air conditioning, which use vapor compression or absorption refrigeration cycles. In the United States, evaporative coolers are often called swamp coolers possibly because of the mildew odor produced by early units.⁶ Air washers and wet cooling towers use the same principles as evaporative coolers but are optimized for purposes other than air cooling.

Evaporative cooling is especially well suited for hot, dry climates. In the United States, the desert/mountain states are especially good locations, and evaporative coolers are very popular in cities like Reno, Las Vegas, Denver, Salt Lake City, and Phoenix and other warm, dry locations throughout the world. In these climates, the cost of an evaporative cooler can be as much as 80% lower than standard central refrigeration air conditioning. Sometimes evaporative cooling and refrigeration are used in combination to cool the air and decrease costs.

In most areas of the United States, dust-mite exposure is strongly associated with respiratory allergies and asthma. The airborne propagules of molds are well known to cause allergies and asthma.^{7,8} However, mites and molds thrive primarily in humid environments where the humidity is above 40% for prolonged periods. Dust mites are rare in dry climates unless the humidity is artificially raised.⁷ McConnell *et al.*⁹ examined a cohort of 3535 children with no history of asthma who were followed for 5 years. Two hundred sixty-five children reported a new diagnosis of asthma during the follow-up period. They reported that in children with no history of wheezing, an increased risk of developing asthma was associated with a humidifier in the home. Ellingson *et al.*² has shown that the relative humidity created by evaporative coolers is associated with an increased concentration of dust-mite allergen. Airborne mold associated with evaporative cooler use included *Aspergillus* sp., which occurred far more frequently than in homes with air conditioning.¹⁰ Our results suggest that a humidifier in the home may contribute to the onset of asthma in this age group. We have shown here, for the first time, that allergic and asthmatic patients using evaporative coolers in a desert environment are significantly more likely to have a positive skin test to dust mites and molds. In addition, the most common sensitizing molds were *Aspergillus*, *Cladosporium*, *Dreschlera*, and *Smuts*.

Our findings of increased mold and dust-mite sensitization in patients with allergic rhinitis and asthma and who live in homes with evaporative coolers complements historical data showing increased dust-mite and *Aspergillus* levels in desert homes.^{2,10} The highest risk group in our study to be sensitized to mold and dust mites was children who were ≤ 6 years of age. Previous studies by our group have ascertained that rural children are capable of being sensitized to mice and cockroaches under 1 year of age.^{11,12} In addition, pollen sensitization can occur at as early as 2–3 years of age in this group.¹³ This study adds to our growing knowledge base of environments in which preschool children can have underrecognized atopy.

These findings may influence allergists' recommendations for both skin testing and avoidance measures for patients with evaporative coolers. Common sense suggests that removal of the evaporative cooler and replacement with an air conditioner would be the optimal avoidance recommendations. Replacing the evaporative cooler with central or window air conditioners may be an option for some households; however, they remain too costly for others. Instead, it may be important to look for ways to reduce the growth of dust mites and mold in homes with evaporative coolers. Maintenance of the evaporative cooler through regular draining and cleaning, removal of built-up sediment, and frequent cleaning of the filter will likely

help.¹⁴ Cleaning with hypochlorite-based cleaning supplies may decrease mite and mold levels and result in significant improvement of asthma quality of life in children.¹⁵ In addition, use of a humidity gauge to keep indoor humidity $<40\%$ may decrease mold and dust-mite growth.

CONCLUSIONS

Allergy to dust-mite and mold allergens is significantly more common in patients living in desert homes using evaporative coolers. The likelihood of positive skin test reactivity to dust mites and molds is higher in allergic rhinitis and asthma patients with evaporative coolers compared with similar patients without such coolers. This increase is more prevalent in small children. Undertaking measures to decrease these allergens by controlling the humidity level and frequently changing the evaporative cooler filters may be beneficial. It will also be important to counsel patients with asthma or allergic rhinitis regarding the increased rate of skin test reactivity when using evaporative coolers in their homes.

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