

# Molds in the Homes of Asthmatic Patients in Isparta, Turkey

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An increasing prevalence of atopic diseases has been demonstrated by several studies.<sup>1</sup> In addition, a 20-to-60 fold variation in the frequency of asthma, rhinitis, and eczema has been reported among different countries.<sup>2</sup> Allergen sensitization is a risk factor for the development of bronchial asthma in both children and adults. Sensitivity to indoor allergens and certain outdoor mold spores has been found to increase the risk of bronchial hyperresponsiveness and asthma symptoms in children.<sup>3</sup> Several investigators have shown in both children and adults that the severity of asthma symptoms will vary with the level of exposure of persons sensitive to indoor allergens.<sup>4,5</sup> Targonski *et al.*<sup>6</sup> studied asthma deaths in individuals 5 to 34 years of age in Chicago from 1985 through 1989 and found that mold spore levels (except tree, grass, or ragweed pollen) were high on days when asthma deaths peaked. Mold spores are prevalent in houses and flourish in the presence of special growth conditions such as humidity. Most of the mold surveys were performed in the outdoor environment in spite

**SUMMARY** This study was planned in order to determine the fungal spores in the air of inside the homes of asthmatic patients living in Isparta (from southwest region of Turkey). The seasonal properties of mold spores in the air of homes of 24 asthmatic and 14 control subjects living in the city of Isparta over a period of one year were investigated. Viable molds were recovered from all 38 houses. Twenty different molds were isolated and identified from the indoor air of the houses in which asthmatic patients and controls lived. The most common isolated genera were *Penicillium* spp. (27.9%), followed by *Cladosporium* spp. (26.3%), *Aspergillus* spp. (14.7%) and *Alternaria* spp. (13.1%) in the indoor air of the houses of asthmatic patients. No differences in colony numbers were observed between asthmatics and control groups. The percentage of molds was higher in kitchens than other parts of the houses such as living rooms and bedrooms ( $p < 0.05$ ). A seasonal variety of the fungal flora in Isparta city region was observed. It is concluded that viable molds are common in houses in Isparta. Reducing indoor molds may improve the health of individuals with fungal-induced diseases like asthma.

of the fact that the major and more relevant environment of harmful allergen exposure is indoors. Nevertheless, there are a few studies examining the indoor environment for molds. The identification of factors influencing the development and the severity of asthma is of obvious relevance for disease prevention program.

This study was planned in order to determine the fungal spores in the indoor air of homes of asthmatic patients living in Isparta (southwest region of Turkey). Therefore the results of this study may be used

as a basis for approaching indoor mold reduction measures.

## MATERIALS AND METHODS

This study was carried out on 24 asthmatic patients as the study group and 14 healthy subjects acting as the control group in Isparta. The diagnosis of asthma was

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made according to the National Institutes of Health criteria<sup>7</sup> in the Chest Disease Department of Süleyman Demirel University Hospital. The study was carried out during the 12 months period from June 2000 to July 2001. Sampling of indoor air was done monthly for one year. Sabouraud dextrose agar culture plates were opened 15 minutes in the kitchen, bedroom and living room of asthmatic and controls on a raised platform.<sup>8</sup> The plates were incubated at room temperature for two weeks. The ratio of colony number and species per plate was recorded. Molds were identified by conventional methods. The same type of mold growing in different places of a house are considered as only one growth for seasonal assessment. Humidity and monthly air temperature results were obtained from the regional meteorology station.

Statistical analyses were performed by Chi-square tests. A *p* value lower than 0.05 was accepted as a significant result.

## RESULTS

Twenty different genera of molds were detected in 38 houses. A total of 389 fungal colonies were identified during this study (251 from indoor air of houses of the asthmatic patients, 138 from indoor air of houses of the control subjects). The colony numbers were not significantly different between asthmatic patients and controls. *Penicillium* spp. (27.1%), *Cladosporium* spp. (26.3%), *Aspergillus* spp. (14.7%) and *Alternaria* spp. (13.1%) were the predominant indoor flora in houses of asthmatic patients. The indoor genera of the molds were similar between asthmatic patients and controls (Table 1). The percentage of the molds detected in the kitchen, bedroom and living room

**Table 1** The percentage of molds in homes of asthmatic patients and controls for 1-year

Molds	Asthmatic patients		Healthy control	
	n	%	n	%
<i>Acremonium</i> spp.	2	0.8	1	0.7
<i>Alternaria</i> spp.	33	13.1	16	11.5
<i>Aspergillus</i> spp.	37	14.7	24	17.3
<i>Bipolaris</i> spp.	4	1.6	1	0.7
<i>Botrytis</i> spp.	1	0.4	1	0.7
<i>Chaetomium</i> spp.	2	0.8	3	2.2
<i>Chrysosporium</i> spp.	3	1.2	1	0.7
<i>Cladosporium</i> spp.	66	26.3	35	25.3
<i>Conidiobolus</i> spp.	2	0.8	2	1.5
<i>Curvularia</i> spp.	2	0.8	2	1.5
<i>Fusarium</i> spp.	5	2	2	1.5
<i>Mucor</i> spp.	9	3.6	6	4.4
<i>Paecilomyces</i> spp.	2	0.8	1	0.7
<i>Penicillium</i> spp.	68	27.1	34	24.6
<i>Phoma</i> spp.	1	0.4	-	-
<i>Rhizomucor</i> spp.	1	0.4	1	0.7
<i>Rhizopus</i> spp.	6	2.4	5	3.8
<i>Scopulariopsis</i> spp.	1	0.4	2	1.5
<i>Stemphylium</i> spp.	5	2	-	-
<i>Ulacladium</i> spp.	1	0.4	1	0.7
<b>Total</b>	<b>251</b>	<b>100</b>	<b>138</b>	<b>100</b>

of the asthmatic patients were 39.2, 32.3 and 28.5, respectively. The percentages of molds were higher in kitchens than in living rooms and bedrooms in the houses of the asthmatic patients (*p* < 0.05). It was found that the fungal flora in the indoor air in Isparta changed with the seasons (Figs. 1 and 2).

## DISCUSSION

In this study, it was found that the predominant genera were *Penicillium* spp. (27.1%), *Cladosporium* spp. (26.3%), *Aspergillus* spp. (14.7%) and *Alternaria* spp. (13.1%) in the indoor air of houses in which asthmatic patients lived in Isparta. Katz *et al.*<sup>9</sup> showed that *Aspergillus* followed by *Alternaria* and *Penicillium* were the most prevalent indoor

molds in Israel. Also Olonitola *et al.*<sup>8</sup> isolated *Penicillium* spp. and *Aspergillus* spp. as the most predominant molds in the houses of asthmatic patients in Nigeria. *Penicillium* spp. and *Aspergillus* spp. are considered to be primarily indoor allergens, but *Alternaria* spp., *Cladosporium* spp., and other outdoor fungal allergens can be found indoors as well.<sup>10</sup>

Several studies have demonstrated the relationship between increased numbers of spores and fungal antigen levels to the presence of allergic symptoms. Of the homes of 20 children with known allergies, 12 (63%) of 19 houses had increased fungal levels. The most commonly identified molds were *Penicillium* spp., *Cladospo-*

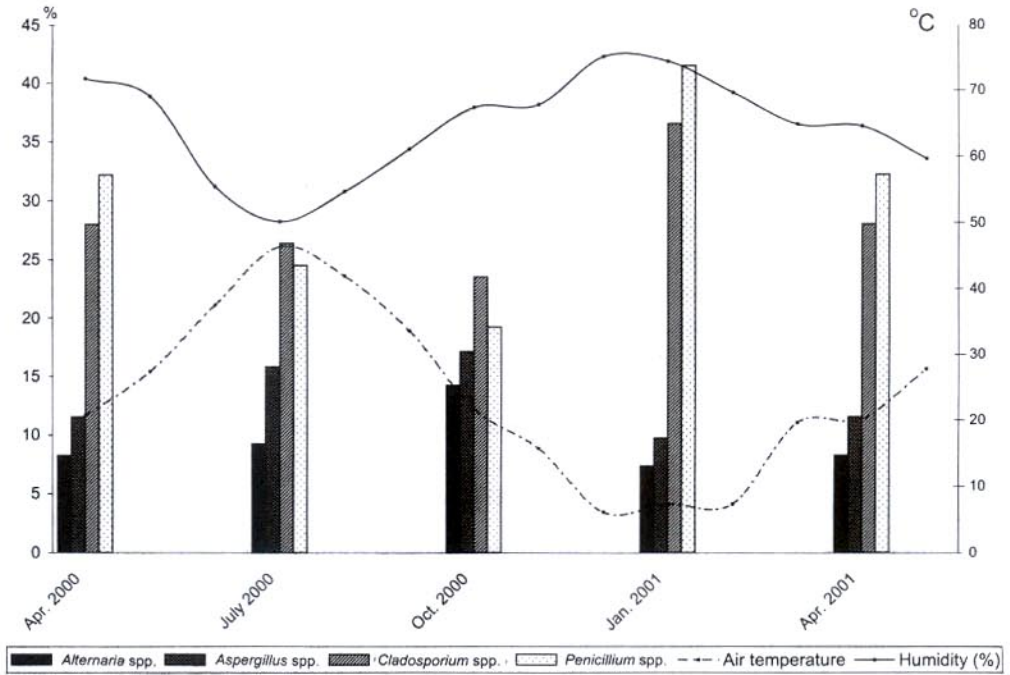


Fig. 1 Indoor mold distribution with air temperature and humidity during the study period.

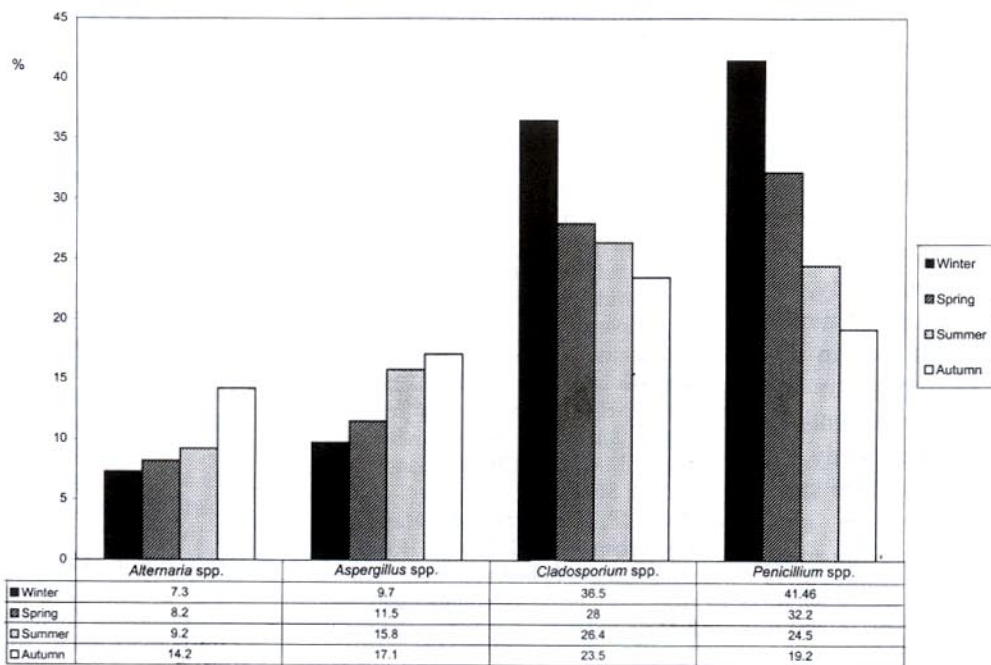


Fig. 2 Seasonal varieties of major indoor molds in asthmatic patients's homes.

rium spp., *Aspergillus* spp. and *Mycelia sterilia*.<sup>11</sup> Those with atopy had higher fungal levels than control subjects in summer. Also the presence of *Cladosporium* spp. correlated with asthma according to a study of the homes of 46 individuals (20 atopic, 26 nonatopic) living in Taiwan.<sup>12</sup> Henderson *et al.*<sup>13</sup> examined factors linked to recurrent wheezing in a case-control study of 343 children 7 to 12 years of age recruited from a general pediatric practice. The antigens most frequently associated with wheezing were house dust mite, cat, and *Alternaria*. Gergen *et al.*<sup>14</sup> studied 4,295 children and young adults 6-24 years of age and measured allergen reactivity by skin-prick test. Asthma without allergic rhinitis was associated with sensitivity to house dust and *Alternaria*. In our study *Alternaria* spp. was determined as the fourth common indoor mold.

Indoor conditions associated with the presence of molds include increased indoor humidity, low ventilation rates, and a high level of outdoor fungal allergens. Locations where molds often colonize include basements, damp indoor walls, bathrooms, kitchens, cool mist vaporizers, window moldings and bookshelves. In our study, we found that the percentage of molds was higher in kitchens than in living rooms and bedrooms in the houses of the asthmatic patients ( $p < 0.05$ ). In our previous study, it was found that *Cladosporium* spp., *Alternaria* spp., *Penicillium* spp. and *Aspergillus* spp. were the most prevalent outdoor molds in Isparta.<sup>15</sup> According to these results, outdoor mold loads contribute to indoor mold

loads in Isparta.

We found a relationship between indoor mold ratio and outdoor weather. The percentage of *Penicillium* spp. was 32.2% in spring, 24.5% in summer and 19.2% in autumn, but 41.4% in winter. The ratio of *Cladosporium* spp. was higher in winter. Nevertheless, the lowest ratio of *Aspergillus* spp. and *Alternaria* spp. was found in winter. In Japan, it was found that indoor fungal numbers of *Cladosporium*, *Aspergillus*, *Walleimia*, and *Penicillium* species made a peak in October and were higher with increasing outdoor temperature and humidity.<sup>16</sup>

In conclusion, viable molds are common in houses of asthmatic patients living in Isparta. It is reasonable to believe that if this exposure was reduced, the severity and the incidence of the resulting illness would be reduced. Therefore, measures to decrease the indoor mold ratio may improve the health of individuals with fungal-induced diseases like asthma.

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