

Letter to the Editor

Is the home environment an important factor in the occurrence of fungal events in cystic fibrosis?

To the Editor,

We have read with great interest the article by Rocchi et al. entitled "Evaluation of mold exposure in cystic fibrosis patients' dwellings and allergic bronchopulmonary risk", which was recently published in the Journal of Cystic Fibrosis [1]. Their results indicate that indoor fungal contamination may be a factor favoring the development of allergic bronchopulmonary aspergillosis (ABPA). Therefore, we would like to report some complementary observations concerning the possible link between bronchial diseases and exposure to fungi in the home of cystic fibrosis (CF) patients.

From November 2013 to March 2014, a case-control study was performed at our pediatric CF center. The study involved 13 CF patients with *Aspergillus* colonization (at least two out of four distinct sputum samples per year) and 13 other CF patients who were always *Aspergillus*-free (mean age: 11.8 years, 53.8% girls). The two groups were paired for sex, age and class of CF mutations. As described by Rocchi et al., we used an electrostatic dust collector system, which enabled us to detect higher counts of fungal CFUs compared with reference methods [2]. After obtaining parental consent, we placed electrostatic wipes in three different locations of the house (child's bedroom, bathroom and living room) over the course of 14 consecutive days. Each family filled a questionnaire regarding the characteristics of the house (e.g., 20 questions concerning ventilation, pets, methods of home cleaning, humidity, age of the home, and exposure to decomposing elements). Identification of the different fungal species was performed via microscopy and matrix-assisted laser desorption/ionization with time-of-flight mass spectrometry (MALDI-TOF). We investigated fungi type and density, and then compared the fungi isolated from the sputa of the children.

The only differences between the 2 groups were a more frequent presence of a garden, of pets and of a house built less than 20 years ago in the colonized group than the control group (84.6% vs. 30.7%, $p = 0.01$; 76.9% vs. 30.7%, $p = 0.007$; 38.4% vs. 0%, $p = 0.01$, respectively). Many fungi were found in the home environment of all the children. *Aspergillus fumigatus* was present in the homes of four colonized patients and that of seven control patients (30.7% vs. 53.8%, respectively, $p = 0.08$). The density of *Aspergillus fumigatus*

was lower in all locations of the homes of colonized patients than in that of control patients (bed room: 1.24 /m²/day vs. 2.08 UFC/m²/day, $p = 0.53$; bathroom: 0.33 vs. 0.68, $p = 0.33$; living room: 1.24 vs. 3.70, $p = 0.24$, respectively), although this was not statistically significant. *Aspergillus fumigatus* strains found in the sputa of patients and the environment were compared, as assessed by testing nine microsatellites [3]. Interestingly, the environmental strains did not cluster together with the strains isolated from the corresponding patient (Fig. 1). Indeed, most of the environmental strains clustered into one group and were distinct from those isolated from the sputa of patients. Moreover, during the three years of the sputum collection phase, none of the patients were colonized by only one specific *Aspergillus fumigatus* strain, although some of the patients tested positive more than once with a particular strain. Thus, the source of contamination of the CF patients may be elsewhere other than the home environment.

The results of our study and of that of Rocchi et al. [1] may differ due to the variations in the populations studied (26 children vs. 16 adults, *Aspergillus* colonization vs. ABPA/sensitized patients, urban vs. rural zone, Mediterranean vs. Continental climate, etc.). However, the presence of a true control group definitively showed that fungal exposure rates were more elevated in control patients compared with infected patients. Our results are similar to those of a recent study published by Pricope et al., in which they assessed home exposure to *Aspergillus* in 34 CF patients (4 to 22 years old) via a visit performed by a home environment medical adviser. No differences were found between the patient samples lacking *Aspergillus*-related markers and those with *Aspergillus*-related markers [4]. Moreover, the fungi found in the home environment were quite different from those identified in the sputa of our patients, which highlights the importance of the patient himself/herself rather than the home environment in the occurrence of fungal events. Factors such as immune function of the CF patient, degree of disease severity, and extent of structural lung damage (as assessed via CT scan) may also play a role in predisposing patients to *Aspergillus*-related diseases.

The occurrence of fungal infections in CF patients is probably multifactorial [5]. The home environment is likely important, although other environments such as hospitals,

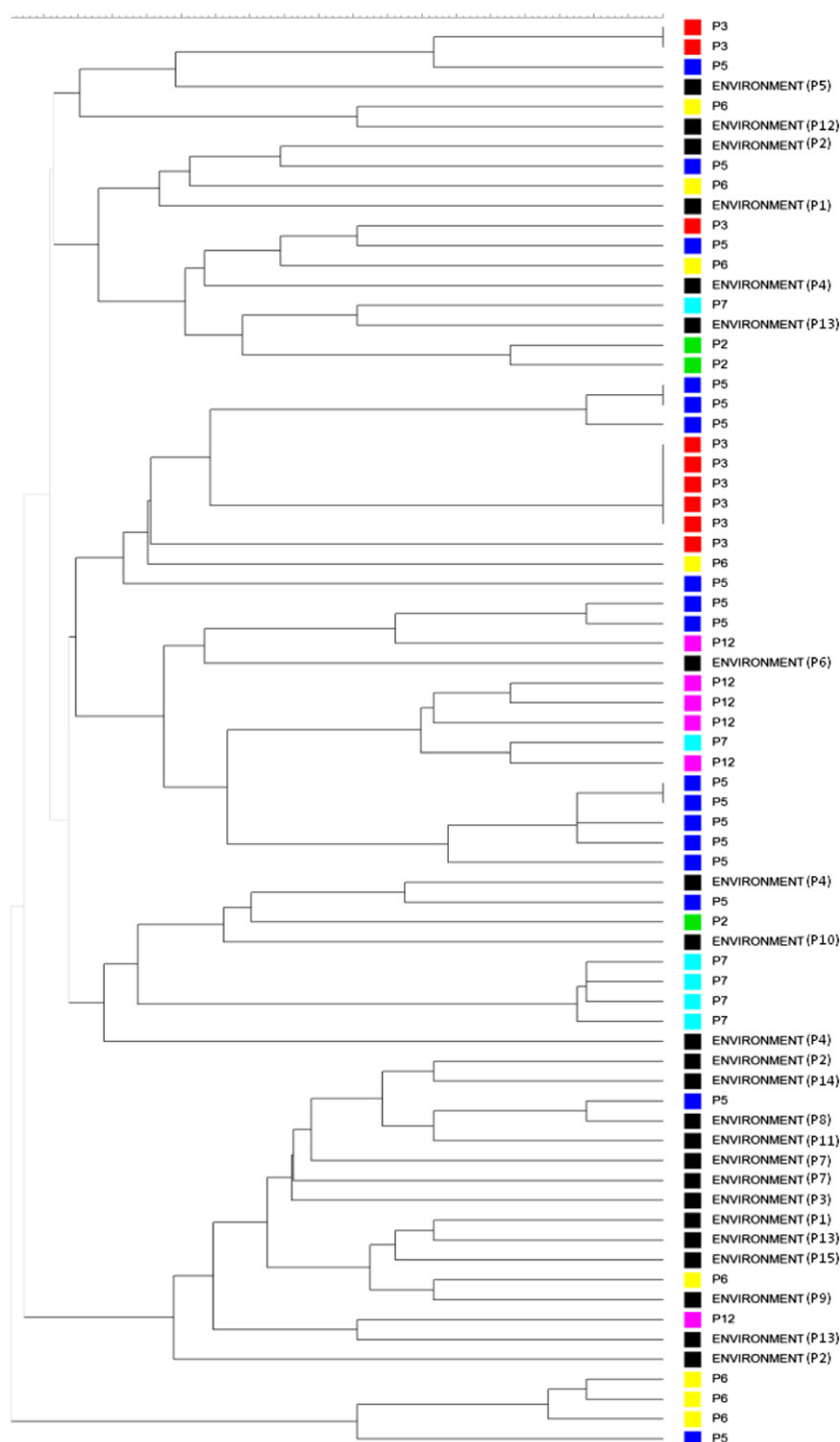


Fig. 1. Cluster analysis based on the *Aspergillus fumigatus* microsatellite results of the strains isolated from the sputums of 26 pediatric CF patients and the environment using the similarity coefficient for categorical values (BioNumerics 7.1., Gand, Belgium). Each patient was assigned a number (P1 to P26) and a color. Environmental strains are represented by a black box, and the corresponding patient is indicated in brackets.

where concentrations of fungi and other microorganisms can be elevated, may represent a more significant source of infection. This study demonstrates that the use of electrostatic wipes combined with an environmental survey could be instrumental in characterizing such infectious agents in future studies.

Conflict of interest

None. (See Fig. 1.)

Acknowledgements to Sandy Moore for proofreading the English version of the letter.

References

- [1] Rocchi S, Richaud-Thiriez B, Barrera C, Grenouillet F, Dalphin JC, Million L, et al. Evaluation of mold exposure in cystic fibrosis patients' dwelling and allergic bronchopulmonary risk. *J Cyst Fibros* 2015;14:242–7.
- [2] Noss I, Wouters IM, Visser M, Heederik DJ, Thorne PS, Brunekreef B, et al. Evaluation of a low-cost electrostatic dust fall collector for indoor air endotoxin exposure assessment. *Appl Environ Microbiol* 2008;74: 5621–7.
- [3] de Valk HA, Meis JF, Curfs IM, Muehlethaler K, Mouton JW, Klaassen CH. Use of a novel panel of nine short tandem repeats for exact and high-resolution fingerprinting of *Aspergillus fumigatus* isolates. *J Clin Microbiol* 2005;43:4112–20.
- [4] Pricope D, Deneuville E, Frain S, Chevrier S, Belaz S, Roussey M, et al. Indoor fungal exposure: what impact on clinical and biological status regarding *Aspergillus* during cystic fibrosis? *J Mycol Med* 2015;25: 136–42.
- [5] Baxter CG, Dunne G, Jones AM, Webb K, Gore R, Richardson MD, et al. Novel immunologic classification of aspergillosis in adult cystic fibrosis. *J Allergy Clin Immunol* 2013;132:560–6.

M. Oudyi
N. Stremmer- Le Bel
*Pediatric CF Centre and Pediatric Pulmonology Unit, CHU Timone-Enfants,
13385 Marseille Cedex 5, France*

R. Piarroux
*Department of Mycology and Parasitology, Aix-Marseille University, 13385
Marseille Cedex 5, France*

J.C. Dubus
*Pediatric CF Centre and Pediatric Pulmonology Unit, CHU Timone-Enfants,
13385 Marseille Cedex 5, France*

Corresponding author at: Pediatric CF Centre and Pediatric Pulmonology Unit,
CHU Timone-Enfants, 264 rue Saint-Pierre, 13385 Marseille Cedex 5, France.
Tel. +33 49138681; fax: +33 491386809.
E-mail address: christophe.dubus@ap-hm.fr.

May 2015

A. Sapet
*Pediatric CF Centre and Pediatric Pulmonology Unit, CHU Timone-Enfants,
13385 Marseille Cedex 5, France*

A.C. Normand
*Department of Mycology and Parasitology, Aix-Marseille University, 13385
Marseille Cedex 5, France*