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# Airborne Fungal Fragments and Allergenicity

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**Abstract**

Exposure to fungi, particularly in water damaged indoor environments, has been thought to exacerbate a number of adverse health effects, ranging from subjective symptoms such as fatigue, cognitive difficulties or memory loss to more definable diseases such as allergy, asthma and hypersensitivity pneumonitis. Understanding the role of fungal exposure in these environments has been limited by methodological difficulties in enumerating and identifying various fungal components in environmental samples. Consequently, data on personal exposure and sensitization to fungal allergens are mainly based on the assessment of a few select and easily identifiable species. The contribution of other airborne spores, hyphae and fungal fragments to exposure and allergic sensitization are poorly characterized. There is increased interest in the role of aerosolized fungal fragments following reports that the combination of hyphal fragments and spore counts improved the association with asthma severity. These fragments are particles derived from any intracellular or extracellular fungal structure and are categorized as either submicron particles or larger fungal fragments.

In vitro studies have shown that submicron particles of several fungal species are aerosolized in much higher concentrations (300-500 times) than spores, and that respiratory deposition models suggest that such fragments of Stachybotrys chartarum may be deposited in 230-250 fold higher numbers than spores. The practical implications of these models are yet to be clarified for human exposure assessments and clinical disease. We have developed innovative immunodetection techniques to determine the extent to which larger fungal fragments, including hyphae and fractured conidia, function as aeroallergen sources. These techniques were based on the Halogen Immunoassay (HIA), an immunostaining technique that detects antigens associated with individual airborne particles >1 microm, with human serum immunoglobulin E (IgE).

Our studies demonstrated that the numbers of total airborne hyphae were often significantly higher in concentration than conidia of individual allergenic genera. Approximately 25% of all hyphal fragments expressed detectable allergen and the resultant localization of IgE immunostaining was heterogeneous among the hyphae. Furthermore, conidia of ten genera that were previously uncharacterized could be identified as sources of allergens. These findings highlight the contribution of larger fungal fragments as aeroallergen sources and present a new paradigm of fungal exposure. Direct evidence of the associations between fungal fragments and building-related disease is lacking and in order to gain a better understanding, it will be necessary to develop diagnostic reagents and detection methods, particularly for submicron particles. Assays using monoclonal antibodies enable the measurement of individual antigens

but interpretation can be confounded by cross-reactivity between fungal species. The recent development of species-specific monoclonal antibodies, used in combination with a fluorescent-confocal HIA technique should, for the first time, enable the speciation of morphologically indiscernible fungal fragments. The application of this novel method will help to characterize the contribution of fungal fragments to adverse health effects due to fungi and provide patient-specific exposure and sensitization profiles.

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