Bioaerosols and Human Health in a Changing World: Need for a Global Electronic Spore and Pollen Information Network (E-SPIN)

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Background: Airborne pollen and fungal spores (bioaerosols) are major causes of respiratory allergy worldwide. Although pollen has been extensively studied, still little is known about fungi. What are the environmental factors affecting bioaerosol abundance? Is there a 'safe' place or time-period that we can 'switch off' bioaerosol exposure and allergies? To answer these, we investigated the spatiotemporal abundance of airborne allergenic pollen and fungal spores in a variety of climatic and pollution regimes, in both field and laboratory conditions and also data-oriented analyses, ultimately attempting to correlate with symptoms of allergic individuals.

Methods: A wide range of pollen and fungal taxa has been examined, locally (Augsburg, Germany), regionally (Bavaria, Germany) and Europe-wide, attempting to detect potential circadian periodicities, seasonality, and long-term trends. Monitoring took place using both conventional volumetric traps (Hirst-type) and novel automatic devices (PoMo, Hund GmbH), on a 2- to 3-hourly basis. Sampling was conducted in a variety of environmental conditions, in terms of vegetation, urbanisation levels, air temperature and pollution levels.

Results: Fungal spores seem to be more abundant when temperature is increased, but with a delay effect, both in field measurements and experimental conditions. Spores showed their peak concentrations mostly in the evening and this pattern was consistent regardless of the bioclimatic zone, air pollution or urbanisation level involved. Regarding pollen, they consistently increased their concentrations with increased temperature and urbanization, locally but also Europe-wide, and seasons became peakier. Specific plant taxa seem to be sensitive indicators of climate change effects, like birch, cypress, plane and plantain. Allergic symptoms of atopic patients are closely related to meteorological factors and abundances of bioaerosols.

Conclusion: Bioaerosol diversity and abundance change over time, in the short- and the long- term. It is expected that this phenomenon will dramatically reflect in the respective allergic symptoms. This poses a potential threat for allergic individuals worldwide and highlights the urgent need for the development of a global bioaerosol information network to warn of high-risk exposure. To achieve this, we need to integrate: novel monitoring techniques like unmanned air vehicles, automatic, real-time bioaerosol monitoring devices, and big data approaches, incorporating bioaerosol distribution data and air quality data.