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Biological Air Contamination in Elderly Care Centers: GERIA Project

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INTRODUCTION:

Healthcare organizations throughout the world have an increasing concern about how to cope with a quickly aging population (Caley & Sidhu, 2011). This trend explains the increasing demand of long-term care services (Damiani *et al.*, 2009) such as Elderly Care Centers (ECCs) (Kembel *et al.*, 2012). In Portugal, the number of ECCs increased 49% between 1998 and 2010. Furthermore, considering that elders often spend a considerable portion of their lives indoors, enhanced by they reduced independency, it is clear that the possibility that adverse indoor climate can influence their health status cannot be ignored (Almeida-Silva *et al.*, 2014). It has been estimated that older persons spend about 19-20 hours per day indoors and the majority spend all of their time inside the ECCs. Older persons may be particularly at risk of detrimental effects from pollutants, even at low concentrations, due to their common and multiple underlying chronic diseases that increases their susceptibility. It is extremely important to assess elderly exposure to biological pollutants due to the adverse health effects caused by biological agents to this susceptible population present in ECCs, enhanced by the time these people spend indoors.

OBJECTIVES:

The study aims were 1) to evaluate the total bacteria and fungi concentrations in a representative sample of ECCs in Porto as compared with the current national standards, 2) to study the variability of this biological parameters among different spaces within ECCs, 3) to identify the main fungi species found in the evaluated areas, and 4) how buildings characteristics may affect the indoor air biological pollutants.

MATERIALS AND METHODS:

Out of a total of 58 ECCs located in Porto urban area, 38% (n =22) accepted to participate in this study. Data were collected for each ECCs in two seasons and the following parameters were measured: building and ventilation characteristics, as well as biological parameters such as total bacteria count, fungi count and identification. It was conducted during summer and winter, from November 2011 to August 2013, at a total of 141 areas within dining rooms, drawing rooms, medical offices and bedrooms (including the bedridden). Air sampling was carried out with a microbiological air sampler (Merck Air Sampler MAS-100) and using *Tryptic Soy Agar* (TSA) for total bacteria and *Malt Extract Agar* (MEA) for fungi. Ambient air samples were also collected for comparison to the indoor measurements. The results obtained were compared with the recently revised Portuguese standards. Classical statistical methods were used to estimate means, medians and frequencies (percentages) in order to obtain insight into the ECCs characteristics and environmental monitoring results within and between buildings. All data were analyzed using IBM SPSS 21.0.

RESULTS AND DISCUSSION:

In the present study, 22 ECCs had an average bacteria concentration within the actual reference terms in both seasons and in all evaluated rooms. Looking back the previous legislation, the values would also be considered in conformity within the limit value. To be noticed that bacteria concentrations were higher in summer for all ECCs evaluated areas.

In summer season, the fungi concentration results, within ECCs and rooms, found mean concentrations all according the references. However, in winter this was not detected. The ECCs indoor fungi mean concentrations, and also in 4 out of 5 assessed areas, presented results above the outdoor concentrations. If the previous legislation were still ruling, fungi concentration would be considered to be within the reference value for ECCs mean and for concentrations found in some evaluated areas.

The most predominant indoor fungi species were *Cladosporium* (73%) in summer, followed by *Penicillium* (52%), *Paecilomyces* (52%) and *Aspergillus flavus* (52%). In winter, *Penicillium* (67%) was the prevalent fungi specie identified, being *Cladosporium* (58%) and *Aspergillus niger* (57%) the other two main species (Figure 1). Nonetheless, indoor vs. outdoor fungi specie identification comparison showed that fungi species indoors were the same as outdoors: *Cladosporium* in majority, followed by *Penicillium*. *Aspergillus fumigatus*, known potential pathogenic/toxigenic species, was also identified.

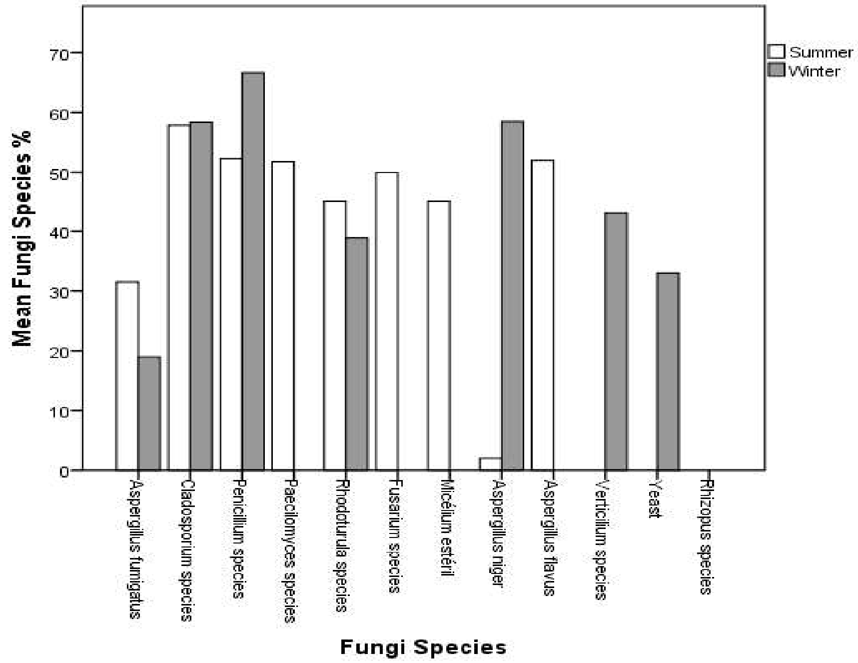

Figure 1 - ECCs main indoor fungi species by season.

Regarding the possible influence of building characteristics on the biological indoor air parameters, our study showed that the presence of bacteria in an ECCs depends on heating/ventilation or the presence of building pathologies, as well as upon the presence of windows sealants and the type of these sealants. On the other hand, fungi concentrations are associated to the building adaption to ECCs, existing sources of pollution, insulation, roof and windows characteristics, and building pathologies such as infiltrations and condensations.

CONCLUSION:

Comparing the results with Portuguese newly legislation, only fungi concentrations in winter did not accomplished the reference levels. Nevertheless, maximum bacteria concentrations were very high in both seasons. It is important to notice that, although biological concentrations were considerable acceptable, in light of Portuguese references, it doesn't assure that there is no risk for people who spend most of the day, or even consecutive days, inside these areas. Especially the elderly people: a group that is known for their impaired immune system and therefore ability to develop diseases, such as respiratory illnesses or airborne infections.

Although fungi main species found were *Cladosporium* and *Penicillium*, considered to be common in indoor air, *Aspergillus flavus*, *Aspergillus fumigatus* and *Aspergillus niger* were also identified, species that produce mycotoxins and therefore can be a cause of several adverse health effects.

For an improvement of IAQ regarding biological agents, control of indoor humidity is essential, eliminating all dampness and mold present in walls, roofs and surfaces. Number of occupants and their habits are also a contributor for the proliferation of microorganisms. Opening the windows, or intake of fresh and clean air, when the room is empty, is another effective and inexpensive measure that can improve IAQ, removing biological agents from its composition.

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