Efficiency of a free-standing air cleaner in reducing children's exposure to fungal spores

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People spend more than 80% of their time indoors and their health can be affected by exposure to various types of particles. The overall goal of this effort is to evaluate the high-efficiency particle air (HEPA) filtration used in homes for reducing exposure to aerosol particles. This is an important step in a large-scale study that aims at quantifying the effect of intervention by utilizing free-standing air purifiers in homes for reducing children's asthma. In this sub-study, we focus on the concentrations of airborne fungal spores.

The investigation is a double-blind, placebo-controlled, randomized intervention study with a cross-over design. Subjects are randomized to either HEPA or "dummy" air purifier (air cleaner without the filter) treatment group for one month, followed by one month wash-out period without any treatment, then will cross-over to the other treatment group for an additional month. The HEPA air cleaner was selected based on a laboratory study investigating the efficiency of several air cleaner models (Peck et al., 2016) and input from a community advisory board.

Airborne fungal spores were collected for 48 hours using Button samplers (SKC Inc., Eighty Four, PA, USA) operating at 4 L/min. Samples were collected indoors and outdoors before and after both HEPA and "dummy" treatment. Additionally, one month long indoor air samples were taken by collecting settling dust on electrostatic dust cloths (EDC; Shorter et al., 2016) in each home during both treatments. Fungal spore samples were analyzed for 36 fungal species with a mold-specific quantitative polymerase chain reaction assay (Vesper, 2011). For the data analysis, the concentrations of the 36 species were summed in each sample to obtain the total number concentrations; in spores/m^3 for the Button sampler results and in spores/mg for the EDC results. Indoor/outdoor (I/O)-ratios were calculated from the Button sampler results to account for the influence of variation in the outdoor spore concentration.

Preliminary data obtained in four homes show that indoor concentrations of fungal spores measured with the Button sampler decreased after both treatments, HEPA and "dummy" (Table 1). On the other hand, the I/O-ratios decreased after the HEPA treatment, but not after the "dummy" treatment (Figure 1). The fungal spore concentrations measured with the EDCs were generally lower during the HEPA treatment (ranging from 1,375 to 7,602 spores/mg) than during the "dummy" treatment (852 to 67,632 spores/mg).

Table 1. Average (± standard deviation) of indoor and outdoor fungal spore concentrations (spores/m^3).

Measured	Indoor	Outdoor
Before HEPA	108±124	1,095±1,392
After HEPA	3±2	1,202±1,929
Before "dummy"	215±178	3,017±2,399
After "dummy"	143±255	3,165±6,130

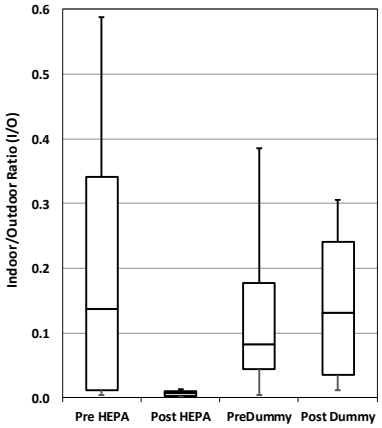

Figure 1. I/O-ratios of spore concentrations. The horizontal lines in the box plot from the bottom represent the minimum, 25%, 50%, 75% percentiles, and the maximum (n=4).

Pilot data show that the HEPA treatment reduced fungal spore concentrations. Future analysis will determine if children's asthma symptoms are also reduced.

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