Real-world Effectiveness of Portable Air Cleaners in Reducing Home Particulate Matter Concentrations

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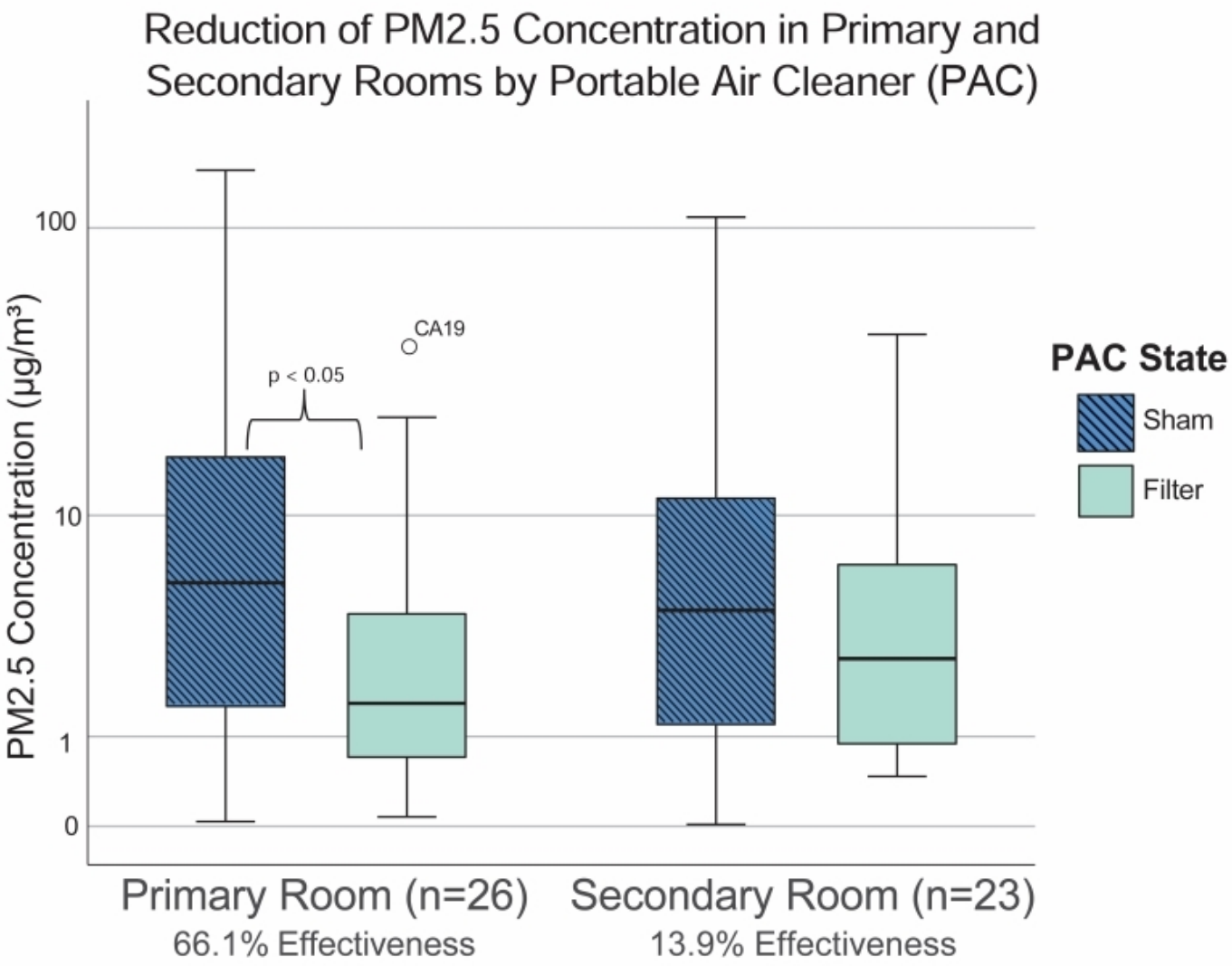
Rationale: Portable air cleaners (PACs) equipped with high-efficiency particulate air (HEPA) filters are gaining interest as an energy-efficient and cost-effective means of decreasing indoor particulate matter (PM) air pollutants and airborne viruses. The performance of PACs in naturalistic settings and in indoor spaces beyond the room containing the PAC (i.e., secondary rooms) is not well characterized. This is the first report of the effects of a PAC on particle concentrations in a secondary room and the impacts of central air systems on PAC performance. Methods: We conducted a single-blinded randomized cross-over interventional study of the homes of adults who tested positive for COVID-19. Real-time measurement of $PM_{2.5}$ and PM_{10} concentrations was performed (AirVisual Pro, IQAIR, La Mirada, California) in 29 homes for two consecutive 24-hour periods in the primary room containing the PAC and a secondary room. The intervention was air filtration with the PAC operated with the HEPA filter installed (“filter” state) versus removed (“sham” state, i.e., control). Results were stratified by time period (overall, day, and night) and usage of a central air handler (any use versus no use). Effectiveness of the PAC was calculated as the percent reduction in mean PM concentrations during the filter state. Significance testing was by Wilcoxon signed rank test. Results: Overall PAC effectiveness in reducing PM concentrations was 66.1% and 66.1% (n=26) for both $PM_{2.5}$ and PM_{10} fractions, respectively, in primary rooms and 13.9% and 25.0% (n=23), respectively, in secondary rooms. When a central air handler was used, PAC-associated reductions in PM in primary rooms was enhanced as overall PAC effectiveness for $PM_{2.5}$ and PM_{10} concentrations increased to 81.1% and 79.4%, respectively, in primary rooms and 63.3% and 64.7%, respectively, in secondary rooms. Conclusions: PACs substantially and significantly reduced $PM_{2.5}$ and PM_{10} concentrations in primary rooms. Although not significant for the number of homes investigated, we also found reduced PM concentrations for secondary rooms in this regard. Central air handlers potentiate the effectiveness of PACs in primary rooms and to a lesser extent in secondary rooms.



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