A randomized crossover trial of portable in-home air purifiers for highway PM and cardiovascular risk: HAFTRAP study update

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Background and Aim

We have shown previously that cardiovascular biomarkers are associated with traffic-related air pollution (TRAP) near highways and that reducing particulate exposure improves blood pressure (BP) in controlled settings. Our aim here is to assess the efficacy of portable in-home high-efficiency particle arrestance (HEPA) air purifiers to reduce indoor concentrations of TRAP and therefore reduce BP and systemic inflammation in a real world, lived-in setting.

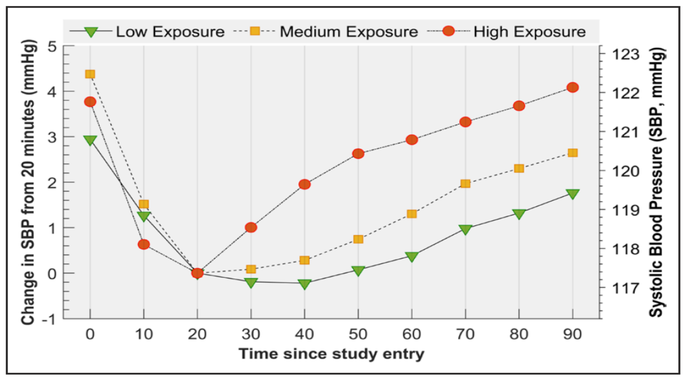


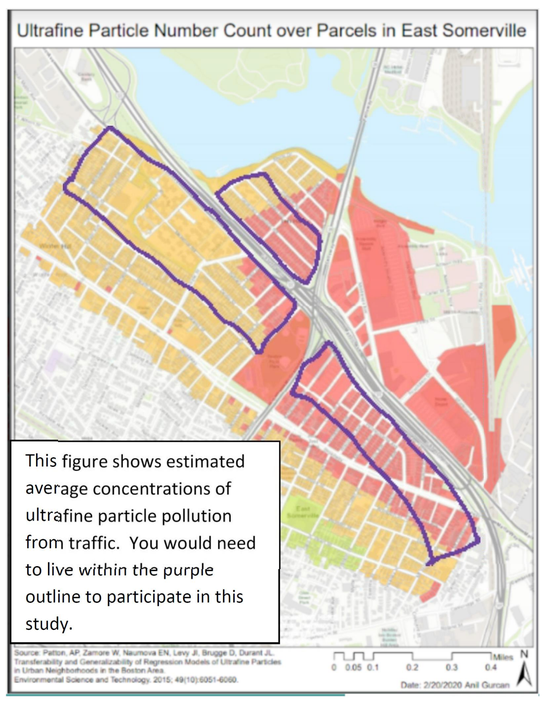
Figure 3. Means and mean changes in systolic blood pressure (SBP) over time by level of exposure. The estimates were derived from a linear mixed model that included 2 fixed covariates, SBP at 20 min and mean room temperature, and 2 time-varying covariates, particle number and black carbon concentrations. Over the 1-h time period, from 30 to 90 min, the mean change in SPB was significantly different among the three levels of exposure (linear trend P=0.019). Mean changes in SBP were significantly different between the low and high levels of exposure as early as 40 min (P=0.048).

Methods

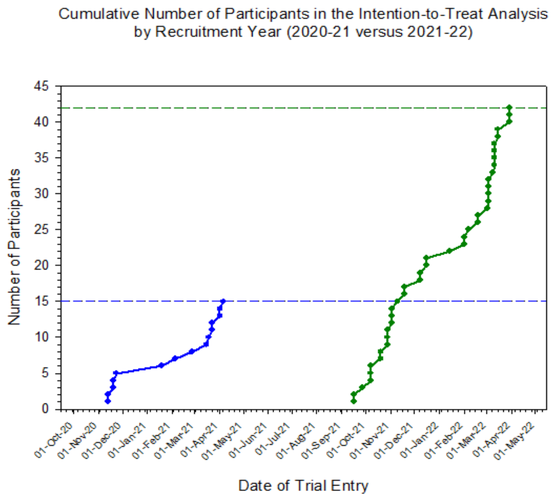
We are conducting a randomized crossover trial of air purifiers in homes <200m from a major highway. Participants receive real or sham filtration for one month each separated by a one-month wash out period. We collect peripheral and central BP, as well as blood samples for inflammatory biomarker analysis before and after each one-month period. We also conduct air monitoring and satisfaction interviews with a subset of homes and participants.

Results

A sample of 57 participants has been enrolled with recruitment ongoing. Thirty-three percent live within 100m of the highway. The average age of participants is 44 years (range: 30-78 years), 68% are female, and 37% are racial/ethnic minorities. The mean (SD) baseline peripheral and central systolic BP are 123 (14) mmHg and 113 (13) mmHg, respectively. Indoor and outdoor PNC measurements indicate that median concentrations were 40-60% lower during HEPA than SHAM and during HEPA use indoor concentrations were 60-70% lower than outdoors. Data on electricity use and quantitative and qualitative feedback suggest air purifiers were on the medium setting most of the time.



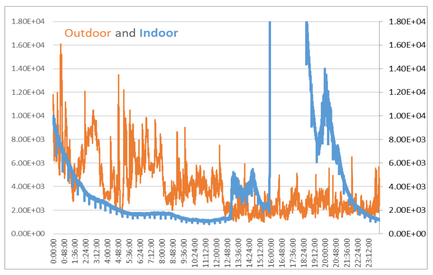
This figure shows estimated average concentrations of ultrafine particle pollution from traffic. You would need to live within the purple outline to participate in this study.



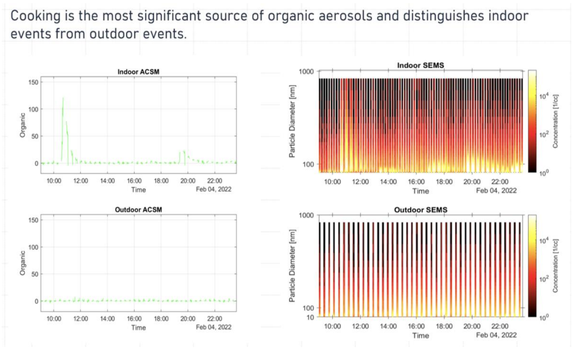
Enrollment by time, years 1 and 2 of recruitment. As of March 31st, 63 participants were consented, of which 57 completed their first home visit, including blood pressure measurements, blood draws, and installation of air purifiers.

Example of an air purifier in a home setting.

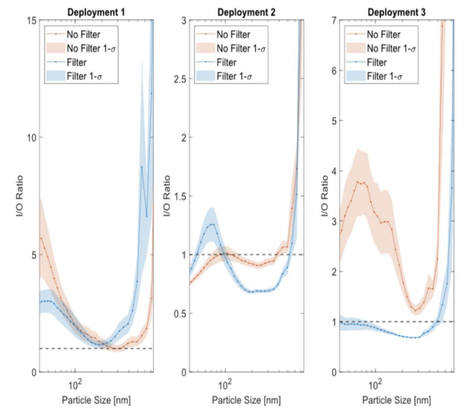
Results (cont.)



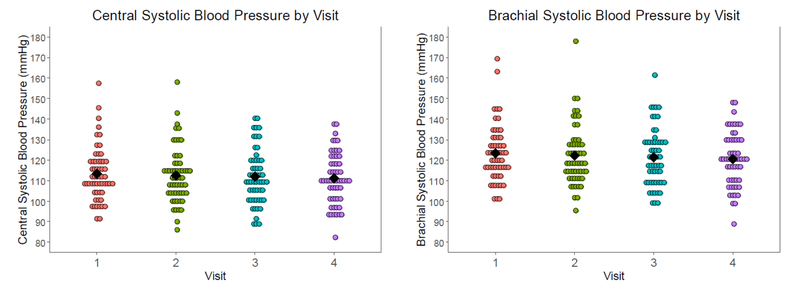
An example of indoor and outdoor PNC data is shown in the Figure (left). Preliminary analysis indicated indoor concentrations during HEPA were 36-51% lower than that observed during SHAM period.



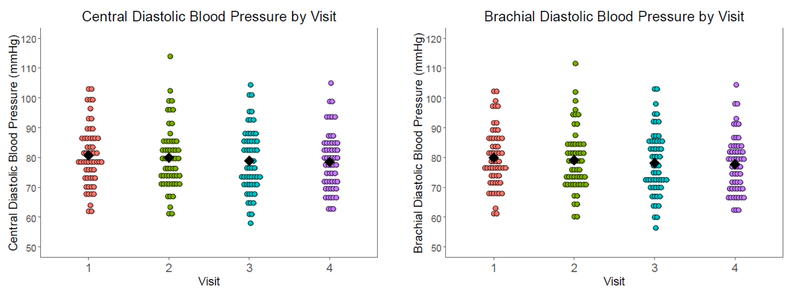
Time series of indoor and outdoor organic PM mass (left) and particle size distribution (right) demonstrate the importance of cooking events at driving exposure.



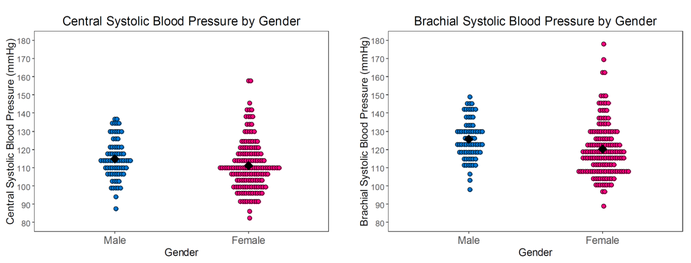
Average indoor:outdoor (IO) ratio in particle size distributions before and after filter installation show size-dependent filter impact on IO ratio.



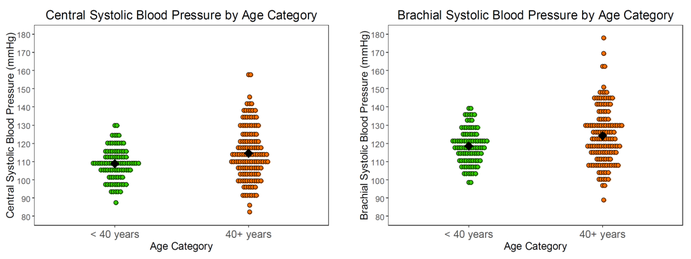
Dotplots showing the study participants' central and brachial systolic blood pressures at each of the four home visits. Each dot represents a participant's blood pressure and the black diamond is the mean blood pressure.



Dotplots showing the study participants' central and brachial diastolic blood pressures at each of the four home visits. Each dot represents a participant's blood pressure and the black diamond is the mean blood pressure.



Dotplots comparing central and brachial systolic blood pressures between males and females. Each dot represents a participant's blood pressure and the black diamond is the mean blood pressure.



Dotplots comparing central and brachial systolic blood pressures between younger and older participants. Each dot represents a participant's blood pressure and the black diamond is the mean blood pressure.

Conclusions

Approximately one-third of the way to our recruitment goal we have good acceptance and compliance with the intervention, quality data and indications that the air purifiers are reducing TRAP as intended. An interim analysis of health outcomes should be possible in a year.

Acknowledgements

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References

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