



Acceptability of home air purifiers to reduce traffic-related air pollution in near-highway residences

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Background

Traffic-related ultrafine particle pollution near highways has been associated with adverse health, such as increased risk of hypertension, coronary artery disease, myocardial infarction, and death^{1,2}. Use of portable air purifiers (APs) in homes is one way to reduce exposure to particulate matter and try to mitigate the risk of adverse health outcomes³. However, the acceptability of having air purifiers in homes has not been well studied.

Methods

This work is part of the Home Air Filtration for Traffic-Related Air Pollution, or HAFTRAP, study, which is a double-blinded, randomized crossover efficacy trial of in-home HEPA air filtration in the reduction of ultrafine particles. The study took place in near-highway residences in Somerville, MA (Figure 1). Households were randomized to 30 days of either filtration or sham filtration, with air purifier units (Figure 2) placed in the living room and bedroom, followed by a 30-day washout period, and then a subsequent 30-day period of the alternative assignment. Home visits were performed at 0, 30, 60, and 90 days. The data used to assess acceptability were compiled from three sources:

1. Responses to follow up questionnaires administered to all participants at the second and fourth home visits (N=56).
2. HOBO logger data to track use of the air purifiers among a subset of participants (N=18). The percent of time the air purifiers were on was calculated from the days of intervention and number of missing days recorded by the HOBO.
3. Responses to structured interviews about participants' experience with the intervention among a subset of participants (N=26).

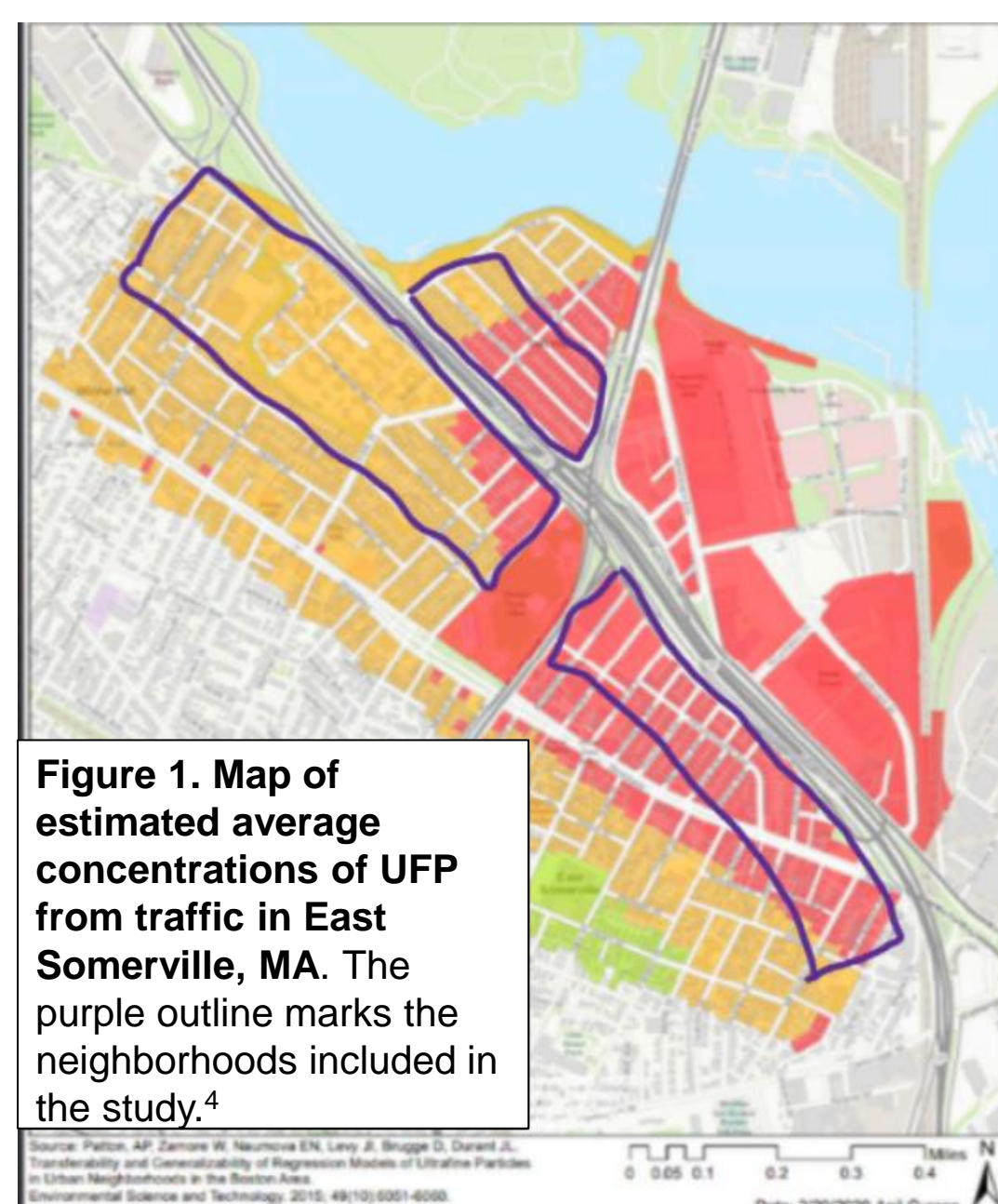


Figure 2. Example of an air purifier in a home.⁵

Results

The average age of the participants was 44.3 years old, ranging from 30 to 78 years old. The sample population was mostly female (67.9%) and not Latinx/Hispanic/Brazilian (78.6%). The majority of participants identified as white (66.1%), while 19.6% identified as multiracial/mixed/other, 5.4% identified as Black or African American, and 5.4% identified as Asian. Participants were asked about noise annoyance, patterns of use, enjoyment, and perception of health improvement. At both home visits, for both the living room and bedroom APs, 47–77% of participants reported not being annoyed by the noise generated by the units (Table 1), just as most participants were generally not bothered by road and air traffic, or other outdoor noise. Though some participants admitted in interviews to being surprised by the noise, others reported liking the white noise, especially in the bedroom.

Table 1. Participant-Reported Noise Annoyance and Use of Air Purifiers. Data were collected from survey responses administered at home visits two and four for all participants (N=56).

	Visit 2		Visit 4	
	Living Room	Bedroom	Living Room	Bedroom
Annoyance from Purifier Noise, n (%)				
Not at all	26 (47.3%)	34 (60.7%)	34 (61.8%)	43 (76.8%)
Slightly	21 (38.2%)	15 (26.8%)	17 (30.9%)	6 (10.7%)
Moderately	7 (12.7%)	6 (10.7%)	2 (3.6%)	6 (10.7%)
Very	0 (0%)	0 (0%)	1 (1.8%)	0 (0%)
Extremely	1 (1.8%)	1 (1.8%)	1 (1.8%)	1 (1.8%)
Days per Month of Filtration, n (%)				
Every day	53 (96.4%)	55 (98.2%)	52 (94.6%)	55 (98.2%)
A few times a week	2 (3.6%)	1 (1.8%)	1 (1.8%)	0 (0%)
Once or twice	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Never	0 (0%)	0 (0%)	2 (3.6%)	1 (1.8%)
Hours per Day of Filtration, hrs				
Mean (SD)	23.5 (2.8)	23.7 (2.1)	23.3 (3.8)	23.6 (3.2)
Minimum	8	8	0	0
Maximum	24	24	24	24
Preferred Purifier Settings, n (%)				
I (Low)	3 (5.5%)	5 (8.9%)	1 (1.9%)	1 (1.8%)
II (Medium)	41 (74.6%)	40 (71.4%)	41 (75.9%)	45 (81.8%)
III (High)	11 (20.0%)	11 (19.6%)	12 (22.2%)	9 (16.4%)

Results (cont.)

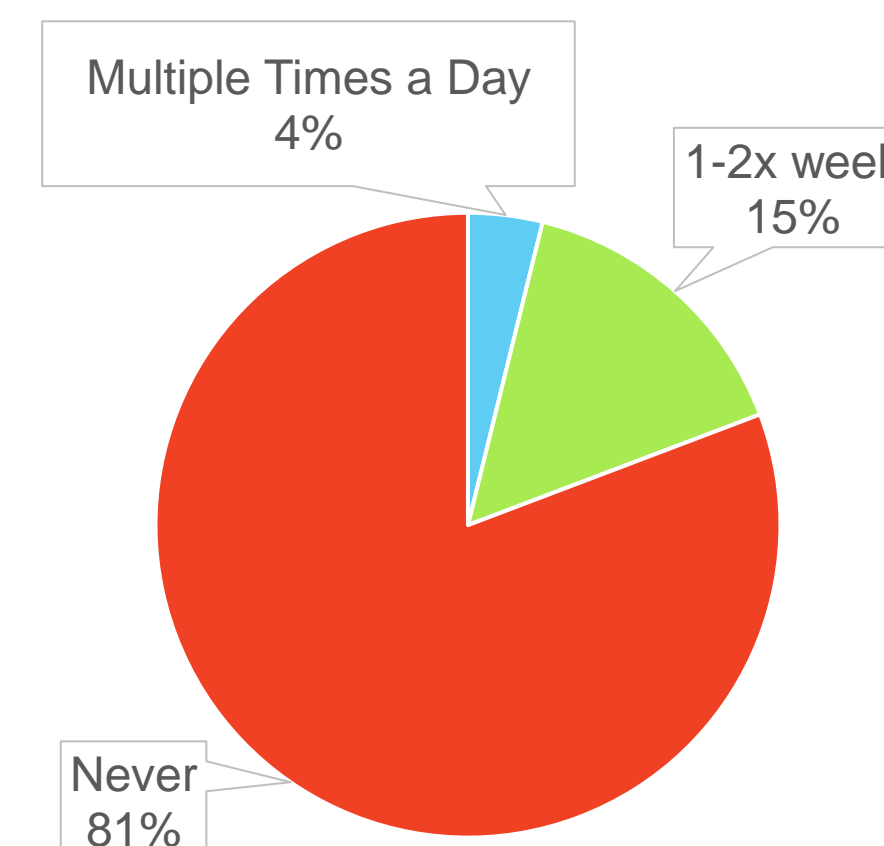


Figure 3. Participant-Reported Frequency of Moving the Air Purifiers in the Last Month. Data were collected from structured phone interviews in a subset of participants (N=26).

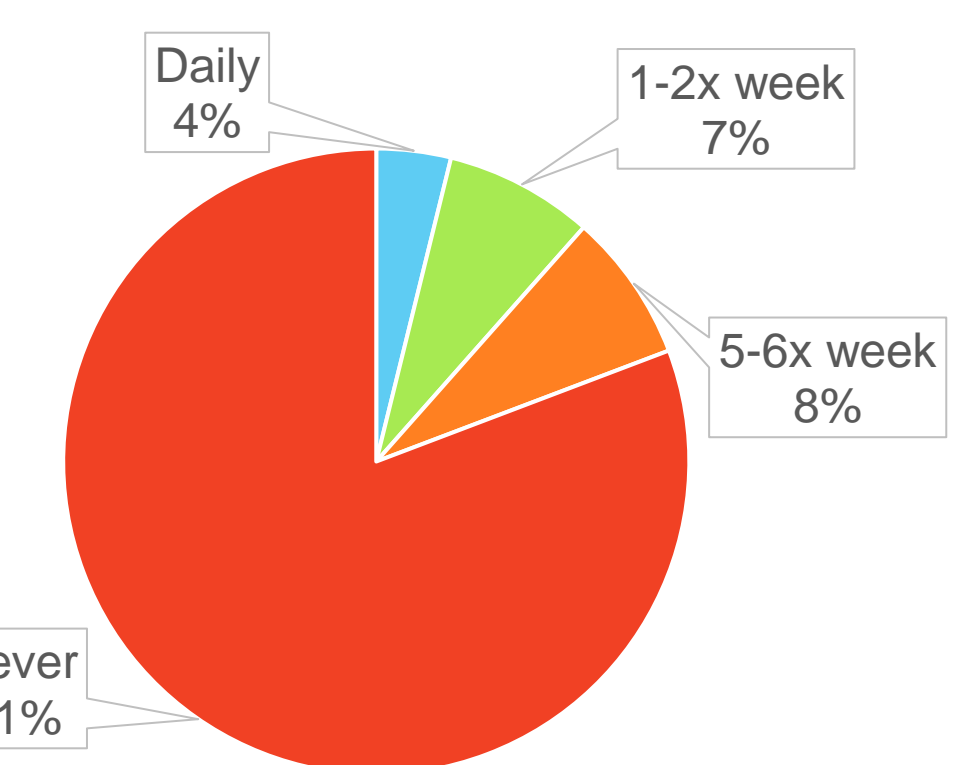


Figure 4. Participant-Reported Frequency of Turning the Air Purifiers Off in the Last Month. Data were collected from structured phone interviews in a subset of participants (N=26).

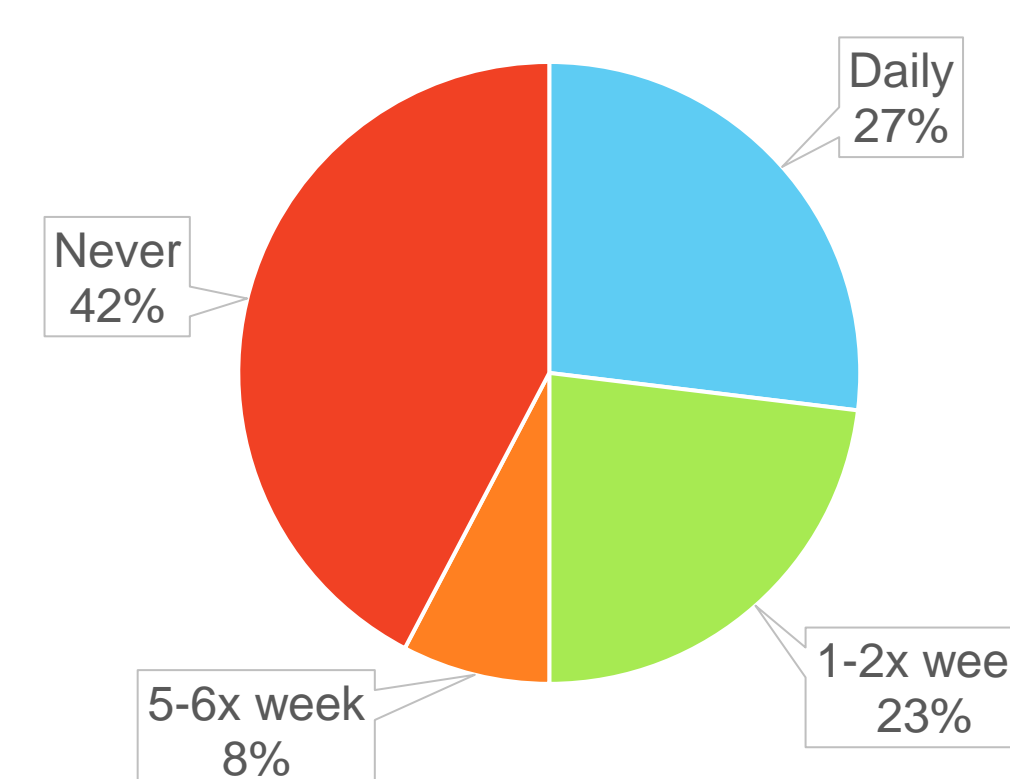


Figure 5. Participant-Reported Frequency of Changing Air Purifier Speed in the Last Month. Data were collected from structured phone interviews in a subset of participants (N=26).

Table 2. Participant-Reported Enjoyment and Perception of Feeling Better with AP Use. Data were collected from survey responses administered at home visits two and four for all participants (N=56).

	Visit 2	Visit 4
Enjoyment of Purifier Use, n (%)		
Never	9 (16.1%)	8 (14.3%)
Rarely	3 (5.4%)	3 (5.4%)
Sometimes	13 (23.2%)	12 (21.4%)
Often	11 (19.6%)	7 (12.5%)
Always	20 (35.7%)	26 (46.4%)
Felt Better with Purifier Use, n (%)		
Never	20 (35.7%)	24 (42.9%)
Rarely	4 (7.1%)	4 (7.1%)
Sometimes	15 (26.8%)	14 (25.0%)
Often	10 (17.9%)	4 (7.1%)
Always	7 (12.5%)	10 (17.9%)

Nearly all participants (>94%) used their APs every day per month, for over 23 hours a day (Table 1). HOBO data similarly showed that the air purifiers ran an average of >99% of the time at both home visits. Most participants (81%) did not move their purifiers to a different location, just as most participants (81%) reported never turning their AP off during the last month (Figures 3 & 4). The majority (71–82%) reported keeping their APs on the medium setting (Table 1). Though the same was said in the interviews, over half of participants (58%) also reported changing the AP speed at some point over the month (Figure 5). Reasons included noise disruption, being out of town, having company, or disliking the cold draft on cold days. Other barriers to AP use were the bulky size of the air purifiers and concerns over the cost of electricity consumption. Despite these barriers, the majority of participants (55–59%) reported often or always enjoying having the purifiers on (Table 2). Reported benefits were the perception of cleaner air with better circulation, as well as the cooling effect on warmer days. Though the questionnaire data showed that the majority of participants (70–75%) reported never, rarely, or sometimes feeling better with the APs (Table 2), the interviews elicited several perceived health benefits: improvement in allergies, congestion, asthma, and illness, especially among children, as well as alleviated concerns about COVID-19. Four households plan to continue AP use after the study, while the rest were not yet convinced of cost vs benefit.

Conclusions

The goal of this work was to assess acceptability of using home air purifiers to reduce TRAP exposure and its associated health effects within near-highway residences. Overall, participants of the HAFTRAP study generally accepted air purifiers for home use. However, they still identified potential barriers, including the air purifiers' noise production, large size, cold draft, and electricity consumption. Results from all three data sources suggest higher AP adherence than reported in other acceptability studies. Perceptions of improved air circulation and respiratory health agree with other published literature, as do the concerns about noise, cold air, and electricity costs. Avenues for future research include assessing acceptability with a larger sample size, and exploring factors affecting acceptability and adherence, such as income, education, and household size.

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