Near highway research findings for Somerville

Background

The Community Assessment of Freeway Exposure and Health study (CAFEH) has conducted extensive research on near highway pollution and health in the Somerville neighborhoods bordering Interstate-93. This research, which was conducted over more than a decade from 2008 to the present, provides deep and detailed, site-specific information and understanding of how highway pollution affects the communities near the highway. This research was primarily funded by NIH, HUD, EPA and the Kresge Foundation. It was conducted by a series of collaborations between Tufts University and the Somerville Transportation Equity Partnership, the City of Somerville and numerous other university, agency and community partners ((more at http://sites.tufts.edu/cafeh/). This HIA is under a separate research grant from NIH that followed on the earlier studies and is aimed at translating our findings into policy and practice in the affected communities.

Air pollution monitoring

CAFEH conducted an extensive mobile monitoring campaign that encompassed areas next to the highway in Somerville (essentially within 400 meters) and a "urban background comparison area (more than a kilometer from the highway). Mobile monitoring involved driving a converted recreational vehicle along a predetermined route through the studies area. The RV was outfitted with multiple air pollution monitoring instruments, including one that measured ultrafine particle concentrations. Figure 1 shows data for ultrafine particle concentrations (<100 nanometers in diameter, our primary concern for near highway pollution) from two of the mobile monitoring trips. A particular problem with studying near highway pollution, and ultrafine particles in

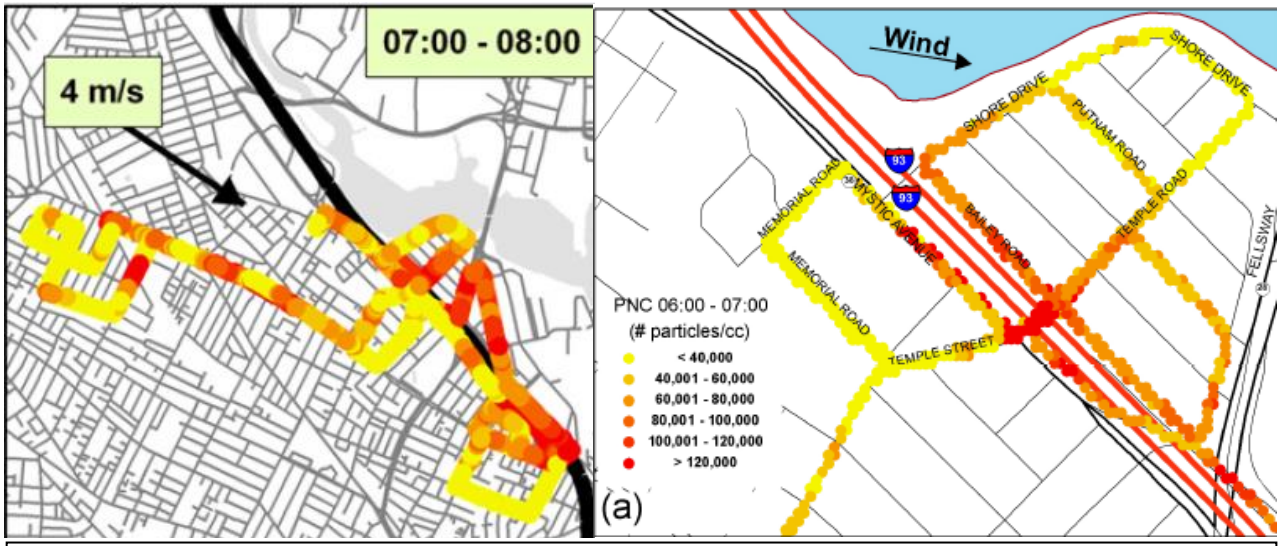

Figure 1. Plots of data from two mobile monitoring trips near I-93 in Somerville that were conducted as part of the CAFEH series of studies. Darker red indicates higher concentrations of ultrafine particles, measured as particle number count or PNC. Higher concentrations can be seen closer to the highway than farther away (Durant, 2010; Padró-Martínez, 2012)

particular, is that their concentration changes in time and space quite rapidly. That is why frequent mobile monitoring was required to gain an understanding of how concentrations varied because of traffic conditions, geographic location and weather.

In general, ultrafine particle concentrations were higher during colder weather (winter especially), on the downwind side of the highway, when wind speed was low (calm air conditions), and during rush hours, especially morning rush hours.

Recruitment of a study population

The goal of the research was to test for associations between near highway ultrafine particle exposures and indicators of cardiovascular health risk. In order to do this, the CAFEH study recruited people, primarily a random sample, but also some convenience participants, in the areas in which mobile air monitoring was conducted (Figure 2). The goal was to recruit people who had a range of exposures from low to high. Besides Somerville, the study recruited in Dorchester/South Boston and in Chinatown/Malden. Because the HIA is focused on Somerville, the focus here is on Somerville data and analysis.

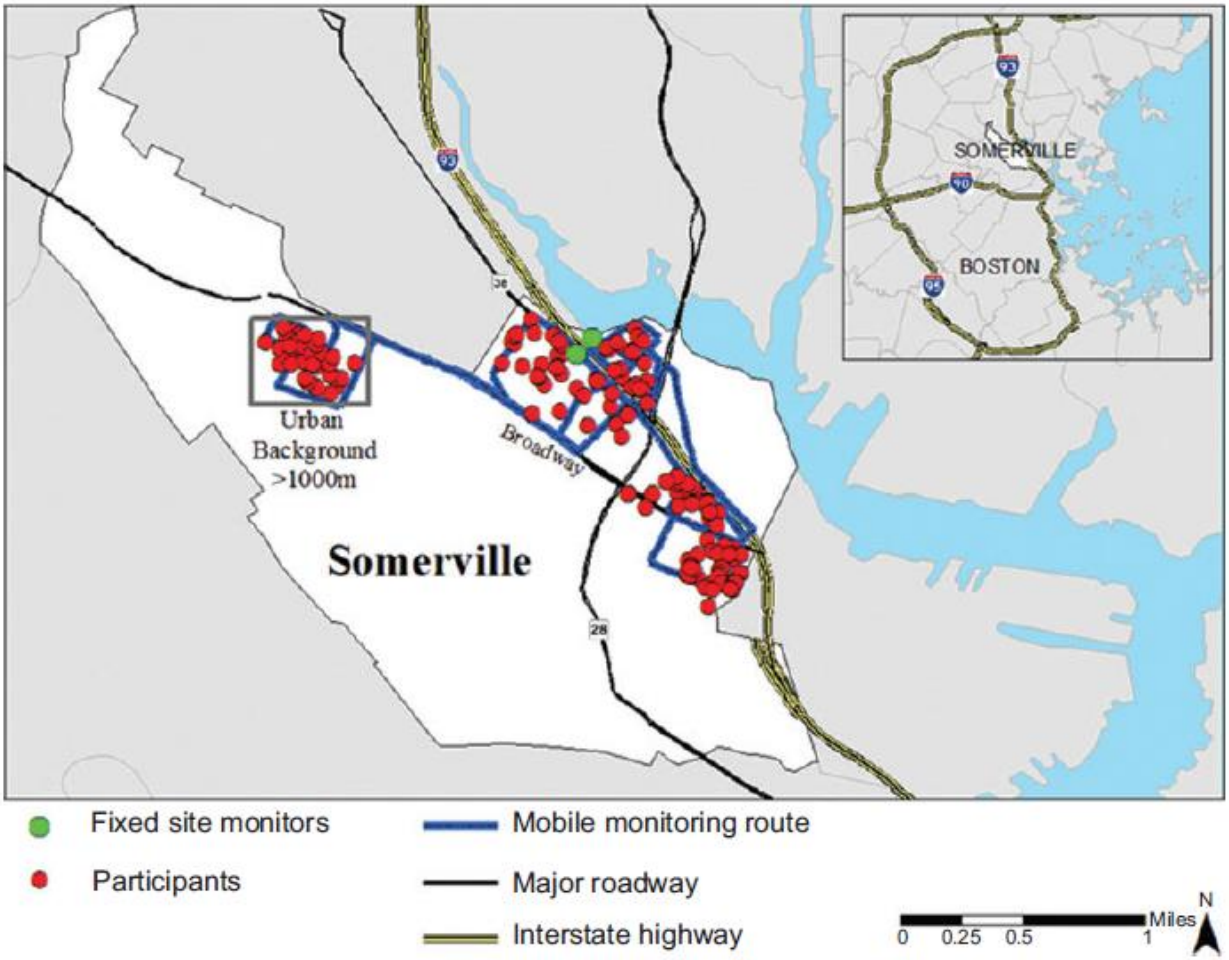

Figure 2. Map of participant residences in the CAFEH study in the Somerville area, (Fuller, 2013).

Predictive model of ultrafine particles

The study used mobile monitoring data to build statistical models that could predict ultrafine particle levels throughout the study areas for the times and places, which were the vast majority of times and place, for which there was no actual monitoring data. Statistical relationships between many variables that measure traffic volume, weather conditions (i.e. wind speed and direction, temperature) and geographic location (i.e. proximity to the highway) were tested for their ability to help predict levels of ultrafines that had been measured in the mobile monitoring campaigns. The final model for Somerville shows that average ultrafine particle levels are higher next to the highway than farther way (Figure 3). The model, though, can predict ultrafine concentrations for every hour od a year for areas of about 20 meters in diameter, so it is extremely detailed.

Estimating exposure to study participants

Because ultrafine particle concentrations are changing so much in space and time and the participants in the study were moving around a fair amount to go to work, run errands, etc., assigning exposure was

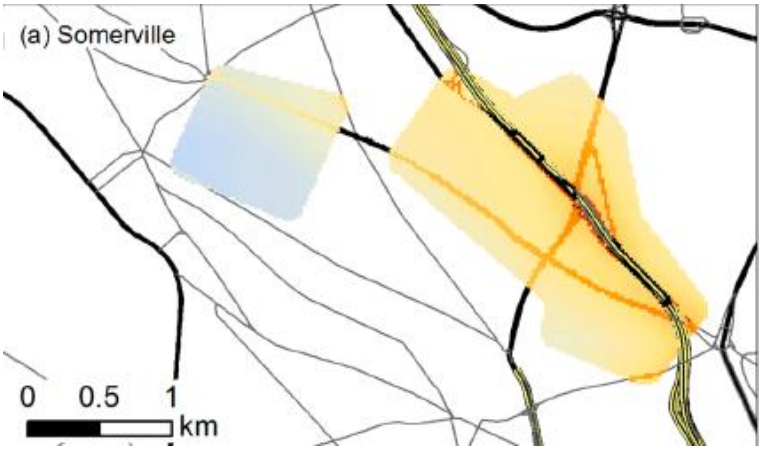

Figure 3. Map of predicted ultrafine particle levels based on statistical modeling for the Somerville areas (Patton, 2014 and 2015).

challenging. The research team used participant reports of where they spent their time and when, along with indoor-outdoor monitoring at some homes to develop a metric by which they could assign personal exposure to each participant for every hour for a year. The exposures assigned to each participant in the Somerville study areas are shown in Figure 4. As with the air monitoring and the statistical model described above, the exposure of people in the study was higher if they lived close to the highway.

Association of ultrafine exposure with health

When the assigned exposure to ultrafine particles was compared to biomarkers in the blood of study participants there was a clear association such that people with higher exposure had higher levels of the biomarker, even after controlling for various factors such as being overweight, or smoking (Figure 5). The biomarker in Figure 5 is a molecule called C-Reaction Protein, or CRP. It is well established to be an indicator of risk for future heart attacks and strokes. Thus, for the Somerville near highway study area, there is site-specific evidence, developed through a rigorous environmental epidemiology approach, that near highway exposure to ultrafine particles raises risk for cardiovascular illness.

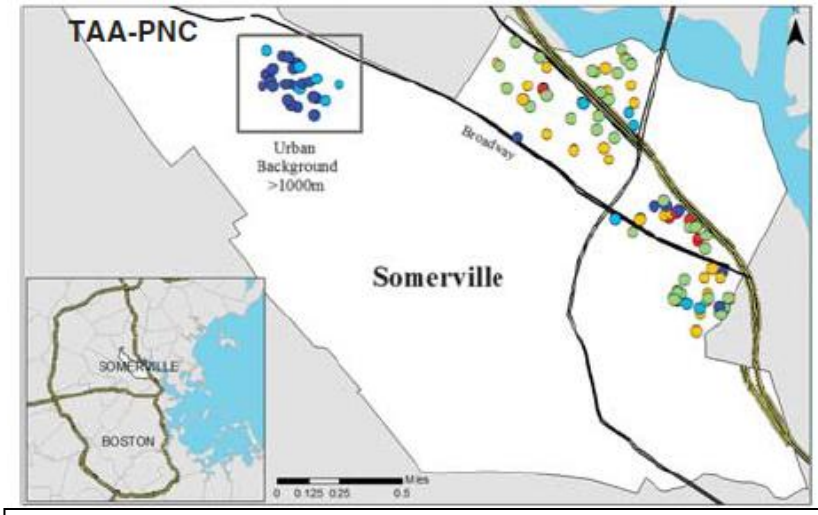

Figure 4. Map of assigned exposures of ultrafine particles for the participants in the CAFEH study that lived in Somerville (Lane, 2015).

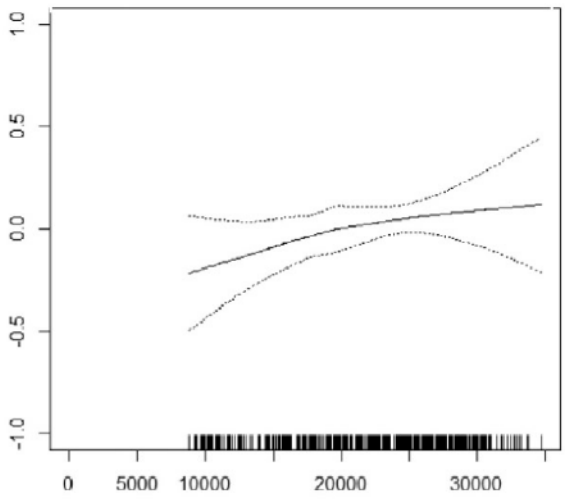

Figure 5. The association of ultrafine particle exposure in Somerville. Study participants with higher ultrafine particle exposure had higher levels of C-Reactive Protein, an indicator of risk for cardiovascular disease, in their blood (Lane, 2016).

In-home air filters

Because of growing community concerns about near highway air pollution, the CAFEH project undertook a pilot air filtration study in the Mystic Housing Development. Filtration units were placed in the windows of 20 homes for 6 weeks. In each home the filers were actively filtering for 3 of the weeks and blowing air, but not filtering the other 3 weeks. This study showed that air filters in the homes could reduce ultrafine particle concentrations inside, but not as much as would be desired. Unfortunately, and possibly because exposures were not reduced enough, there was no benefit in the health measures that were collected. More research is needed to find out whether filters of this sort can benefit people living near highways. In the meantime, it is important to explore other strategies that might be protective as well, such as sound walls.

References

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