Is A-Weighting an Environmentally Unjust Community Noise Metric?*

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Background: Urban noise is ubiquitous and known to negatively impact community residents' mental and physical health through consistent activation of the fight-or-flight stress response. In cities across the United States, there is a complex mixture of sound sources, which vary in character and sound pressure level. While humans process sound primarily through the auditory system, low frequency sound can be processed outside of the auditory system. These types of sounds also travel long distances, penetrate thick structures, and are most prevalent in communities near major transportation and industrial networks. Aim: We consider two community noise models. The first uses A-weighting, which severely penalizes sounds in the low frequency range (< 500 Hz). The second is a model more sensitive to low frequency sounds. We compare these model predictions to assess the strengths and limitations of only using A-weighted metrics to measure and regulate community noise.

Methods: In total, a representative sample of 715 short-term sound measurements was collected across Providence from Sep-Dec 2022, during the day and night and on all days of the week. Land-use regression models were created for A-weighted and low frequency sound based on these measurements. Land-use and social characteristics of parcel centroids and average weather conditions of samples were used in these models to predict and map estimated sound for all ~44k parcel centroids at all time points. We tested differences in sound by social and health classes across all parcels, which we defined as communities with a significant portion of residents living in poverty and having poor health.

Results: Models predicted sound levels with minimal covariates, with R2 of 0.42 and 0.29 for A-weighted and low frequency models respectively, and minimal testing error with an average difference between predicted and actual decibels (dB) of 2 dBA for modeled A-weighted sound and 4.5 dB for modeled low frequency sound. While both A-weighted and low-frequency models sound levels were highest in EJ communities. A-weighting is most influenced by traffic sound while low-frequency sound is most influenced by industrial sound.

Conclusions: While A-weighted metrics are useful in community noise assessments, it is also important to consider additional weighting schemes that penalize low-frequency sound less, especially in communities near major industrial land use. Prior research shows that communities near major industrial activity are EJ communities. Using only A-weighting in these communities may underreport the true community noise environment.

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