Urban trees and asthma: a call for epidemiological research

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Air pollution is now the greatest environmental cause of premature death, and more than 80% of people living in urban areas that monitor air pollution are exposed to air quality levels that exceed World Health Organization (WHO) limits. Likewise, prevalence rates for asthma – which has been linked to poor air quality – have been increasing in many countries over the past few decades. In both scholarly literature and popular media, one strategy to address these seemingly interconnected problems has received increasing attention, namely, urban greening and tree planting in particular. This is reflected in recent issues of this journal.1,2

Yet, an interdisciplinary review of refereed literature that we conducted with colleagues from epidemiology, atmospheric science, plant science, urban ecology, environmental engineering, and landscape planning finds no scientific consensus to support this strategy.3 There are inconsistencies within models, between models, among empirical studies, and between model and empirical studies. Moreover, urban trees can in many cases reduce air quality and increase asthma through pollen production, synergistic interactions between pollen and air pollution, emitting biogenic volatile organic compounds (BVOCs) that contribute to ozone (O₃) formation, and concentrating air pollution by reducing air flow in urban streets flanked by buildings where people walk, bike, and drive.

The etiology of asthma is very complex and includes a range of environmental, genetic, and demographic factors. There are also substantial differences in how disciplines approach the topic of urban trees, air quality, and asthma. Natural science generally uses models, laboratory, and field studies to assess biophysical processes linking urban trees with air pollution; and in some instances, layered modeling is used to project estimates of asthma morbidity and mortality.4,5 But respiratory health benefits derived from such studies are rarely supported by epidemiological research, which highlights links with pollen, not air pollution.

Importantly, most public health studies in our review find adverse associations between urban trees and asthma.

Some observational studies do find links between green space and reduced respiratory disease, but they do not to the best of our knowledge identify air pollution reduction as the mechanism. One exception includes Alcock et al.,6 which correlated reductions in asthma hospitalization with air pollution reduction via urban trees. Yet, other studies show no protective effect of urban trees on asthma morbidity via air pollution reduction.7,8 Another study posits that asthma reductions may be explained by greater and more diverse microbial exposure in vegetated spaces.9 It is also conceivable that urban flora may reduce asthma by decreasing stress – a risk factor for asthma and one of the most consistently identified benefits that people derive from spending time in or near greenspaces.

All of this raises the pressing question: If urban trees are a promising means to decrease asthma and respiratory disease by reducing air pollution levels, why is there such a dearth of public health scholarship and empirical evidence demonstrating this relationship?

The substantial differences in how epidemiology and natural science study and draw conclusions relating to air quality and urban vegetation exhibit disciplinary crosstalk – poor communication, unconscious misunderstandings, and inconsistent use of terms, literature, and findings between disciplines. In the case at hand, disciplinary crosstalk is exacerbated by the ascendance of ecosystem services as the dominant conceptual frame for depicting, studying, and valuing vegetation in cities. Ecosystem services refers to the benefits people derive from ecosystem functions; human health has been described as the central aspect of these services. Yet, public health scholarship is still not integrated in ecosystem services literature, and this is particularly noteworthy in a subfield focusing on urban ecosystem services (see Figure 1).

In light of the aforementioned gaps, we are issuing a call for epidemiological research on urban trees, air quality, and respiratory health to inform landscape and urban planning. This supports similar calls for interdisciplinary research on the human health effects of spending time in or near greenspaces,10 and it also addresses a policy issued by the American Public Health Association (APHA) entitled, “Improving Health and Wellness through Access to Nature.”11

![Figure 1: Relationship between urban ecosystem functions, urban ecosystem services and disservices, and disciplinary expertise pertaining to air quality and human health (reproduced from Eisenman et al. 2019 with permission from Elsevier). BVOCs = biogenic volatile organic compounds.](https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(19)30193-6/fulltext)
We are in no way suggesting that trees should not be planted in cities. Trees are essential for people-friendly streets (see Figure 2), and urban flora provides numerous wildlife and human health and well-being benefits unrelated to air quality. Indeed, urban greening may be essential for future generations—the vast majority of whom will live in cities and may not have much contact with flora. But we do not believe that there is currently sufficient evidence to support citywide tree planting as a strategy to improve respiratory health via air quality improvement. Recommending this in scientific and popular literature risks obfuscating more than illuminating public policy on a health issue such as asthma that affects millions of people worldwide. It could also detract from the most important strategy to improve air quality—reducing air pollution.

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References


