Collaboration for Environmental Evidence

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Plain Language Summary
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Systematic Review Update
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Urban green areas are cooler and have lower concentrations of nitrogen oxides air pollution than non-green areas, but this varies according to type and extent of vegetation

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Photo: Nerea Martí Sesarino

In summer, urban green areas, including parks, gardens, green roofs and walls, can be cooler than urban areas without vegetation. The magnitude of the cooling effect depends on factors such as the nature of park vegetation or green roof water level. Park cooling effects can extend up to roughly 1 km from the park edge. Nitrogen dioxide (NO_2) concentrations can be lower under or within tree canopies compared with open areas but this effect varies across tree species. Vegetated urban spaces, especially areas with trees, have the potential to provide public health benefits in terms of improved thermal comfort and air quality.

Why is this Evidence Synthesis Needed?

Human-induced climate change is expected to result in an increase in the intensity, frequency and duration of extreme heatwaves, posing a serious health risk for humans. The problem will be greater in urban areas because they are already warmer due to the 'heat island effect'. Air pollution in cities can have serious detrimental effects on public health as well as on urban vegetation, water and soil quality. This review of 308 studies from around the world explores whether urban green areas, such as parks, gardens, trees in streets, parks or woodlands, green roofs and walls, might help to mitigate these risks to public health and the urban environment through reducing urban air temperatures, improving thermal comfort and reducing air pollution. The review also explores how these effects might be influenced by factors such as type of vegetation or other features of green areas.

This synthesis measures the impact of urban green areas on air temperatures, thermal comfort, exposure to UV radiation and ground level concentrations of nitrogen oxides (NOx) and ozone. It explores how this impact differs between different types and extents of urban green areas.

Main Findings

Are green areas cooler than non-green areas within the same urbanisation and how does this vary across different types of greening?

Air temperature under trees was on average 0.8 °C cooler. Areas with trees could be warmer at night. Daytime cooling effects varied across tree species due to differences in shading from UV radiation. Urban woodlands were on average 1.6 °C cooler. The park/garden cooling effect was on average 0.8 °C and influenced by tree cover. The cooling effect of parks extended up to roughly 1 km. Grassy areas, in parks/gardens or elsewhere, were cooler during the day and night by on average 0.6 °C. Green roofs and walls cooled surface temperature by 2°C and 1.8 °C on average, respectively, influenced by substrate water content, plant density, and cover.

What is the effect of urban greening on air pollution by NOx and ozone?

Ground-level NOx concentrations were significantly lower on average in green areas compared with non-green areas. NO_2 concentrations can be lower under or within tree canopies compared with open areas but effect varies between tree species. No clear impact of trees or other green areas on ground level ozone concentrations was identified.

How do urban green areas affect public health directly?

People's thermal comfort can be improved under the shade of trees and in parks/gardens with trees compared with non-shaded non-green sites, during the day. There were insufficient studies to explore the effect of urban green areas on other public health measures.

What are the Implications of the Review Findings?

Urban parks/gardens, although cooler on average than non-green areas, vary considerably in extent and type of vegetation which can affect cooling performance. Trees in parks or gardens, clusters or woodland provide cooling effects and improved thermal comfort in their immediate environment in daytime. However, maximising tree canopy coverage for daytime cooling has to be balanced with providing open grassy areas to promote nighttime cooling, particularly in streets. The overall impact on urban temperature might depend upon density and spacing of green spaces. Green roofs and walls can provide surface temperature cooling effect during the day and/or night but this is influenced by substrate type, depth and water content, plant species, extent of vegetation cover and density. The design of green roofs and walls should therefore be informed by the local climate and water availability. Although green areas, especially trees, could provide an environment with lower NO_2 concentrations, removal of these pollutants varies between species, as does tree emission of compounds that can promote ozone formation. Choice of species for urban areas needs to be guided by both factors.

Future research and synthesis should focus on:

- The relationship between size and shape of green area, and cooling effect
- Optimal density and spacing of green areas
- Overall benefit of different tree species
- Effect of urban green areas on public health

Application of research findings should take local climate and water sustainability into account.

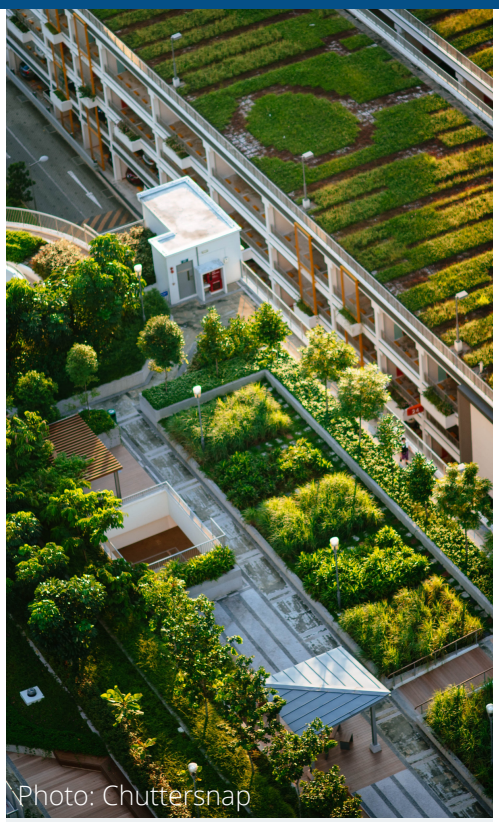

Photo: Chuttersnap

Synthesis Time Frame

This review updates a previously published CEE systematic review and includes studies published up to 2018. This CEE Systematic Review was published in June 2021.

Full Citation

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Link to Publication

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