



Healthy lakes, healthy lives

Dr George Crisp

Doctors for the Environment
Australia



Healthy lakes, healthy people

Green & Blue Spaces: Benefits, Degradation and Health Risks



Health aspects of



The case for green & blue space

Documented benefits to mental & physical health



Degradation & loss

What happens when these spaces decline



Solastalgia

The psychological toll of watching a place degrade



Mosquitoes & vector-borne disease

Infectious disease risk



Algal blooms & cyanotoxins

Water contact, the overlooked inhalation route, potential for neurological diseases

Mental health benefits of green & blue space

- Contact with and proximity to blue and green spaces is consistently linked to lower rates of depression, anxiety, and psychological distress across long-term population studies.
- Reduction in ADHD symptoms
- Natural settings support attention restoration and stress recovery.
- Improved mood and reduced stress during and after physical activity.

44 M

people worldwide projected to live with dementia — green /blue space shows protective links to cognitive decline

environmentally mediated effects through improved air quality, noise attenuation, reduced heat exposure



Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood

Kristine Engemann^{a,b,c,1}, Carsten Bøcker Pedersen^{c,d,e}, Lars Arge^f, Constantinos Tsirogiannis^f, Preben Bo Mortensen^{c,d,e}, and Jens-Christian Svenning^{a,b}

^aSection for Ecoinformatics & Biodiversity, Department of Bioscience, Aarhus University, 8000 Aarhus C, Denmark; ^bCenter for Biodiversity Dynamics in a Changing World, Department of Bioscience, Aarhus University, 8000 Aarhus C, Denmark; ^cCentre for Integrated Register-based Research, Aarhus University, 8210 Aarhus V, Denmark; ^dNational Centre for Register-based Research, School of Business and Social Sciences, Department of Economics and Business Economics, Aarhus University, 8210 Aarhus V, Denmark; ^eThe Lundbeck Foundation Initiative for Integrative Psychiatric Research, Aarhus University, 8210 Aarhus V, Denmark; and ^fCenter for Massive Data Algorithmics, Department of Computer Science, Aarhus University, 8200 Aarhus N, Denmark

Edited by Terry Hartig, Uppsala University, Uppsala, Sweden, and accepted by Editorial Board Member Susan T. Fiske January 14, 2019 (received for review May 2, 2018)

Urban residence is associated with a higher risk of some psychiatric disorders, but the underlying drivers remain unknown. There is increasing evidence that the level of exposure to natural environments impacts mental health, but few large-scale epidemiological studies have assessed the general existence and importance of such associations. Here, we investigate the prospective association between green space and mental health in the Danish population. Green space presence was assessed at the individual level using high-resolution satellite data to calculate the normalized difference vegetation index within a 210 × 210 m square around each person's place of residence (~1 million people) from birth to the age of 10. We show that high levels of green space presence during childhood are associated with lower risk of a wide spectrum of psychiatric disorders later in life. Risk for subsequent mental illness for those who lived with the lowest level of green space during childhood was up to 55% higher across various disorders compared with those who lived with the highest level of green space. The association remained even after adjusting for urbanization, socioeconomic factors, parental history of mental illness, and parental age. Stronger association of cumulative green space presence during childhood compared with single-year green space presence suggests that presence throughout childhood is important. Our results show that green space during childhood is associated with better mental health, supporting efforts to better integrate natural environments into urban planning and childhood life.

geographic information systems | mental health | psychological ecosystem services | remote sensing | urban planning

The number of people living in cities is increasing, and, globally, more than 50% of the human population is now city dwellers, with no sign of this trend slowing down (1). Urban living often offers good sanitation, access to health care, nutrition, and education (2), but has also been associated with adverse health effects (3, 4). In some societies, urban residents have almost 50% higher risk of developing psychiatric disorders such as anxiety and mood disorders compared with their rural counterparts (5–7), and

Dose–response relationships from other studies show that higher doses of green space are associated with better mental health (13), and long-lasting positive effects of moving to greener areas (18) suggest causation, albeit most of these studies are small and cross-sectional. Whether the association with green space is specific or applies to a broader spectrum of psychiatric disorders and to what degree the association is independent from urbanization in general or just mirrors the urban–rural gradient are unknown. Access to green space partially depends on socioeconomic factors, such as housing prices, and the extent to which this explains associations between green space and mental illnesses is another unknown aspect.

Exposure to green space may influence mental health through both psychological and physiological pathways, as green spaces serve as settings for individual and social behavior and can mitigate negative influences of other aspects of the physical environment (19). These mechanistic pathways could vary for different psychiatric disorders, with green space as a shared risk-decreasing

Significance

Growing up in urban environments is associated with risk of developing psychiatric disorders, but the underlying mechanisms are unknown. Green space can provide mental health benefits and possibly lower risk of psychiatric disorders. This nation-wide study covering >900,000 people shows that children who grew up with the lowest levels of green space had up to 55% higher risk of developing a psychiatric disorder independent from effects of other known risk factors. Stronger association between cumulated green space and risk during childhood constitutes evidence that prolonged presence of green space is important. Our findings affirm that integrating natural environments into urban planning is a promising approach to improve mental health and reduce the rising global burden of psychiatric disorders.

Author contributions: K.E., C.B.P., P.B.M., and J.-C.S. designed research; K.E. performed

Mental health benefits of green & blue space

- Contact with and proximity to blue and green spaces is consistently linked to lower rates of depression, anxiety, and psychological distress across long-term population studies.
- Reduction in ADHD symptoms
- Natural settings support attention restoration and stress recovery.
- Improved mood and reduced stress during and after physical activity.

44 M

people worldwide projected to live with dementia — green /blue space shows protective links to cognitive decline

environmentally mediated effects through improved air quality, noise attenuation, reduced heat exposure

Solastalgia: grief for a place you haven't left



“The homesickness you have when you are still at home.”

Coined by Australian environmental philosopher Glenn Albrecht (2003–2005), solastalgia names the distress of watching environmental change degrade the home environment while you're still connected to it — distinct from nostalgia, which is grief for a place left behind.

Albrecht developed the concept from fieldwork with communities affected by open-cut coal mining in the Upper Hunter Valley, NSW — watching their landscape and sense of place transform against their will.

How it presents;

- Grief, desolation and a felt loss of identity tied to place
- A sense of powerlessness over change happening around you
- Elevated distress reported in communities near mining, drought and coastal erosion

RELEVANCE TO DEGRADED URBAN NATURE

The same dynamic applies at neighbourhood scale: residents who watch a familiar wetland or remnant bushland decline can experience a genuine, place-specific form of psychological distress

Physical health benefits of green & blue space

- Life expectancy
- Cardiovascular illness
- Metabolic – obesity, diabetes
- Cerebrovascular events
- Respiratory health
- Kidney disease
- Immunoregulation
- Cancer

Exercise in green space - Reduced blood pressure, increased HR variability



COMPENDIUM ON ENVIRONMENTAL IMPACTS ON CARDIOVASCULAR HEALTH AND BIOLOGY

Greenspaces And Cardiovascular Health

Rachel J. Keith, Joy L. Hart , and Aruni Bhatnagar 

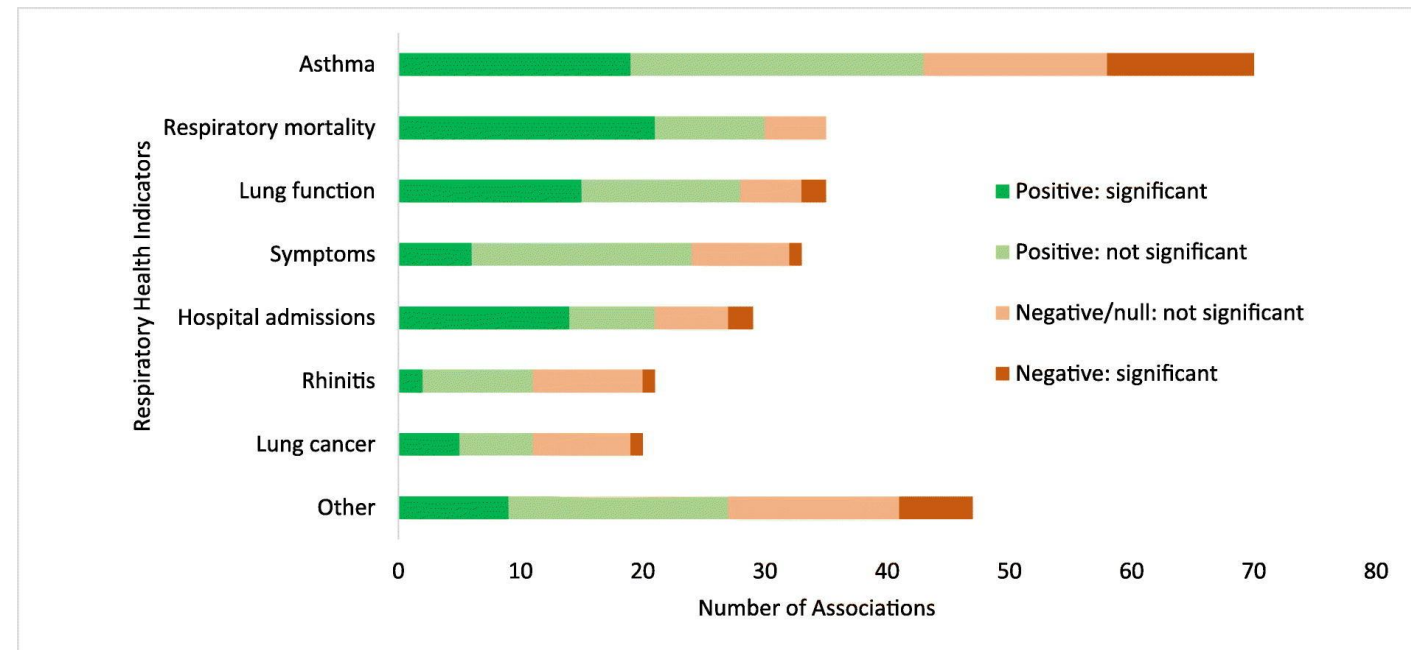
Abstract: Accumulating evidence suggests that living in areas of high surrounding greenness or even brief exposures to areas of high greenery is conducive to cardiovascular health, which may be related to the environmental, social, psychological, and physiological benefits of greenspaces. Recent data from multiple cross-sectional, longitudinal, and cohort studies suggest that living in areas of high surrounding greenness is associated with a lower risk of all-cause and cardiovascular mortality. High levels of neighborhood greenery have been linked also to a decrease in the burden of cardiovascular disease risk factors as reflected by lower rates of hypertension, dyslipidemia, and diabetes. Those who live in greener environments report better mental health and more frequent social interactions, which can benefit cardiovascular health as well. In this narrative review, we discuss evidence linking greenspaces to cardiovascular health as well as the potential mechanisms underlying the beneficial effects of greenspaces, including the impact of vegetation on air, noise and light pollution, ambient temperature, physical activity, mental health, and biodiversity. We review literature on the beneficial effects of acute and chronic exposure to nature on cardiovascular disease risk factors, inflammation and immune function, and we highlight the potential cardiovascular effects of biogenic volatile organic compounds that are emitted by trees and shrubs. We identify current knowledge gaps in this area and underscore the need for additional population studies to understand more clearly and precisely the link between greenness and health. Such understanding is urgently needed to fully redeem the promise of greenspaces in preventing adverse environmental exposures, mitigating the effects of climate change, and creating healthier living environments.

Key Words: cardiovascular diseases ■ climate change ■ inflammation ■ risk factors ■ temperature

Physical health benefits of green & blue space

- Life expectancy
- Cardiovascular illness
- Metabolic – obesity, diabetes
- Cerebrovascular events
- Respiratory health
- Kidney disease
- Immunoregulation
- Cancer

Exercise in green space - Reduced blood pressure, increased HR variability



Green - blue space is a critical determinant of health

How and what do we know ?

- Observations:

Studies consistently find health benefits across a wide range of health outcomes and many different locations

- Pathways - Physiological Mechanism(s) ?

Health pathways - mechanisms

- Noise attenuation and Temperature (Urban Heat Island) modulation
- Air Quality : Removal of air pollutants
- Biogenic amines (VOCs)
- Microbes / microflora
- Physiological effects (neurohormonal pathways)
- Recreational / activity
- Social effects (connection / cohesion)
- * Potential Confounding factors – Socio-economic Status

Physical & social pathways to health



Cardiometabolic health

Proximity and access to green/blue space is associated with reduced risk of cardiovascular disease, hypertension, obesity, and diabetes.



Reducing environmental harm

Vegetation and water buffer urban heat, filter air pollution, and dampen noise — reducing exposure.



Physical activity

These spaces provide facility for walking, cycling and recreation, and resulting health benefit.



Social connection

Shared green and blue spaces support community interaction, place attachment, and social cohesion.

Healthy green / blue space is a public health asset ...

- The mental, physical and social benefits of nature are well documented — but they depend on the ecology and environmental conditions staying healthy.
- Degradation doesn't just erase benefit; it can create new hazards — cyanotoxins, vector-borne disease, and psychological distress.

What's lost when green & blue space declines

Degradation is rarely a single event — it accumulates through drainage, pollution, clearing, and neglect, and each stage strips away part of the health benefit.

1

Habitat & vegetation loss

Clearing and infill reduce canopy cover, reduced cooling, air-filtering, and restorative benefits

2

Water quality decline

Pollution, nutrient runoff, reduced rainfall, higher temperatures, invasive species / loss of ecological services

3

Reduced use & access

As spaces become degraded, unsafe, or less appealing, visitation drops — and with it, the physical activity and stress-relief benefits.

4

New health hazards

The same degraded conditions that reduce benefit can actively introduce harm: toxins, disease vectors, and odour/aesthetic decline.

Blue-Green Algal Blooms & Human Health

*How do cyanobacteria in
waterways affect our health?*



Harmful agent

Cyanotoxins and algal toxins

neurotoxins, hepatotoxins,
cytotoxins, irritants, gastrointestinal
toxins

Exposure pathways

Ingestion

Direct Contact

Inhalation





Most types of algae do not cause health problems, but some algal blooms can be a public health threat. Contact with an algal bloom may cause a number of health problems including:

- › skin rashes
- › eye irritation and redness
- › earaches
- › itchiness
- › swollen lips
- › [hay fever](#) symptoms
- › [asthma](#)
- › possible skin tumours
- › [Gastroenteritis](#)
- › neurological effects.

Certain types of algae can also produce toxins (poisons) that can contaminate shellfish and make them unsafe to eat. Find out more about the risks of collecting [wild shellfish](#).

Large numbers of dead fish (fish kills) can also occur when algal blooms decrease the level of oxygen in a water way. Dead fish should not be collected to eat or be fed to pets.

If you have been exposed to an algal bloom, wash off any of the plant



Inhalation: the overlooked toxin exposure pathway

Wind and wave action can aerosolise bloom-affected water into microscopic droplets — carrying cyanotoxins directly into the air people breathe near the lake.

- Airborne microcystins have been measured in fine particulate matter (PM2.5) near affected lakes, confirming toxins travel well beyond the water's edge.
- Laboratory exposure studies show inhaled microcystin-LR triggers airway inflammation, and reports during active blooms link nearby exposure to a marked rise in asthma and respiratory complaints.
- Experimental evidence that L-BMAA plays an important role in slow developing neurodegenerative diseases (ALS, PD and Alzheimer's Dementia)



Reported acute symptoms

- Respiratory & eye irritation
- Coughing and breathing difficulty
- Headaches, nausea.
- Asthma flare-ups nearby active blooms

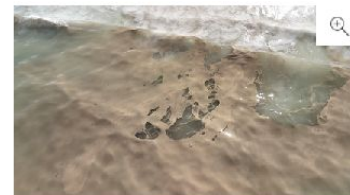
Less research on inhalation health effects — but the exposure pathway is confirmed.



Algal bloom monitoring and reporting

If a local or state government officer, member of the public or other agency notices visual signs of an algal bloom such as discoloured water, surface scum or floating mats/debris, sightings should be reported to:

- Department of Water and Environment Regulation (DWER) Algal Watch team on (08) 6250 8064 (office hours) or email peu@water.wa.gov.au and
- Department of Health Environmental Health Directorate on (08) 9222 2000 (office hours) and email algalblooms@health.wa.gov.au



Photographer: John Kelly

Role of local government

Local government environmental health services play a key role in responding to **algal blooms** of public health concern. This involves:

- undertaking algae / phytoplankton samples (as required) to confirm that the water is safe for recreation, irrigation and other activities
- taking steps to prevent or reduce the likelihood for people and their pets from accessing or coming into contact with water e.g. through the installation of health warning signs or implementing management or operational measures
- issuing social media and/or website health advice to the local community to make sure people are appropriately informed of any health risks
- investigating sources of pollution that may be causing excess nutrients to enter a waterbody and determine measures to minimise further occurrences

The Department of Health will notify local government of an algal bloom and/or animal deaths (fish kills) of potential public health concern:

- as part of monitoring programs managed by the Department of Water and Environmental Regulation (DWER), the Department of Biodiversity, Conservation and Attractions (DBCA), and the Department of Primary Industries and Regional Development (DPIRD)
- visual sightings of algal blooms or animal deaths (fish kills) reported by the public or other agencies

Local governments should also notify relevant state government agencies as soon as it becomes aware of any algal bloom or animal deaths (fish kills) reported by the public or observed during field inspections.

Algal bloom health risks

[Learn more about the health risks of algal blooms.](#)

Related links

- [Health risks of algal blooms](#)
- [Algal blooms - Department of Water and Environmental Regulation \(external site\)](#)
- [Phytoplankton Ecology Unit \(external site\)](#)
- [Healthy estuaries in WA \(external site\)](#)
- [Swan and Canning river monitoring and reporting \(external site\)](#)
- [Fish kills \(external site\)](#)

Protecting nature is a public health issue

- Precautionary principle
- Public Health Act

All scientific work is incomplete - whether it be observational or experimental. All scientific work is liable to be upset or modified by advancing knowledge.

That does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time.

Sir Austin Bradford Hill 1964



Thank you for listening