

The Healing Power of Nature

How Green Space is Improving
Health and Wellbeing in Cities





Dear Reader,

Ms. Johnson, as I will call her, was a 38-year old woman who came to the emergency department with chest pain. My team and I conducted a thorough workup to look for a heart attack, a blood clot in her lungs, or any other life-threatening illness. With negative results in hand, I sat down to talk with Ms. Johnson about her symptoms and make sure we hadn't missed anything. She shared that she was under a lot of stress, feeling the weight of significant family responsibility and few resources. While I could not provide immediate relief for her situation, I did advise her to speak with her doctor about talking to a psychologist. I also asked her if she ever spent time outside in nature. She said no, that she never felt she had time to visit the park near her house. I shared with her what I have learned through my research—about nature's power to heal—and encouraged her to give nature a try.

I will never know what happened to Ms. Johnson—did she go outside? Did it help? In my work as an emergency medicine doctor, I care for many people suffering the downstream effects of poverty, discrimination, and the resultant life stress. I have seen first-hand the relationship between one's neighborhood environment and their health. This has been the motivation for my research—understanding how we can modify the neighborhood environment to promote health and how I came to be a believer in nature.

Admittedly, I was at first a skeptic. Parks, trees, trails, green schoolyards—nice-to-have amenities but not fundamental to the health of a community. Science—including my own—slowly shifted my thinking. In some ways, the nature-health connection is as old as time; it is only recently in human evolution that we live apart from nature in our built up cities. Researchers are now catching up, pushing the envelope beyond mere associations to showing actual causality between nature and health. This report highlights what we know about nature and health in urban areas, and aims to push nature to the center of our conversation about what it means to create healthy, thriving cities.

Sincerely Yours,

Eugenia C. South, MD, MS

Assistant Professor of Emergency Medicine

Perelman School of Medicine at the University of Pennsylvania

Eugenia.South@penmedicine.upenn.edu | @Eugenia_South (Twitter)



Table of Contents

Nature's Healing Power

What Is Nature? p.4

The Nature-Health Connection

What We Know p.5

General Mental Health

Depression p.6

Stress p.7

Mental Fatigue p.8

Burnout & Wellness p.9

Physical Health

Cardiovascular Health p.10

Obstetrical Outcomes p.11

Community Health

Social Cohesion p.12

Crime & Perceptions of Safety p.13

Inequity in Access to Green Space p.14

Where Do We Go From Here? p.15

Innovative Programs p.16





Nature's Healing Power

What is nature?

Think fast: You are standing in nature. What do you see? An expansive wilderness; a national park; an undisturbed forest? Surveys have shown that when most of us think of nature, spaces filled with green that help us unwind and disconnect—we envision something removed. Something grand of scale. A remote destination.

We don't necessarily think of a singular carpet of grass rooted and flourishing where an abandoned building once stood; a clutch of trees; or a pocket park tucked within a bustling city neighborhood. Broadening how we define nature—especially in the urban context—may be vital to fully experiencing its benefits in our everyday lives.

Recent discoveries have in fact shown us that nature's power to heal—both our physical and mental health, and the health of our communities—can happen in a neighborhood park; a community garden; even that aforementioned square of grass that occupies the footprint of an abandoned city lot. This is good news for the 80 percent of Americans living in metropolitan areas, those whose daily lives will bring them into contact with these modest versions of nature far more than the wild.¹

It's this more small-scale—and thus oftentimes attainable—version of nature that we will be focusing on in this report. Think trees, pocket parks, greened vacant lots, community gardens, trails, and green school yards.

The Nature-Health Connection

What we know

An increasing number of diverse research disciplines are now immersed in understanding the nature-health connection: social scientists to epidemiologists, neuroscientists to physicians. As a result, the growing body of scientific evidence is gradually nudging nature into the realm of public health and traditional medicine as a tool healthcare providers can use to promote healthy living. This is evidenced through the development of therapeutic gardens in hospital settings and physician-administered nature prescription programs. A decided shift is afoot.

This report, a collaboration between Nature Sacred, a non-profit dedicated to supporting and growing the number of small, accessible urban green spaces, Dr. Eugenia South, a physician-scientist with expertise in the health benefits of nature, and the Pennsylvania Horticultural Society, compiles some of the most recent evidence underscoring the health benefits of nature. While not an exhaustive review of the full body of existing literature, we highlight high-impact studies across a range of outcomes. We present the research in such a way that time-crunched urban planners, administrators and decision-makers, healthcare providers and public health officials, and community foundations can gain a quick briefing, absorbing key facts that help strengthen and inform decisions around the development of green infrastructure in cities and communities, and suggest ways to connect people with nearby nature.



General Mental Health

THE HEALING POWER OF NATURE

Roughly 80 percent of the US population lives in urban areas. And those who live in these more densely populated and oftentimes congested environments are at a higher risk of experiencing mental health issues. Researchers have found, though, that within these urban areas, residents who have more green space near their homes report significantly lower symptoms of depression, stress and anxiety.^{2,3,4} This is the case even when controlling for a number of other factors that could have influenced their results; think education level, household income, and neighborhood-level socioeconomic factors. It appears that nature is not just a marker for a well-off neighborhood; rather there is something about green space itself that makes us healthier.

Likewise, a study in Denmark evaluated the amount of nature near the childhood homes of more than 900,000 adults. Compared to those who grew up with high levels of nearby nature, those who grew up with less green space were at a higher risk of developing psychiatric disorders—including mood disorders, substance abuse, and schizophrenia — as adults. This held true within rural areas, suburban areas, and of course, urban areas.⁵

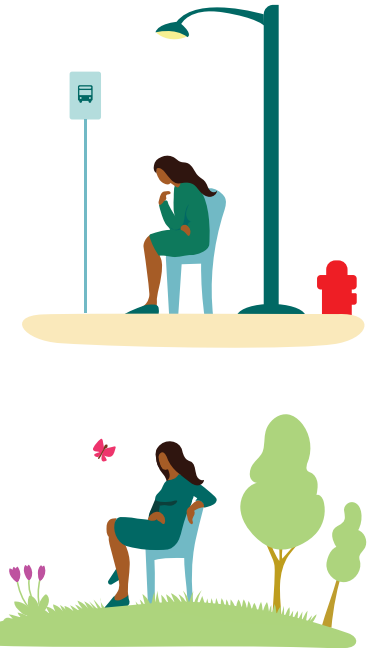
While individual treatments—like therapy and medications—will always remain a cornerstone of addressing mental illness, the authors of both studies suggested greening as a low-cost means to help address mental health on a population level.

Depression

More than 16 million Americans experience an episode of clinical depression each year; many more have feelings of depression that don't meet the clinical definition. And a large percentage of these go untreated, especially people from low-resourced neighborhoods.

In Philadelphia, PA, Dr. South and her colleagues conducted a first-of-its-kind study to see if planting new micro-green spaces in previously urban vacant lots could impact health. This study, a randomized controlled trial—the highest level of scientific evidence—found that people living near these new green spaces felt less depressed and had overall improvements in their mental health; people who lived near areas that did not get new green space had no improvements in their mental health. These effects were the strongest for people living in neighborhoods below the poverty line.⁶

A United Kingdom-based study of over 7,500 pregnant women found that those who had the most green space near their homes were 18-23 percent less likely to experience depressive symptoms, compared to those who lived in areas with the least amount of green.⁷ Similarly, scientists in Australia demonstrated that people who visited a park for 30 minutes or more had significantly fewer cases of depression.⁸ Research from cities around the world is pointing to nature as an antidote to the mental strain of urban living.



Stress

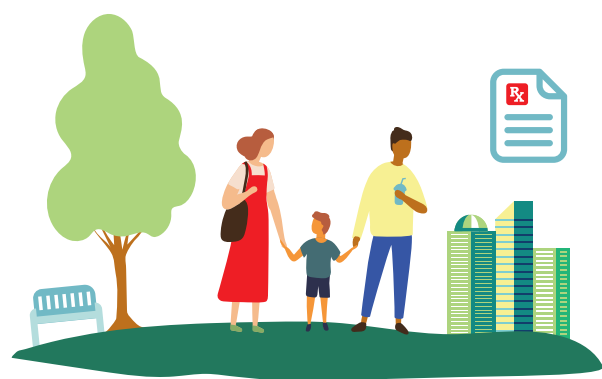
While stress is a natural part of the human existence, too much stress can lead to a litany of negative consequences—from lower productivity at work to negative social interactions to physical problems like asthma exacerbations, ulcers, and even heart disease. A 2011 study by the American Psychological Association found that most Americans are suffering from moderate to high stress.⁹

When under stress, our bodies release hormones like adrenaline, causing our hearts to beat faster, our breathing to become more rapid. This is good if we are in danger or need to focus on a high-intensity task, but becomes harmful when occurring day in and day out. But just as doctors identify a healthy diet and physical activity as a means to combat stress, nature, too, is being added to the list. Stress reduction, in fact, is one of the key mechanisms through which nature is thought to impact health.

A study in Philadelphia, PA, by Dr. South showed that simply walking past newly-greened vacant lots significantly decreased heart rate, a marker of acute stress. Heart rate did not change in a control group when walking past non-greened areas.¹⁰ Multiple studies have

drawn similar conclusions—spending time in or walking through green space reduces heart rate, blood pressure, and other physiologic markers of stress.¹¹

Researchers in Oakland, CA, have also found that weekly physician-prescribed group park visits increased resilience and reduced stress among low-income parents and families.¹² Parents also reported decreased feelings of loneliness. Authors pointed to the need among pediatricians for community resources, like nature exposure, to help address stress in children.

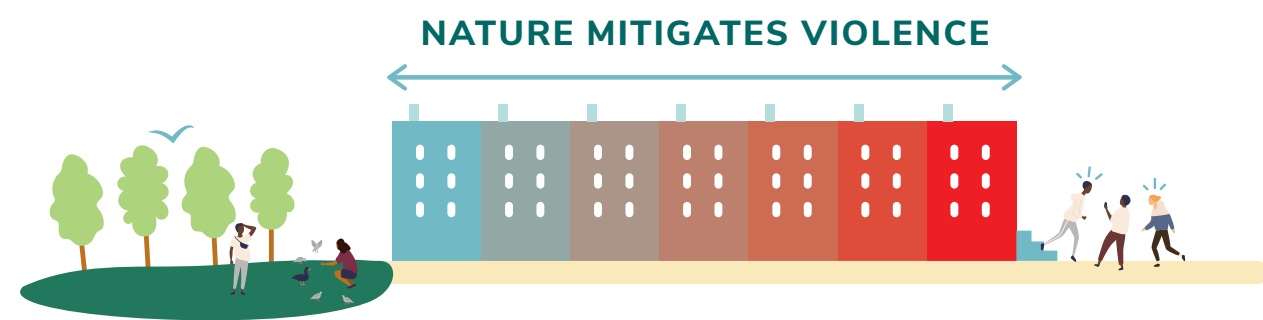


Weekly park visits—increasingly prescribed by physicians—can affect resilience and stress.

Mental Fatigue

“Mental fatigue,” that state of exhaustion caused by prolonged periods of focused cognitive activity, is a side effect of modern society.¹³ This tiredness of the brain, as it’s sometimes called, can manifest in a number of ways—for example, difficulty concentrating and managing our moods, and even leading to angry outbursts or violent behavior.

The latter was investigated in a study of public housing buildings in Chicago, IL. Researchers found that people with more small-scale nature in their immediate living



environment reported lower levels of mental fatigue and fewer episodes of aggressive behavior compared to residents in less verdant surroundings.¹⁴

Rumination—a pattern of harmful thinking in which the mind gets stuck in a loop of negative, self-related thoughts that can be difficult to break—can lead to depression and other mental illness. Taking a walk in nature, but not in a built environment, has been shown to help reduce this type of negative thinking.¹⁵ Brain scans of study participants who walked in nature showed reduced blood flow to the part of the brain that controls negative emotions. Walking in nature literally changes your brain.

Burnout & Wellness



Staff enjoying a break in their outdoor garden space, a “Sacred Place”, at Legacy Emanuel Medical Center in Portland, OR.

Burnout, characterized by symptoms of emotional exhaustion, depersonalization, and loss of personal efficacy, has skyrocketed among healthcare providers—namely nurses and doctors. The negative consequences are far-reaching—impacting personal wellbeing and relationships, quality of patient care, and costs to the health system.^{16,17} Some employers are exploring innovative ways to leverage nature to mitigate burnout and enhance wellness. In Portland, OR, a hospital created a micro-green space at the threshold of an intensive care unit, encouraging staff to use the space during their workday. A study that looked at symptoms of burnout in nurses who took their breaks outdoors versus indoors found that the former had fewer symptoms of emotional exhaustion and depersonalization.¹⁸

Taking breaks in outdoor green space can reduce burnout.





Physical Health

Cardiovascular Health

THE HEALING POWER OF NATURE

Cardiovascular disease is the leading cause of death in the US and affects nearly half of all adults.¹⁹ Very recent research is pointing to nature as a potential population-based approach to reducing heart disease. Researchers in Miami, FL, investigated the relationship between greenness on the block people live and four types of cardiovascular disease (heart attacks, coronary heart disease, heart failure, and irregular heartbeat). People living on blocks with higher levels of greenness had significantly lower levels of all four types of heart disease.²⁰ This study demonstrated the immediacy of nature in the place people often spend the most amount of time—their home.

In Toronto, CA, researchers quantified the cardiovascular health benefit of living on a street with high-density tree canopy. In short, people who live on a street with 11 or more trees had significantly lower cardio-metabolic disease—including diabetes, hypertension, and heart attacks. The researchers report the effect is equivalent to an annual income increase of \$20,000 or moving to a neighborhood with \$20,000 higher median income.²¹ A study underway in Louisville, KY, is evaluating the impact of planting mature trees on the future prevention of heart disease. This randomized controlled trial—that highest level of scientific inquiry—will provide us with the most robust evidence of trees on health to date.²²



Obstetrical Outcomes

While many of the benefits we've referenced so far apply directly to children, the fact is the benefits of nature exposure can begin well before a child takes its first breath.

Birth weight is an important early indicator of infant health. The harmful repercussions of low birth weight are broad, ranging from infant mortality to adult mental and physical illness. While there are many factors that affect birth weight, researchers have found that expectant mothers who live in areas with more tree canopy experience fewer “small for gestational age” births than those who live in more tree-barren environments.²³

Other studies too have explored the relationship between maternal exposure to nature and birth weight. A review article found that residential greenness within a 100-meter buffer was associated with higher birth weights. The authors also noted that the impact was more prevalent among the mothers who were less educated, suggesting again that nature may play a role in buffering the ill health effects of life-stress.²⁴



EFFECTS OF BIRTH WEIGHT CAN LAST A LIFETIME.



Community Health

Social Cohesion

When we talk about community health, we commonly are referring to the health of a set of individuals grouped collectively based on shared geography. In recent years, there's been much talk of the growing fragmentation of society—the erosion of community connectedness, of social cohesion—and the subsequent negative impact on health.

In fact, greater social cohesion—which has been defined as the existence of positive social relationships and a sense of belonging in one's neighborhood—is considered by many a critical component to a community's ability to achieve maximal health.²⁵

So where does nature enter the picture?

One means to foster social cohesion within a community is via shared spaces. Social scientists have studied the relationship between the presence of green space in particular and the amount of social contact among community residents. What we've learned is that less green space in people's living environment coincides with feelings of loneliness and a perceived shortage of social support.²⁶ More green space has been linked to a greater sense of belonging and cooperation between neighborhoods. In fact, in the previously mentioned study of greening in Philadelphia, people living near newly-greened spaces reported going outside to socialize more with neighbors.¹⁸

Crime & Perceptions of Safety

The health of a community and its members is impacted not only by sickness and disease, but also by crime.

In the study referenced earlier in the report—involving the greening of vacant urban lots in Philadelphia—police-reported crime was analyzed to determine the impact on gun violence.²⁷ Violent crime dropped in the vicinity of the treated lots up to 29 percent in the poorest neighborhoods—while residents living in proximity to these lots reported feeling much safer.

Vacant lot greening is a relatively low-cost intervention—with cities spending approximately \$1.75 per square foot to green and an even lower cost to maintain. A separate cost evaluation of the greening intervention found that for every dollar spent on greening, the return on investment to the taxpayer and to society for the prevention of firearm violence was \$26 and \$333 respectively.²⁸

Other research has indicated a link between low tree canopy and increased crime. Social scientists studied a vanishing tree canopy in Cincinnati, OH—the result of an infestation of invasive tree pests—and observed an association with increased theft, breaking and entering, property crime incidents and elevated numbers of simple assaults, felony assaults, and violent crimes after trees were destroyed.²⁹

And in yet another study alluding to the role nature may play in helping tamp gun violence, Dr. South was part of a team of fellow researchers who documented an association between tree canopy and lower levels of adolescent gun assault in Philadelphia, PA.³⁰

TREE CANOPIES MAY LOWER LEVELS OF GUN ASSAULT BY URBAN YOUTH





DOSE

With our deepening understanding of nature's therapeutic value, researchers across the globe are digging deeper to put a finer point on the question: How often and for how long does one need to spend time in nature to reap the health benefits? The short reply is that we don't yet have a certain answer and need more research before definitive guidelines are established. This said, several recent studies are suggesting an early answer.

Two separate papers published within the past year both suggest roughly the same amount of time per visit—just 20-30 minutes of exposure—for measurable benefits to manifest. One of these studies found that 30 or more minutes spent in an outdoor green space could reduce the population prevalence of depression and high blood pressure by up to 7 percent and 9 percent respectively.³¹ The second, a small US-based study involving urban dwellers, reported that people who spent just 20 minutes in an outdoor place where they felt connected to nature experienced a drop in stress hormones.³²

Another study looked at the cumulative time spent in nature per week and found that 120 minutes a week was a threshold to convey health and wellbeing benefits. This could be over one visit or multiple visits.³³

Inequity in Access to Green Space

While nature is essential to every community, access is not equal. And oftentimes, the neighborhoods that arguably need nature most—those grappling with the realities of entrenched poverty and legacies of segregation—are the ones with less access to parks and tree canopy. The implications are far-reaching, including on air quality and climate; a recent analysis showed that summer temperatures could vary by as much as 20 degrees across various parts of the same city, depending on how many trees were in a neighborhood.³⁴

Important to note is that "access" to green spaces doesn't always equate to the presence of green space, particularly in high-crime neighborhoods. A team of researchers studying nationwide disparities in access to parks and green spaces looked at how social access barriers—issues like safety, traffic, and walkability—could often influence actual use of the spaces.³⁵

And still, other studies have indicated that income-related inequality in health may be less pronounced among populations exposed to greener environments.³⁶

Where Do We Go From Here?



While physicians and researchers continue the quest to more deeply understand questions of dose and mechanisms, ample evidence already indicates that nature is essential to our wellbeing. By building safe and accessible green space into our neighborhoods, we have the potential to significantly improve the lives of people and communities. But we need to act.

Community members can identify areas—like a vacant lot—that can be transformed with nature, drawing their neighbors into a planning process and beginning the initiative to add a green space near their homes. A number of resources exist for how to get started, including many at www.naturesacred.org. City governments can act in multiple ways, many of which have been alluded to in this paper: by supporting lot conversion programs; by making investments in community green spaces; driving a cross-sector collaboration involving city public health officials, parks and recreations departments, universities, community groups, and private entities. Health systems can make targeted investments into green space around hospitals to improve the health of those they serve. Finally, researchers can continue to grow the evidence base needed to prove nature is a health investment worthy of our time and resources.



Innovative Programs

Nature in Cities

The Pennsylvania Horticultural Society's (PHS) Philadelphia LandCare Program

What is it? A Philadelphia-based program that has gained national recognition for its strategic approach to neighborhood redevelopment by taking aim at the city's many vacant lots—and converting them to clean, green spaces with productive use.

How does it work? The PHS LandCare Program encompasses installation and maintenance, and has revitalized more than 12,000 parcels covering 16 million square feet of vacant land in Philadelphia neighborhoods. These parcels are strategically chosen for their public safety issues; proximity to walking routes to schools, parks, recreation centers, and commercial corridors; and lack of open space and green amenities. Eighteen community organizations and 15 local for-profit landscaping companies collaborate with the program, hiring local residents and volunteers to perform the landscape maintenance work in the neighborhoods where they live. This effort gives them a direct role in keeping their neighborhoods clean and safe. Numerous studies have demonstrated the effectiveness of this program in impacting neighborhood health and safety.^{6,10,26,27,29}

More information: <https://phsonline.org/programs/landcare-program>

Nature Sacred Network

What is it? A living network of healing green spaces, occurring primarily in urban settings, designed to improve mental health, unify communities, and engender peace.

How does it work? Members of the network collaborate and share ideas to help their Sacred Places thrive—from problem solving and solution sharing to ideating ways to keep the community connected, involved—in the space.

More information: www.naturesacred.org



10-Minute Walk Challenge

What is it? A campaign—spearheaded by the Trust for Public Lands, the National Recreation and Park Association and Urban Land Institute—that has as its goal to see that every person in every city in America has a great park within a 10-minute-walk by 2050.

How does it work? By urging mayors to sign on to the challenge, to publicly commit to achieving the 10-minute-walk standard for every resident in their cities. The campaign is targeting change in three primary areas: planning, funding, and policies. Examples of these include: city bond measures; zoning changes intended to encourage park development; park master plans focused on access and quality; the expansion of “joint use” agreements that open school playgrounds, tracks, and gyms for public use after hours; and other innovative strategies.

More information: <https://10minutewalk.org>



Park Rx America

What is it? A non-profit organization that is working to decrease the burden of chronic disease, increase health and happiness, and foster environmental stewardship by prescribing nature, like other Park Rx movement initiatives, during the routine delivery of healthcare by a diverse group of healthcare professionals.

How does it work? Park Rx America has created a growing database of close to 10,000 parks and green spaces that physicians can prescribe, integrating a searchable park formula with Electronic Health Records, making it easier for healthcare providers to find suitable parks for their patients. Other resources, including research on the specific health benefits of nature, are also provided to physicians.

More information: <https://parkrxamerica.org>

References

- 1 Measuring America: Our Changing Landscape, US Census Bureau, Dec. 8, 2016.
- 2 Beyer KM, Kaltentbach A, Szabo A, Bogar S, Nieto FJ, Malecki KM. Exposure to neighborhood green space and mental health: evidence from the survey of the health of Wisconsin. *Int. J. Environ. Res. Public Health* 2014, 11(3), 3453-3472
- 3 Vries, Sjerp De, et al. "Streetscape Greenery and Health: Stress, Social Cohesion and Physical Activity as Mediators." *Social Science & Medicine*, vol. 94, 2013, pp. 26–33., doi:10.1016/j.socscimed.2013.06.030.
- 4 Hartig, Terry, et al. *Annual Review of Public Health* 2014 35:1, 207-228
- 5 Engemann, Kristine, et al. "Residential Green Space in Childhood Is Associated with Lower Risk of Psychiatric Disorders from Adolescence into Adulthood." *Proceedings of the National Academy of Sciences*, vol. 116, no. 11, 2019, pp. 5188–5193., doi:10.1073/pnas.1807504116.
- 6 South, Eugenia C., et al. "Effect of Greening Vacant Land on Mental Health of Community-Dwelling Adults." *JAMA Network Open*, vol. 1, no. 3, 2018, doi:10.1001/jamanetworkopen.2018.0298.
- 7 Mceachan, R R C, et al. "The Association between Green Space and Depressive Symptoms in Pregnant Women: Moderating Roles of Socioeconomic Status and Physical Activity." *Journal of Epidemiology and Community Health*, vol. 70, no. 3, 2015, pp. 253–259., doi:10.1136/jech-2015-205954.
- 8 Shanahan, Danielle F., et al. "Health Benefits from Nature Experiences Depend on Dose." *Scientific Reports*, vol. 6, no. 1, 2016, doi:10.1038/srep28551.
- 9 Clay, R. A. (2011, January). Stressed in America. *Monitor on Psychology*, 42(1). <http://www.apa.org/monitor/2011/01/stressed-america>
- 10 South, Eugenia C., et al. "Neighborhood Blight, Stress, and Health: A Walking Trial of Urban Greening and Ambulatory Heart Rate." *American Journal of Public Health*, vol. 105, no. 5, 2015, pp. 909–913., doi:10.2105/ajph.2014.302526..
- 11 Kondo, Michelle C., et al. "Does Spending Time Outdoors Reduce Stress? A Review of Real-Time Stress Response to Outdoor Environments." *Health & Place*, vol. 51, 2018, pp. 136–150., doi:10.1016/j.health-place.2018.03.001.
- 12 Nooshin Razani, Saam Morshed, Michael A. Kohn, Nancy M. Wells, Doug Thompson, Maoya Alqassari, Amaka Agodi, George W. Rutherford. Effect of park prescriptions with and without group visits to parks on stress reduction in low-income parents: SHINE randomized trial. *PLoS One*. 2018 Feb 15;13(2):e0192921.
- 13 Marcora, Samuele M., et al. "Mental Fatigue Impairs Physical Performance in Humans." *Journal of Applied Physiology*, vol. 106, no. 3, 2009, pp. 857–864., doi:10.1152/jappphysiol.91324.2008.
- 14 Kuo, Frances E., and William C. Sullivan. "Aggression and Violence in the Inner City." *Environment and Behavior*, vol. 33, no. 4, 2001, pp. 543–571., doi:10.1177/00139160121973124.
- 15 Bratman, Gregory N., et al. "Nature Experience Reduces Rumination and Subgenual Prefrontal Cortex Activation." *Proceedings of the National Academy of Sciences*, vol. 112, no. 28, 2015, pp. 8567–8572., doi:10.1073/pnas.1510459112.
- 16 Han, Shasha, et al. "Estimating the Attributable Cost of Physician Burnout in the United States." *Annals of Internal Medicine*, vol. 170, no. 11, 2019, p. 784., doi:10.7326/m18-1422.
- 17 American Medical Association. *Your Family Feels the Fallout of Physician Burnout Too*, 2018 Aug; www.ama-assn.org
- 18 Cordoza M, Ulrich RS, Manulik BJ, Gardiner SK, Fitzpatrick PS, Hazen TM, Mirka A, Perkins RS. Impact of Nurses Taking Daily Work Breaks in a Hospital Garden on Burnout. *Am J Crit Care*. 2018 Nov;27(6):508-512.
- 19 Benjamin, Emelia J., et al. "Heart Disease and Stroke Statistics—2019 Update: A Report From the American Heart Association." *Circulation*, vol. 139, no. 10, 2019, doi:10.1161/cir.0000000000000659.
- 20 Wang K, Lombard J, Rundek T, Dong C, Gutierrez CM, Byrne MM, Toro M, Nardi MI, Kardys J, Yi L, Szapocznik J, Brown SC. Relationship of Neighborhood Greenness to Heart Disease in 249 405 US Medicare Beneficiaries. *J Am Heart Assoc*. 2019 Mar 19;8(6):e010258.
- 21 Kardan, Omid, et al. "Neighborhood Green space and Health in a Large Urban Center." *Scientific Reports*, vol. 5, no. 1, 2015, doi:10.1038/srep11610.
- 22 Green Heart Louisville, <http://louisville.edu/greenheart>
- 23 Donovan, G. H., Michael, Y. L., Butry, D. T., Sullivan, A. D., & Chase, J. M. (2011, 01). Urban trees and the risk of poor birth outcomes. *Health & Place*, 17(1), 390-393. doi:10.1016/j.healthplace.2010.11.004
- 24 Dzhambov, A. M., Dimitrova, D. D., & Dimitrakova, E. D. (2014). Association between residential greenness and birth weight: Systematic review and meta-analysis. *Urban Forestry & Urban Greening*, 13(4), 621-629. doi:10.1016/j.ufug.2014.09.004
- 25 Bruhn, John. *Group Effect*. Springer, 2014.
- 26 Maas J, van Dillen SME, Verheij RA, Groenewegen PP. Social contacts as a possible mechanism behind the relation between green space and health. *Health Place*. 2009 Jun;15(2):586-595.
- 27 Branas, Charles C., et al. "Citywide Cluster Randomized Trial to Restore Blighted Vacant Land and Its Effects on Violence, Crime, and Fear." *Proceedings of the National Academy of Sciences*, vol. 115, no. 12, 2018, pp. 2946–2951., doi:10.1073/pnas.1718503115.
- 28 Branas, Charles C., et al. "Urban Blight Remediation as a Cost-Beneficial Solution to Firearm Violence." *American Journal of Public Health*, vol. 106, no. 12, 2016, pp. 2158–2164., doi:10.2105/ajph.2016.303434.
- 29 Kondo, Michelle C., et al. "The Association between Urban Trees and Crime: Evidence from the Spread of the Emerald Ash Borer in Cincinnati." *Landscape and Urban Planning*, vol. 157, 2017, pp. 193–199., doi:10.1016/j.landurbplan.2016.07.003.
- 30 Garvin EC, Cannuscio CC, Branas CC. Greening vacant lots to reduce violent crime: a randomised controlled trial. *Inj Prev*. 2013 Jun;19(3):198-203.
- 31 Shanahan, Danielle F., et al. "Health Benefits from Nature Experiences Depend on Dose." *Scientific Reports*, vol. 6, no. 1, 2016, doi:10.1038/srep28551.
- 32 Hunter, Marycarol R., et al. "Urban Nature Experiences Reduce Stress in the Context of Daily Life Based on Salivary Biomarkers." *Frontiers in Psychology*, vol. 10, 2019, doi:10.3389/fpsyg.2019.00722.
- 33 White, Mathew P., et al. "Spending at Least 120 Minutes a Week in Nature Is Associated with Good Health and Wellbeing." *Scientific Reports*, vol. 9, no. 1, 2019, doi:10.1038/s41598-019-44097-3.
- 34 Popovich, Nadja, and Christopher Flavelle. "Summer in the City Is Hot, but Some Neighborhoods Suffer More." *The New York Times*, *The New York Times*, 9 Aug. 2019, www.nytimes.com/interactive/2019/08/09/climate/city-heat-islands.html.
- 35 Wen, Ming, Xingyou Zhang, Carmen Harris, James Holt, Janet Croft. "Spatial Disparities in the Distribution of Parks and Green Spaces in the USA." *Annals of Behavioral Medicine*, vol. 45, no. S1, 2013, pp. 18–27., doi:10.1007/s12160-012-9426-x.
- 36 Mitchell, Richard, and Frank Popham. "Effect of Exposure to Natural Environment on Health Inequalities: an Observational Population Study." *The Lancet*, vol. 372, no. 9650, 2008, pp. 1655–1660., doi:10.1016/s0140-6736(08)61689-x.



Nature Sacred

Nature Sacred exists to inspire, inform and guide communities in the creation of public green spaces—called Sacred Places—designed to improve mental health, unify communities and engender peace. For over 25 years, Nature Sacred has partnered with over 130 communities across the country to infuse nearby nature into places where healing is often needed most: distressed urban neighborhoods, schools, hospitals, prisons and more. Through a collaborative, community-led process and an evidence-based design model, each Sacred Place is bonded together by a common goal: to reconnect people with nature in ways that foster mindful reflection, restore mental health and strengthen communities. As each community imagines its own space, the design becomes a unique reflection of the community's culture, story and place—making it inherently sacred to them. Learn about our model, our approach and our Sacred Places: naturesacred.org



Pennsylvania Horticultural Society

The Pennsylvania Horticultural Society, an internationally recognized nonprofit organization founded in 1827, plays an essential role in the vitality of the Philadelphia region by creating healthier living environments, increasing access to fresh food, growing economic opportunity, and building deeper social connections between people. PHS delivers this impact through: comprehensive greening and engagement initiatives in more than 250 neighborhoods; an expansive network of public gardens and landscapes; year-round learning experiences; and the nation's signature gardening event, the Philadelphia Flower Show. PHS provides everyone with opportunities to garden for the greater good as a participant, member, donor, or volunteer. For information and to support this work, please visit PHSonline.org.