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Science FINDINGS

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"Science affects the way we think together."
Lewis Thomas

Nearby Nature—A Cost-Effective Prescription for Better Community Health?

Guy Kramer

"Metro nature" in Vancouver, Washington. Trees, parks, and gardens in cities are profoundly important for human health and wellness for city dwellers of all ages.

IN SUMMARY

A balanced diet and regular exercise are fundamental for good health, and a daily dose of nature may be equally important. Nearly 40 years of research has demonstrated that "metro nature"—nature found in urban environments, such as parks or tree-lined streets—provides positive and measurable health benefits and improves people's quality of life.

A research team led by Kathleen Wolf, a research social scientist with the U.S. Forest Service Pacific Northwest Research Station, found that the health benefits associated with metro nature have a calculable economic impact. The team surveyed peer-reviewed studies that documented the effects of metro nature on human health and identified six social and public health outcomes: increased birth weight; reduced symptoms of attention-deficit hyperactivity disorder (ADHD); better school performance; and decreased crime, cardiovascular disease, and Alzheimer's disease. Using publicly available economic data, the team estimated the potential health care cost savings.

The researchers found that metro nature could provide an annual savings and benefits in the United States of up to $6.8 billion, specifically by reducing prescription costs for ADHD and Alzheimer's disease by nearly $3.4 billion, and increasing graduation rates, which results in increased lifetime annual income. The findings suggest that investing in metro nature can improve both the livability of a city and quality of life.

"In all things of nature there is something of the marvelous."
—Aristotle

After decades spent researching how nature in the urban environment influences human health and enhances the quality of life within cities, Kathleen Wolf, a research social scientist with the U.S. Forest Service Pacific Northwest Research Station, remained puzzled by a key question.

Early in her research career, Wolf conducted a series of surveys studying the relationship between urban forest canopy in business districts and shopper response. She found that the presence of trees influenced shopper's buying habits: shoppers claimed they would travel greater distances, stay longer, and spend more money in business districts with trees, compared to districts without trees.

It was an intriguing result that Wolf kept in the back of her mind as she spent the next decade exploring the psychological and physiological effects of nature on people. She coined the term "metro nature" to raise awareness of the natural settings present in cities, whether in the form of street or yard

trees, urban forests, city parks, or community gardens, and how this nature improves the livability of cities. "Americans are beginning to understand that you don't need to get out of the city to appreciate nature or be restored by nature," Wolf explains. "In fact, from an equity perspective, there are a lot of urban residents who are just not able to get away."

Connecting Metro Nature, Human Health, and Economics

The past decade has seen an emerging community of science that includes researchers across the country and around the world who are exploring the links among metro nature, human health, and quality of life. In response to this ever-expanding field, Wolf developed the websites *Green Cities: Good Health* and *Human Dimensions of Urban Forestry and Urban Green* as resources for planners, managers, and the public. As the research expanded our understanding of the interplay of metro nature and human health, Wolf and others realized there was a crucial missing component—the economic value of metro nature, particularly in regard to human health.

"Economics can't capture all the values that people hold for nature, but it is a common language," she explains. "It earns you a place at the table when discussing budgets and policy."

KEY FINDINGS

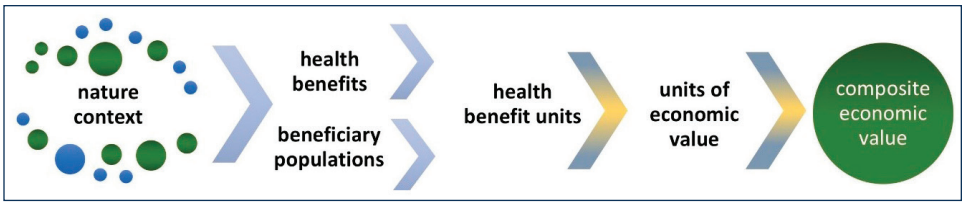
- In urban environments, metro nature contributes to improved health and wellness over a person's lifetime, which can reduce health care costs.
- More than 5 million children in the United States are diagnosed with attention-deficit hyperactivity disorder (ADHD), and two-thirds of those are treated with medications. Nature-based play and activity are found to reduce symptoms. Reduced use of prescribed medications could equal up to $1.9 billion in savings per year.
- Window views from classrooms and green campuses reduce student stress, enhance attention, and improve graduation rates. Lifetime incomes for increased numbers of graduates could total more than $1.3 billion annually in the United States.
- Cardiovascular disease is the primary cause of adult death in the United States. Studies show associations between access to nearby nature and reduced cardiovascular disease mortality. Annual avoided costs could reach $1.2 billion in the United States.
- More than 5 million Americans have Alzheimer's disease or other dementia disorders. Treatment and care costs are expensive and ongoing. Access to nature could partially replace medication costs, resulting in an annual cost savings of nearly $1.5 billion in the United States.

And when the health benefits of metro nature are presented within an economic framework, it's possible to calculate a return on investment, which is crucial when city planners or engineers select projects to invest in.

Yet undertaking a study to explore this relationship gave Wolf pause, and that is likely why it hadn't already been undertaken by others. "There are market dynamics for products that we extract from forests such as timber, or value-added products such as furniture. These products can readily be priced and sold," she explains. "However, indirect health benefits are not readily exchanged on markets, so one has to find proxies. For example, if you experience reduced depression because you walk outdoors in nature, you may not have to pay as much for counseling or medication. Yet how do you calculate the cost savings?"

In 2012, Wolf decided it was time to explore the linkage. She approached Stephen Grado, professor of forestry, and Marcus Measells, an extension associate, both with Mississippi State University's Department of Forestry. The researchers weren't daunted by the challenge that Wolf presented. "Steve said very graciously, 'Let's give this a try,'" she recalls, 'Let's explore this intersection of health benefit and economics.'" With funding from U.S. Forest Service State and Private Forestry, on recommendation of the National Urban and Community Forestry Advisory Council, Wolf hired Alicia Robbins, then a post-doctorate at the University of Washington, as the fourth member of the team.

It was a truly collaborative effort. Wolf brought expertise in environmental psychology, Grado and Measells contributed expertise in forest economics, specifically calculating economic value for nonmarket benefits and services, and Robbins, also an economist, served as a liaison between the two disciplines and assisted with the analytics. Robbins was attracted to the project because it combined two of her interests: economics and urban forestry. "I've always been interested in trees and how people use them," she says.



To calculate the economic value of metro nature, Wolf's study team developed the process summarized above, It is based on other economic valuation approaches and draws from research on human epidemiology, public health administration, and natural resources economics.

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Assigning Value to Health and Nature

Before the economic calculations could begin, the team reviewed thousands of peer-reviewed journal articles to identify social and public health outcomes that had direct economic consequences. From among the numerous reported findings, the team identified six indicators that span a person's lifetime and have a calculable economic value, whether as health care costs, income levels, or social services: infant birth weight, attention-deficit hyperactivity disorder (ADHD), school performance, crime, cardiovascular disease, and Alzheimer's disease.

How does metro nature influence these six indicators? From their literature review, Wolf and her colleagues found significant effects:

- The presence of tree canopy and green spaces resulted in mothers generally delivering babies with healthier birth weights.
- Symptoms of ADHD were reduced after children played in nature or green spaces for just 20 minutes.
- Graduating from high school results in a higher lifetime income, and high schools with green campuses had higher graduation rates.
- Metro nature in neighborhoods, such as landscaped vacant lots or community gardens, can contribute to reduced crime levels.
- Men living in neighborhoods with greater nature coverage had a reduced risk of cardiovascular disease.
- Older adults with cognitive disorders had reduced symptoms of agitation and depression and were able to better maintain mobility if they had regular exposure to nature.

Wolf's team could calculate the economic impact of these nature-linked health and social

Guy Kramer

Having trees parks and gardens near the homes of pregnant women is correlated with healthier infant birth weight. Neighborhoods with large street trees, like the one pictured above in the Seattle metro area, also have been found to have lower crime rates.

Guy Kramer

Children climb a tree in a plaza in Leavenworth, Washington. Routine activity outdoors can help reduce ADHD symptoms for children.

Guy Kramer

Adults living in communities with large trees may have reduced risk for death from cardiovascular and respiratory disease.

Guy Kramer

Taking a walk in the city: nature access for elders can support physical activity, and contribute to improved cognitive function and reduced dementia.

outcomes because each, when met or avoided, had a corresponding monetary value.

As Robbins describes it, "If you plant trees, what does that mean in terms of the observed cost savings of health care?" For the health care indicators, this can be the cost of prescription drugs to manage symptoms or number of days spent in a hospital. Crime has costs associated with replacing stolen property or city police budgets, and for crimes against a person, there can be health care costs. With the U.S. Census Bureau reporting the annual income of individuals in relation to their education level, it's possible to compare how income levels differ in relation to education level.

Using publicly available datasets created by agencies and organizations such as the Centers for Disease Control and Prevention, Alzheimer's Association, and American Heart Association, the team conducted an economic valuation analysis of each indicator. Robbins, Grado, and Measells were responsible for developing a general valuation framework and performing the valuation analysis.

"It was an innovative effort to assign economic value to health outcomes where there really wasn't an established economic link or methodology," Robbins says. "We had to tease out proxies to calculate economic values."

Wolf agrees that a challenge with the project was that "most of the studies we reviewed weren't created with a dollar value in mind."

Although Wolf had hypothesized that metro nature contributed to reducing health care costs, she was surprised by the potential economic impact of the six indicators, as applied across the entire United States. When babies are born with a higher birthweight, the resulting annual cost savings could be $5.5 million. Reducing falls in older adults can result in a $1.7–$2.4 billion annual cost savings. Crime reduction would generate an annual cost savings of $928 million. The potential avoided costs of cardiovascular disease, which is the primary cause of adult death, is more than $1 billion annually. With more than 5 million children diagnosed with ADHD and two-thirds treated with medications, a partial reduction in medications could result in nearly $1.9 billion in annual savings.

Wolf cautions that these are preliminary numbers with room to build in more precision, and the analysis assumed a presence of nature as described in the source studies. There are also many other health outcomes that could be valued. "Our research sets the stage and can open the conversation further," she says. "Metro nature does have economic consequences, an important finding for policy and planning in cities."

Kathleen Wolf

Green stormwater infrastructure, such as the bioswales pictured above, can be co-designed to achieve water management and human health co-benefits for people of all ages.

Designing With Nature in Mind

Even with today's wealth of health-related research, metro nature is often only appreciated for its aesthetic qualities, such as the beauty of a boulevard lined with mature trees. Many public decisionmakers still refer to tree or parks programs as "beautification."

However, it's becoming recognized that a tree-lined boulevard and other landscapes are a component of a city's green infrastructure, providing public benefits that previously were associated with traditional utilities or a city's grey infrastructure. Trees provide valuable ecosystem services, such as stormwater mitigation, improved air quality, and reduced energy costs. Using i-Tree, a software tool developed by the U.S. Forest Service, city planners, urban foresters, or the general public can calculate the economic value of an entire forested area, or even individual trees. And unlike a city's grey infrastructure, such as single-purpose drains and pipes that convey stormwater to a treatment plant, green infrastructure can simultaneously perform multiple functions and at a significant cost savings.

"Co-design for co-benefits," is a theme that Wolf now emphasizes when she speaks about the benefits of metro nature. "We have to be smarter to enable the city to function like a forest," she says. "If we get creative, we can get the ecological functionality of a forest, even within built systems."

It's this vision of city planning that prompted Jessie Israel, The Nature Conservancy's Puget Sound conservation director, to reach out to Wolf and propose a partnership. Israel's team now focuses on cities.

"The public knows The Nature Conservancy for a half-century track record [of] working on land deals outside of cities," she explains. "However, our vision is to work at the nexus of people and nature, and we can't succeed at that unless we also bring resources to work inside cities."

Through its 2-year-old Global Cities: Natural Solutions for Nature and People program, The Nature Conservancy wants to better integrate metro nature into the urban landscape to make cities more resilient and livable, especially in regard to climate change. One of Israel's goals is reducing stormwater pollution in the Puget Sound. Toxic runoff from hard, urban surfaces makes up 75 percent of the pollution in the Puget Sound. Yet she says it doesn't make sense to focus exclusively on water quality when human health disparities, population growth, economic development, and climate-change impacts are key issues in cities throughout the Puget Sound region.

The strategic integration of nature into cities can perform the dual role of improving the health of its citizens while making cities resilient. "Metro nature is one of the closest things we have to a silver bullet," Israel says. "We all want to be healthy. Most of us intuitively see the quality of life benefits that come from bringing more nature into our communities."

Communicating that metro nature, with its documented public health and infrastructure benefits, is part of the solution, is a challenge, however. "The extent that people have been able to extract out, especially on the human health side, the benefits of nature doesn't get much attention," Robbins says.

And when the public does recognize the health benefits of nature, it's usually seen in terms of personal choice or individual benefits, such as consuming organic food or drinking bottled water. What's missing is the awareness of the community-level health benefits that everyday experiences of nature provide.

This is why The Nature Conservancy, in collaboration with Wolf, published *Outside Our Doors and Nature's Riches: the Health and Financial Benefits of Nearby Nature,* to spread the message of the health benefits and economic cost savings that nature provides. "Once you start talking about the human benefit of metro nature, then we can talk about why it makes good financial sense to invest in green infrastructure," Israel explains. Another recent effort is a short video, *The Power of Trees*.

A co-design for co-benefits strategy that incorporates metro nature into city planning and new development requires a shift in policies, as benefits span multiple city departments. Although a city's parks department may manage its trees for recreation and habitat benefits, those trees also provide stormwater management services that may fall under the purview of the public works department.

"As public servants and urban designers, we were trained to think in a siloed way to reduce risk, save money, and create predictable facilities," Israel says. "However, with climate-change impacts becoming more relevant to decisionmakers, and reduced funding to solve a multitude of community needs, the name of the game is now about being able to be nimble, integrated in our approach, and leverage resources for maximum value to the public."

"The health of the people is really the foundation upon which all their happiness and all their powers as a state depend."

—Benjamin Disraeli

LAND MANAGEMENT IMPLICATIONS

- Metro nature is an inclusive term that includes urban forest, parks, gardens, green streets, and urban ecosystems. Nature in cities can be planned and managed using comprehensive and systems-oriented goals to yield environmental, human health, and social co-benefits.
- Public health officials are increasingly interested in how infrastructure improvements can be integrated with efforts to improve human health and wellness. Metro nature is an important, though often overlooked, aspect of a city's infrastructure.
- Potential economic returns and health care savings—for communities, households, and individuals—are more likely if the parcels and spaces for metro nature are planned and managed to optimize public access and provide engaging programs.

For Further Reading

House, E.; O'Connor, C.; Wolf, K. et al. 2016. Outside our doors: the benefits of cities where people and nature thrive. Seattle, WA: The Nature Conservancy, Washington State Chapter: http://www.washingtonnature.org/cities/outsideourdoors/.

The Nature Conservancy; University of Washington; University of British Columbia; Duwamish Tribe. The power of trees [Video]. Seattle, WA. http://www.washingtonnature.org/power-of-trees-video.

University of Washington. 2016. Green cities: good health. http://depts.washington.edu/hhwb/.

Wolf, K.L.; Measells, M.K.; Grado, S.C.; Robbins, A.S.T. 2015. Economic values of metro nature health benefits: a life course approach. Urban Forestry and Urban Greening. 14: 694–701. https://www.fs.usda.gov/treesearch/pubs/49803.

Wolf, K.L.; Robbins, A.S.T. 2015. Metro nature, environmental health, and economic value. Environmental Health Perspectives. 123(5): 590–598. https://www.fs.usda.gov/treesearch/pubs/49509.

Wolf, K.L. 2016. Nature's riches: the health and financial benefits of nearby nature. University of Washington and The Nature Conservancy. http://www.naturewithin.info/New/2016.11.Economic_Benefits_of_Nature_in_Cities.KWolf.pdf.

Wolf, K.L. 2005. Business district streetscapes, trees and consumer response. Journal of Forestry. 103(8): 396–400. http://www.naturewithin.info/CityBiz/BizTreesAll_JFor.pdf.

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