City Trees & Human Health :: Evidence to Action

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College of the Environment

Good Health Grows on Trees
30 May 2019
Outline

1. History :: Environmental Health :: Urban Sustainability

2. Nature as Social Determinant of Health

3. Evidence = Shift (policy)
Environmental Health
Rachel Carson (1907-1964)
A Remarkable Career

• aquatic biologist, U.S. Bureau of Fisheries
• 1950s full time nature writer
• 1951 Sea Around Us, National Book Award
• The Edge of the Sea, Under the Sea Wind
• 1962 Silent Spring, national pesticide policy
• launched grassroots environmental movement
• creation of the Environmental Protection Agency
Pervasive Pesticides
Environment = Toxin, Risk
Beyond Toxicity
Human Health and the Natural Environment

Howard Frumkin, MD, DrPH, FACP, FACEP

Abstract: Research and teaching in environmental health have centered on the hazardous effects of various environmental exposures, such as toxic chemicals, radiation, and biological and physical agents. However, some kinds of environmental exposures may have positive health effects. According to E.O. Wilson’s “biophilia” hypothesis, humans are innately attracted to other living organisms. Later authors have expanded this concept to suggest that humans have an innate bond with nature more generally. This implies that certain kinds of contact with the natural world may benefit health. Evidence supporting this hypothesis is presented from four aspects of the natural world: animals, plants, landscapes, and wilderness. Finally, the implications of this hypothesis for a broader agenda for environmental health, encompassing not only toxic outcomes but also salutary ones, are discussed. This agenda implies research on a range of potentially healthful environmental exposures, collaboration among professionals in a range of disciplines from public health to landscape architecture to city planning, and interventions based on research outcomes.


Environment & Health Benefit
the Sanitary to Sustainable City

sanitary is efficient and hygienic
supply & removal
of materials and services
reconnect natural systems
green infrastructure possibilities
Industrial Age – city squalor

Filthy Cities!
Baltimore: Public Works Museum
stormwater retention
Thornton Creek Water Quality Channel (Seattle, SvR Design)
1 hectare, treats runoff from 275 hectares (1 hectare = 2.47 acres)
the Chenoggye freeway
Seoul, South Korea
~ 1970-2005
Cheonoggyecheon Stream Restoration
8.4 km, $900 M
Cascading Benefits
Designing Green Stormwater Infrastructure for Human Wellness

co-author:

co-author & printing:
The Nature Conservancy
Outline

1. History :: Environmental Health :: Sanitary to Sustainable Cities

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City Nature Settings

NEARBY NATURE INCLUDES A VARIETY OF SPACES AND PLACES

URBAN FOREST CANOPY

BIOPHILIC DESIGN

PARKS AND GARDENS

GREEN STORMWATER INFRASTRUCTURE
Urban Forests and Newborns

the natural environment may affect pregnancy outcomes . . .

10% increase in tree-canopy cover within 50m of a house

= lower number of low weight births

(1.42 per 1000 births)

Donovan et al., Health & Place 2011;
Hystad et al., Env Health Perspectives 2014
Healthy Microbiome

- control obesity & asthma
- boost immune function
- improve mental health

need contact with ‘Old Friends”

put aside the Hygiene Hypothesis
~10 to 100 trillion microbes in healthy gastrointestinal (GI) tract

intestinal microbiome development

Arrieta et al. 2014. Frontiers in Immunology
Eat Dirt!
Trees & Physical Activity

• school children in cities grades 6 to 8
• relationship of tree cover to outside-of-school physical activity
• 5% increase in treed area cover = 5% increase in free-time physical activity

public health officials moderate activity recommendations

parks, active living, active transit
public health officials
moderate activity
recommendations

parks, active living, active transit
EAB Tree Loss & Public Health

1990 to 2007, 1,296 counties in 15 states infected areas vs. no bugs
15,000 more deaths from cardiovascular disease
6,000 more deaths from lower respiratory disease
controlled for demographic, human mortality, and forest health data at the county level

Toledo, Ohio in 2006, pre EAB

2009, EAB in neighborhood

photo credits: Dan Herms, Ohio State U

Sacramento Study :: LIDAR x CHIS data
7,900 adults, 250 m buffer, covariates

more tree cover
= better overall health
= better social cohesion

Improving Depression

20 adults with major depression walk in a park setting and a built setting

- 50-minute walks one week apart
- before-after testing:
  - Mood: Positive and Negative Affect (PANAS)
  - Cognition: Backward Digit Span (BDS)

Cognitive and affective improvements after walking in a nature setting

Berman et al. 2012. Journal of Affective Disorders
Neighborhoods with Trees

10 more trees on a city block?
health benefits comparable to $10,000 household income increase OR being 7 years younger

Kardan et al., 2015, Scientific Reports
Alzheimer’s Disease & Dementia
Provide wander gardens & horticulture therapy

- 10.5% reduction in amount of medications used in dementia facility
- 30% fewer falls, accompanied by a reduction in fall severity

Detweiler et al. 2009. American Journal of Alzheimer’s Disease and Other Dementias

www.rph.org/eden.html
Tree cover shows an inverse relationship with depressive symptoms in elderly residents living in U.S. nursing homes

Matthew H.E.M. Browning a, b, c, Kangjae Lee b, Kathleen L. Wolf c
City Trees & Human Health

- newborn & infant health
- increased physical activity for kids
- overall adult health
- social cohesion
- respiratory & cardiovascular health
- reduced depression
- elder care improvements
Data Story: Human Health Benefits Across the Life Cycle
WHO Health Definition

A state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (1946)
Social Determinants
Green Cities: Good Health
www.greenhealth.washington.edu

Sponsors:
USDA Forest Service,
(U&CF Program + Pacific NW Research)
University of Washington
NGO partners

Thanks!
to U of WA students:
Katrina Flora
Mary Ann Rozance
Sarah Krueger

Research Reviews & Summaries
Local Economics

Trees in cities are not grown and managed for products that can be bought and sold on markets, but they do provide many intangible services and functions! This article serves two purposes. First, it introduces valuation methods that are used to convert intangible benefits to dollar sums. Then, it shows how nonmarket valuations can support local decision-making.

Fast Facts

- The presence of larger trees in yards and as street trees can add from 3% to 15% to home values throughout neighborhoods.

- Averaging the market effect of street trees on all house values across Portland, Oregon yields a total value of $1.35 billion, potentially increasing annual property tax revenues $15.3 million.

- A study found 7% higher rental rates for commercial offices having high quality landscapes.

- Shoppers claim that they will spend 9% to 12% more for goods and services in central business districts having high quality tree canopy.

- Shoppers indicate that they will travel greater distance and a longer time to visit a district having high quality trees, and spend more time there once they arrive.
Green Cities: Good Health
database of >4,500 peer reviewed publications
2016

design: milepost

coop-author: US Forest Service

coa-author & printing: The Nature Conservancy
Introduction

Writers, philosophers, and naturalists have praised the benefits of nature for human health, happiness, and well-being for centuries, but only relatively recently have researchers begun studying and quantifying the complex relationship between human health and nature.

In 1984, Roger Ulrich, professor and director of the Center for Health Systems and Design at Texas A&M University, published the results of a pioneering study that looked at the recovery rates of gall bladder surgery patients in relation to the views from their rooms in a Texas hospital. Some of the patients looked out over a garden and grove of trees, while others had a view of a brick wall. Ulrich found that patients with a natural view spent fewer days in the hospital and used fewer pain medications (Ulrich 1984).

Ulrich’s study helped open the door to a new field of inquiry focused on illuminating the ways that nature influences our physical, mental, and social lives. More than three decades later, a broad and diverse body of scientific literature describes the human health value of nature, confirming that trees, parks, gardens, and other natural settings are as essential to livable and sustainable cities as the other critical systems that keep their residents moving and working.

Findings from the current literature indicate the wide range of effects.

CONTENTS

1 Introduction
2 Defining Nature and Health Research
3 Pollution and Physical Health
4 Active Living
5 Features that Promote Physical Activity
6 Mental Health
7 Stress Reduction
8 Social Health, Cohesion, and Resilience
9 Social Equity and Access to Nature
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Outline

1. History :: Environmental Health :: Sanitary to Sustainable Cities

2. Nature as Social Determinant of Health

3. Evidence = Shift (policy)
Policy ‘Shift’

1. urban forest planning & management
2. medicine/public health
3. influenced by economics
Vegetation & Mental Health

- vegetation cover and afternoon bird abundances
- lower prevalence of depression, anxiety, and stress:
  - depression, more than 20% cover,
  - anxiety, more than 30% cover,
  - stress, more than 20% cover

“dose” at which health issue is lower

Canopy Cover & Stress

images of canopy cover varied 0-60% 

Shinrin yoku (forest bathing)

- extensive research
- restorative experiences
- workers retirees
- networked system, 52 bases in Japan
The medicine of being in the forest

We are the leading global voice for forest bathing and forest therapy

Santa Rosa, California
Parks Prescription

Date: __________________________

Dr: __________________________

Name: _________________________

I recommend:

☐ Walking

☐ Other: _______________________

___________________________ minutes a day

___________________________ days per week

* Health Canada suggests moderate activity of 30 minutes per day | 5 days a week

Benefits of daily activity

• Improve overall physical and mental health
• Maintain a healthy weight
• Reduce the risk of diabetes and other chronic conditions
• Lower cholesterol levels
• Manage stress and anxiety

Signature: _____________________

doctors of BC
Parks Prescription

1. Get a prescription for ParksRx from your healthcare provider.
2. Visit www.REACHforbetterhealth.com
3. Enter your zip code
4. Click

Pick your park

Exercise in the park and share outcomes with your healthcare provider.

PARKS Rx
Your Prescription For Better Health

This information is provided for educational purposes and is not to be considered medical advice.

Made possible with funding from the Centers for Disease Control and Prevention.
healthy trees.
happy people.

www.leaflimb.com  919.787.9551
<table>
<thead>
<tr>
<th>WI Leading Causes of Death, 2017</th>
<th>Deaths</th>
<th>Rate***</th>
<th>State Rank*</th>
<th>U.S. Rate**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Heart Disease</td>
<td>11,680</td>
<td>157.6</td>
<td>26th</td>
<td>165.0</td>
</tr>
<tr>
<td>2. Cancer</td>
<td>11,318</td>
<td>153.2</td>
<td>28th (tie)</td>
<td>152.5</td>
</tr>
<tr>
<td>3. Accidents</td>
<td>3,746</td>
<td>58.3</td>
<td>17th</td>
<td>49.4</td>
</tr>
<tr>
<td>4. Chronic Lower Respiratory Disease</td>
<td>2,834</td>
<td>38.3</td>
<td>34th (tie)</td>
<td>40.9</td>
</tr>
<tr>
<td>5. Stroke</td>
<td>2,513</td>
<td>33.5</td>
<td>38th</td>
<td>37.6</td>
</tr>
<tr>
<td>6. Alzheimer’s disease</td>
<td>2,428</td>
<td>31.6</td>
<td>29th</td>
<td>31.0</td>
</tr>
<tr>
<td>7. Diabetes</td>
<td>1,433</td>
<td>19.4</td>
<td>35th</td>
<td>21.5</td>
</tr>
<tr>
<td>8. Flu/Pneumonia</td>
<td>974</td>
<td>12.9</td>
<td>39th</td>
<td>14.3</td>
</tr>
<tr>
<td>9. Suicide</td>
<td>926</td>
<td>15.4</td>
<td>27th</td>
<td>14.0</td>
</tr>
<tr>
<td>10. Kidney Disease</td>
<td>922</td>
<td>12.5</td>
<td>27th</td>
<td>13.0</td>
</tr>
</tbody>
</table>

**Causes of Adult Death in Wisconsin?**

source: U.S. Centers for Disease Control and Prevention
## Economics! U.S dollars

<table>
<thead>
<tr>
<th>Wisconsin</th>
<th>Range for States</th>
<th>All U.S</th>
</tr>
</thead>
<tbody>
<tr>
<td>annual per capita spending</td>
<td>$8,702 (2014)</td>
<td>$10,348 (2016)</td>
</tr>
<tr>
<td>% of GDP, state &amp; local spending</td>
<td>17.3% (2009)</td>
<td>W VA 23.4% Wyoming 11.2%</td>
</tr>
</tbody>
</table>

KATHLEEN L. WOLF, PH.D.

also in Spanish and Arabic
Nearby nature experiences are important across the entire life cycle, from cradle to grave.

Research about nature benefits and economic value is fairly new. Some of the quantified health benefits of nature in cities are easier to convert to economic value than others. Here are some preliminary valuations - estimated for the entire U.S. on an annual basis.

INFANTS

BIRTH WEIGHT

Over recent generations, birth weight is often used as a proxy for a range of health outcomes in adulthood. Studies have shown that higher birth weight is associated with lower risk of type 2 diabetes, cardiovascular disease, and certain cancers.

OVERALL HEALTH AND WELL-BEING

ECONOMIC BENEFITS:

- Increased physical activity
- Reduced asthma
- Reduced risk of obesity
- Improved school attainment
- Reduced risk of adult skin conditions

IMMUNE FUNCTION

IMMUNE STRENGTH:

- Improved immune system leads to reduced illness and chronic disease across a lifetime.

FAMILY DYNAMICS

IMPROVED FAMILY DYNAMICS:

- Reduced stress and anxiety
- Improved communication

FUTURE FINANCIAL SUCCESS

ECONOMIC BENEFITS:

- Increased graduation rates
- Increased earnings

CRIME & SAFETY

ECONOMIC BENEFITS:

- Reduced crime rates
- Reduced property crime

CONTRIBUTING ANALYSTS:

Dr. Stephen Grado & Marcus Measells, MSU; Dr. Alicia Robbins, Weyerhaueser
### Valuation Sources

*Benefit x Nature x Health Outcome*

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Metro Nature</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn Birth Weight</td>
<td>increased tree canopy cover near mothers' homes</td>
<td>fewer small for gestational age babies</td>
</tr>
<tr>
<td>Attention Deficit &amp; Hyperactivity Disorder</td>
<td>greener play areas vs built outdoor or indoor settings</td>
<td>reduced symptoms potentially reducing medication</td>
</tr>
<tr>
<td>School Performance</td>
<td>green views from classrooms and cafeteria</td>
<td>reduced dropout rate - average annual income</td>
</tr>
<tr>
<td>Crime Reduction</td>
<td>trees and lawn in outdoor common areas</td>
<td>reduced violent and non-violent incidence and costs</td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td>presence of residential tree canopy</td>
<td>reduced incidence or severity of cardiovascular disease</td>
</tr>
<tr>
<td>Alzheimer’s Disease</td>
<td>wander garden in care facility</td>
<td>reduced medications for patients</td>
</tr>
</tbody>
</table>

common values: avoided costs & burden of illness
## Summary Table

<table>
<thead>
<tr>
<th>Benefit (geographic scope)</th>
<th>Minimum ($)</th>
<th>Maximum ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn Health (U.S.)</td>
<td>5.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Attention Deficit Hyperactivity Disorder (U.S.)</td>
<td>383.5</td>
<td>1,917.7</td>
</tr>
<tr>
<td>Schools (U.S.)</td>
<td>20.4</td>
<td>1,262.9</td>
</tr>
<tr>
<td>Crime (U.S.)</td>
<td>340.6</td>
<td>899.4</td>
</tr>
<tr>
<td>Cardiovascular Disease (U.K., U.S.)</td>
<td>1,220.0</td>
<td>1,220.0</td>
</tr>
<tr>
<td>Alzheimer's Disease (U.S.)</td>
<td>724.6</td>
<td>1,449.2</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>2,694.4</td>
<td>6,754.5</td>
</tr>
</tbody>
</table>

Avoided Costs Potential?

Urban Forestry & Urban Greening
Volume 41, May 2019, Pages 39-47

Is green land cover associated with less health care spending? Promising findings from county-level Medicare spending in the continental United States

Douglas A. Becker a, Matthew H.E.M. Browning a, b, Ming Kuo a, Stephen K. Van Den Eeden c
Lifecycle :: disease & illness

Cumulative U.S. DALYs for the Leading Disease/Disorder Categories by Age (2010)

Disability Adjusted Life Year

Data courtesy of WHO
Avoided Costs Potential?

$3 trillion
17% of US GDP


- $222 billion
- $134 billion
- $57 billion
Urban Forests for Human Health: A Focused Economic Valuation

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Healthy trees are rooted in research!
Donate now at www.treefund.org

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TREE Fund • 552 S. Washington St., Ste. 109, Naperville, IL 60540
Summary

1. History :: Environmental Health :: Sanitary to Sustainable Cities

2. Nature as Social Determinant of Health

3. Evidence = Shift (policy)
Seven Sisters Oak, Mandeville :: Chuck Cook, The Times-Picayune
So the tree rustles in the evening . . .

Trees have long thoughts, long-breathing and restful,

just as they have longer lives than ours.

Hermann Hesse, *Trees: Reflections and Poems*
Human Dimensions of Urban Forestry and Urban Greening

What's New?
Nature and Consumer Environments
Research about how the urban forest influences business district visitors.

Trees and Transportation
Studies on the value of having quality landscapes in urban roadsides.

Civic Ecology
Studies of human behaviors and benefits when people are active in the environment.

Policy and Planning
Integrating urban greening science with community change.

Urban Forestry and Human Benefits
More resources, studies and links...

Green Cities: Good Health
human health & well-being research

Projects Director
Kathleen L. Wolf, Ph.D.