Why are trees important?
human health and economics

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University of Washington

Tree Fund Webinar Series
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Health is...

A state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity

(World Health Organization, 1946)
Best available science – nature & health?

Green Cities: Good Health
www.greenhealth.washington.edu

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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
How are urban trees associated with human health?
Urban Trees & Human Health

- Literature Review
- Economic Implications
- Urban Forest Planning & Planting
Urban Trees & Human Health: A Scoping Review

Purpose:
To carefully collect and synthesize the peer-reviewed evidence concerning urban trees and human health.
Project Team

- Kathleen Wolf, Ph.D., University of Washington
- Sharon Lam, MSc, University of Toronto
- Jennifer McKeen, MPH, Simon Fraser University
- Gregory Richardson, MUP, Health Canada
- Matilda Van Den Bosch, M.D, University of British Columbia
- Adrina Bardekjian, Ph.D., Tree Canada
Method

Keyword search (n = 2563)

Abstract review (n = 436)

Quality assessment (n = 215)

Final article set (n = 199) (201 studies)

Synthesize and present findings
Associations between urban trees & health
What did we learn?

- single & park trees
- pollen
- tree canopy/NDVI
- image/simulation

credit: Univ of Utah
What did we learn?

Health Outcomes Themes:

- Tree Pollen and VOCs
- Active Living/Weight Status
- Psychophysiological Stress
- Excess Heat and Thermal Comfort
- Cardiovascular Function
- Mental Health, Anxiety and Mood
- Air Pollutants and Respiratory Condition
- Other Restoring Capacities (e.g., Birth...)
- Cognition and Attention Restoration
- Other Reducing Harm (Crime, UVR)
- Clinical Outcomes
What did we learn?

Publication Dates by Decade

- 1980-1989: 0
- 1990-1999: 10
- 2000-2009: 50
- 2010-2018: 140
Health Care Spending in U.S.

- $10,348 annual per capita (2016)
- $3.5 trillion total
- 17.9% of Gross Domestic Product
15 Leading Causes of Death in U.S., 2017

- Diseases of heart
- Cancer
- Accidents (unintentional injuries)
- Chronic lower respiratory diseases
- Cerebrovascular diseases
- Alzheimer's disease
- Diabetes mellitus
- Influenza and pneumonia
- Nephritis, nephrotic syndrome and nephrosis
- Intentional self-harm (suicide)
- Chronic liver disease and cirrhosis
- Septicemia
- Essential hypertension & renal hypertension
- Parkinson's disease
- Pneumonitis due to solids and liquids

Total deaths (2017):

source: U.S. Centers for Disease Control and Prevention
Costly chronic diseases

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

Data courtesy of WHO

(Disability Adjusted Life Year)
Nature & Health Economics Analysis Process

- **human scale: individual to community**
- **screen for benefits**
  - urban forestry
  - parks
  - gardens, etc.
- **green condition**
- **valuation strategy**
  - market
  - non-market
Nature & Health Annual Savings

Millions of U.S. Dollars (2012)

<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>Totals</td>
<td><strong>2,694.4</strong></td>
<td><strong>6,754.5</strong></td>
</tr>
</tbody>
</table>

Nearby nature experiences are important across the entire life cycle, from cradle to grave.

**INFANTS**

**BIRTH WEIGHT**
Reduced birth weight affects long-term childhood health and development, and has been linked to some adult diseases. Low birth weight is associated with shorter life expectancy and lower income. Pregnant women who have more access to green spaces near their homes generally have babies with higher birth weights.

**IMMUNE FUNCTION**
**ECONOMIC IMPACT:** Strengthened immune system leads to reduced illness and chronic disease across a lifetime.
We are most vulnerable in the early months of our lives, when the brain and immune systems are developing. Exposure to outdoor environments can increase the immune system's effectiveness.

**FAMILY DYNAMICS**
**ECONOMIC IMPACT:** Improved family dynamics; perhaps reducing mental health treatment and counseling services.
An infant’s parents and siblings adjust their stress levels and are more likely to interact with each other.

**Note:** All economic values are in 2016 U.S. dollars, and are potential annual savings across the entire U.S.

**CHILDREN & TEENS**

**OVERALL HEALTH AND WELL-BEING**
**ECONOMIC IMPACT:** Increased physical activity, reduced asthma, or other causes of emergency department visits, hospitalizations and missed school days, and reduced risk of adult skin conditions.
Negative conditions in a child’s environment can cause both immediate and ongoing health impacts. Nature is a positive influence, providing children with the opportunity to learn, play, and develop intellectual skills that improve both health and later life achievement. Green spaces can also provide air quality and space for play, which can improve mental and physical health.

**ADHD**
**ECONOMIC IMPACT:** Estimated to save $134 billion dollars per year.
Millions of children ages 4 to 17 are treated for Attention Deficit Hyperactivity Disorder (ADHD) in the U.S. Nature exposure is a potential alternative treatment, as it can provide an environment where children can learn, play, and develop intellectual skills.

**FUTURE FINANCIAL SUCCESS**
**ECONOMIC IMPACT:** $1,261 increase in high school graduates’ lifetime annual income.
School performance affects not only the education and career success of students, but also the economy. Education is a key factor in economic development. High school graduates who have access to nature in their communities are more likely to graduate and find employment.

**ADULTS**

**DEPRESSION AND STRESS**
**ECONOMIC IMPACT:** Reduced frustration, mental distress, and depression disorders, and improved quality of life.
Many adults with depression and stress benefit from exposure to nature. Nature can help reduce stress, improve mood, and increase overall well-being.

**CARDIOVASCULAR DISEASE**
**ECONOMIC IMPACT:** $81,483 annual savings, based on a 1.2% reduction in medical expenditures.
Cardiovascular disease is the leading cause of premature death in the U.S. Nature exposure can help reduce the risk of cardiovascular disease.

**CRIME & SAFETY**
**ECONOMIC IMPACT:** Reduced risk of crime.
Nature exposure can help reduce the risk of crime, especially for children and teenagers.

**OLDER ADULTS**

**MOBILITY & QUALITY OF LIFE**
**ECONOMIC IMPACT:** $1.7 billion savings on health care costs from falls per year.
Falls are a significant problem for older adults. Nature exposure can help reduce the risk of falls and improve mobility.

**HYPERTENSION**
**ECONOMIC IMPACT:** $1.8 billion savings on treatment costs annually.
Hypertension, or high blood pressure, is one of the most common chronic diseases in the U.S. Nature exposure can help reduce the risk of hypertension.

**COGNITIVE DISORDERS**
**ECONOMIC IMPACT:** $8.9 billion annual savings in medical services, not counting the cost of home care services.
Cognitive disorders, such as Alzheimer’s disease, can be prevented with nature exposure. Nature exposure can help reduce the risk of cognitive disorders.

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.

Contributing analysts:
Dr. Stephen Grado & Marcus Measells, MSU; Dr. Alicia Robbins, Weyerhaeuser
Urban Forests for Human Health: A Focused Economic Valuation

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Strength of Evidence

<table>
<thead>
<tr>
<th>Strength</th>
<th>Evidence Type</th>
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<tbody>
<tr>
<td>STRONG</td>
<td>Experimental Study (i.e., a randomized controlled trial)</td>
</tr>
<tr>
<td>MODERATE</td>
<td>Quasi-experimental Study</td>
</tr>
<tr>
<td>PROMISING</td>
<td>Correlational Study with statistical controls for selection bias</td>
</tr>
<tr>
<td>DEMONSTRATES A RATIONALE</td>
<td>Well-specified logic model informed by research or evaluation</td>
</tr>
</tbody>
</table>

source: PearsonSchool.com
Trees & Health Valuation Potential

cancer

diabetes, respiratory illness, asthma, healing/recovery

cardiavascular disease, mental disease, ADHD

strength of evidence

clinical illness & disease incidence
### Health Care Costs: Clinical Illness & Disease Incidence

<table>
<thead>
<tr>
<th>Illness or Disease</th>
<th>Annual Costs (U.S.)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>hospital stay/recovery</td>
<td>$1.1 trillion (2017)</td>
<td>debt.org</td>
</tr>
<tr>
<td>diabetes</td>
<td>$327 billion (2017)</td>
<td>American Diabetes Association</td>
</tr>
<tr>
<td>mental disease</td>
<td>$201 billion (2013)</td>
<td>Health Affairs journal</td>
</tr>
<tr>
<td>ADHD</td>
<td>$143 billion (2013)</td>
<td>American Academy of Child and Adolescent Psychiatry</td>
</tr>
<tr>
<td>asthma</td>
<td>$82 billion (2013)</td>
<td>American Thoracic Society</td>
</tr>
<tr>
<td>respiratory illness</td>
<td>$36 billion (2010)</td>
<td>American College of Chest Physicians</td>
</tr>
</tbody>
</table>
Trees & Health Valuation Potential

- Physical activity, weight control, UV screen, better sleep
- Birth weight, pain relief, crime reduction, thermal comfort
- Stress reduction, mental function, social cohesion

Strength of evidence

Health & wellness

‘Protection’
Avoided Costs = Health Savings

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
Urban Trees & Human Health

Literature Review

Economic Implications

Urban Forest Planning & Planting
Urban forest management for human health
‘Trees are Good’ but could they be better?

have evidence re: trees & health
are associated cost reductions & savings
perhaps expand policy and goals?

• canopy goals: 35-40%
• connectivity: 20 – 50 minute walks
• address pollen concerns
• enable activity (forest bathing, walking loops)
3.2. Plant Entrances

Plant entrances can also incorporate distant views to natural spaces such as mountains and water bodies, or views from within the building. Implementing plantings near entrances to ensure that the spaces created feel welcoming to all members of society. The presence of vegetation at building or site entrances as well as welcoming occupants inside. The view from within refers to the presence of green, which may include trees or other vegetation, at and ensure the sightlines are preserved or enhanced from within the building entrance; (Figure 4. The View from Within)

Climate change

The view from within: if trees were closer to apartment buildings. This facilitated increased social interaction and supervision of children in otherwise isolating environments. In the case of high-rise buildings, vegetation near entrances also shortens the amount of time it would take for occupants to reach some green space. The horizontal distance to green space is a metric that has been used to assess the importance of parks and trees in underserved communities, regardless of demographic, cultural or socio-economic conditions. Example may include “pocket parks” and linear greenways.

Table 1 includes a novel metric which has not yet been tested: vertical distance to green space. Vertical distance to green space is important, especially in areas of high demand for physical space. Additionally, such biophilic building designs offer direct benefits for building efficiencies, by offering cooling effects, and subsequent energy savings. Seasonality should be considered when designing plantings near entrances to ensure that the spaces created feel welcoming to all members of society.

View sketch of window looking over landscape; (Figure 2. Plant Entrances)

A study of building users in the United Kingdom found that residents spent more time outside if trees were closer to apartment buildings. This facilitated increased social interaction and supervision of children in otherwise isolating environments. In the case of high-rise buildings, vegetation near entrances also shortens the amount of time it would take for occupants to reach some green space. The view from within: if trees were closer to apartment buildings. This facilitated increased social interaction and supervision of children in otherwise isolating environments. In the case of high-rise buildings, vegetation near entrances also shortens the amount of time it would take for occupants to reach some green space.

Exposure to green space, along with its associated benefits, has been shown to correlate with demographic and socio-economic conditions. Example may include “pocket parks” and linear greenways.

Trees and plants can play an important role in improving access to visible green space, particularly in higher-density neighborhoods, where development occurs upwards rather than outwards, and in cities with increasingly dense neighborhoods, where development occurs upwards rather than outwards, and in cities with increasingly high demand for physical space. Additionally, such biophilic building designs offer direct benefits for building efficiencies, by offering cooling effects, and subsequent energy savings. The view from within: if trees were closer to apartment buildings. This facilitated increased social interaction and supervision of children in otherwise isolating environments. In the case of high-rise buildings, vegetation near entrances also shortens the amount of time it would take for occupants to reach some green space.

When applied appropriately, horizontal distance to green space is a metric that has been used to assess the importance of parks and trees in underserved communities, regardless of demographic, cultural or socio-economic conditions. Example may include “pocket parks” and linear greenways.

The view from within: if trees were closer to apartment buildings. This facilitated increased social interaction and supervision of children in otherwise isolating environments. In the case of high-rise buildings, vegetation near entrances also shortens the amount of time it would take for occupants to reach some green space. The view from within: if trees were closer to apartment buildings. This facilitated increased social interaction and supervision of children in otherwise isolating environments. In the case of high-rise buildings, vegetation near entrances also shortens the amount of time it would take for occupants to reach some green space.
Tree Planting for Health

Bring Nature Nearby

Retain the Mature

Tree Planting for Health

Generate Diversity

Create Refuge

Tree Planting for Health

Connect Experiences

Optimize Green Infrastructure
