



## The Public Health Value of Urban Trees and Green Spaces

### Introduction

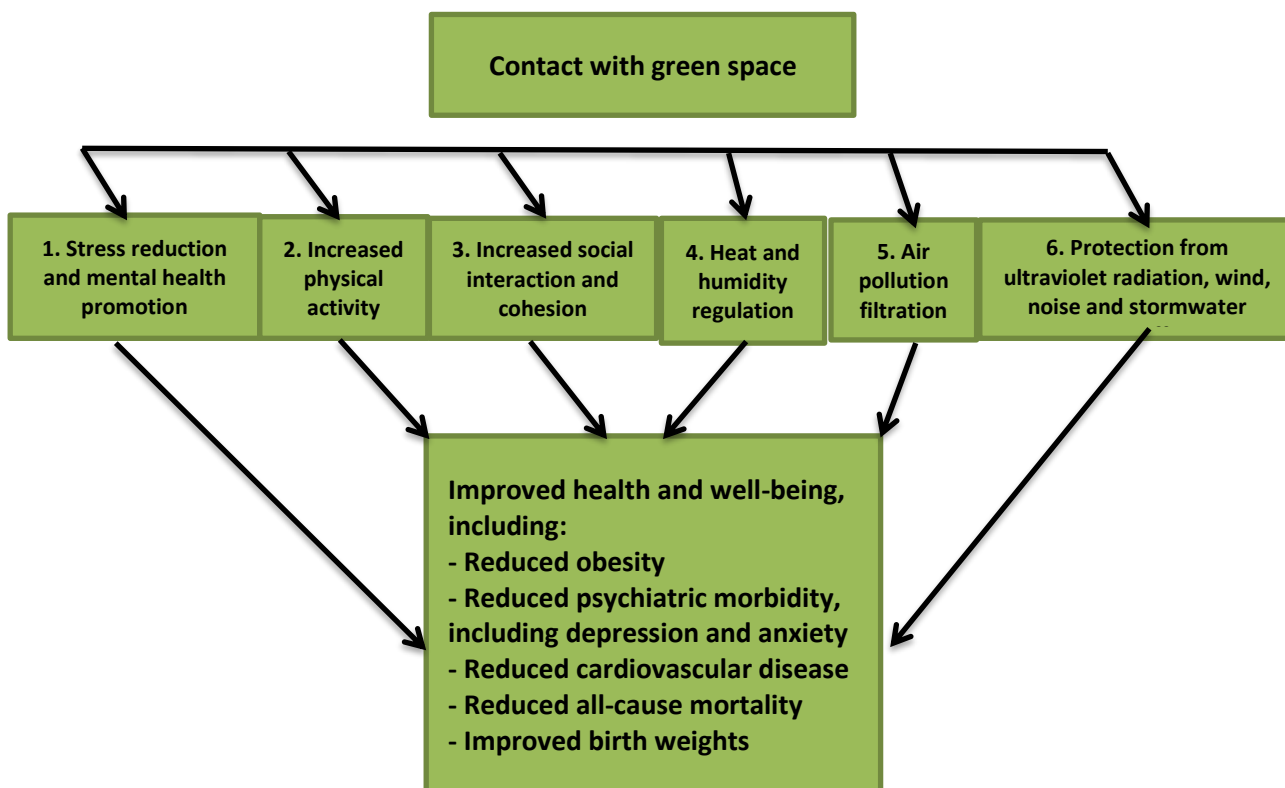
The urban environment impacts people’s health and well-being.<sup>1</sup> Access to green spaces plays an important role in providing significant health benefits in reducing chronic disease risk factors such as obesity, physical inactivity, heart disease, and diabetes. Urban trees and forests are an important component of quality green spaces and help create the physical environments that can foster health.

Living near green space is related to better self reported well-being, and this is more pronounced in low income neighbourhoods.<sup>2</sup> The community benefits from contact with green spaces that affect general well-being include physical, mental, social, environmental and economic. Urban green space is an under-utilize public health resource that offers a potential for address the growing burden to mental health and disease in Ottawa.<sup>3</sup>

Urban forests, trees, and green spaces also have important effects on regulating air quality and thermal comfort in urban settings, as well as on exposure to ultraviolet radiation, wind and noise. This will become more important as climate change increases average temperatures and results in extreme weather events.

Research into the health benefits of green spaces that include trees and urban forests have demonstrated a range of health benefits, through a number of pathways. These are described in the figure below, and expanded upon in this document.

Figure 1: Associations and pathways through which green space benefits health (adapted from [James et. al, 2015](#)).<sup>4</sup>





## 1. Stress Reduction and Mental Health Promotion

Mental health is essential for overall health and well-being and impacts people's ability to enjoy life.<sup>5</sup> Mental health is an issue in our community, with associated pressures. In Ontario, mental illness is more than 1.5 times the burden of all cancers, and seven times the burden of all infectious diseases.<sup>6</sup> Ten percent of Ottawa residents age 19 and over report having been diagnosed with a mood disorder; 9% report an anxiety disorder; 1 in 4 students in grades 7-12 report visiting a mental health professional at least once in the past year, and there were nearly 1,200 emergency room visits due to self harm among Ottawa residents<sup>7</sup>.

There is growing evidence that exposure to green space reduces stress, anger, fatigue, sadness, anxiety and increase energy independent of other benefits such as physical activity.<sup>8</sup> Researchers found that surgical patients who had access to nature healed more quickly than those who did not.<sup>9</sup> Living near urban green space can lead more time spent outside and better self-reported mental and physical health. For example, children who are active in nature perform better on tests, and dementia patients exposed to nature were calmer.<sup>10</sup>

## 2. Increased Physical Activity

Regular physical activity is an important factor in mitigating and preventing chronic diseases and promoting health. Physical activity can be recreational or purposeful, such as walking or cycling to work, school or running errands. In Ottawa only one in four (22%) students (grades 7 to 12) reported meeting physical activity recommendations of 60 minutes per day and close to half of adults (47%) report they are overweight or obese. Additionally, only 19% of students in grades 7-12 in Ottawa use active transportation to get to school whereas 10% of residents use it to get to work.<sup>8</sup> Being active is known to reduce the risks of chronic diseases, including cardiovascular disease, stroke, hypertension, colon cancer, breast cancer, and Type 2 diabetes. It promotes positive self-esteem and helps to prevent overweight and obesity.<sup>11</sup>

Living near urban green space is beneficial to physical activity.<sup>11</sup> Physical activity in natural environments, compared with exercising indoors, has been associated with greater positive feelings.<sup>12</sup> Higher greenness in neighbourhoods was associated with lower odds of children and youth increasing their Body Mass Index scores. A significant association was found between children's weight status and the presence of parks larger than one acre within 800 metres of their homes.<sup>13</sup> There is an emerging practice whereby health practitioners are prescribing "time outdoors" to encourage physical and mental health due to the proven benefits.<sup>14</sup>

Trees contribute to making urban green spaces attractive environments for physical activity. When they are planted along roads they can reduce perceived width and thereby calm traffic which can indirectly promote active transportation as it is perceived as safer.<sup>15</sup>

## 3. Increased Social Interaction and Cohesion

Social relationships and connections with friends, family, neighbours, and volunteer organizations have a direct association with health. People with fewer social ties have a mortality rate double those with more social ties. Lacks of social connections have been linked to an increase risk for health conditions such as cardiovascular disease, atherosclerosis, high blood pressure, cancer, impaired immune function, reduced mobility, depression and slower recovery times.<sup>16</sup>



Community design that is able to incorporate accessible green space and trees can have a positive impact on creating spaces that encourage social interactions and connections, by making spaces more attractive, cooler, and more beautiful. They foster a sense of place and belonging.<sup>11,17</sup>

Additionally, they can also have the potential to address social disparities. A more even distribution of trees across communities can equalize the benefits from green space and trees. Low income areas may benefit greater from urban green spaces than more affluent neighbourhoods as it provides spaces and opportunities to connect that they otherwise wouldn't have.<sup>18</sup> In more vulnerable neighbourhoods, perceived safety of community green spaces is an important factor to its use.<sup>19</sup> For older adults vulnerable to social isolation, green space has been shown to provide an environment for mental restoration and social connections.<sup>20</sup>

#### **4. Heat and Humidity Regulation**

Urban heat island is a term used to describe built-up areas that are hotter than nearby rural areas due to the way human-made surfaces absorb and store heat. The average air temperature of a city in large urban centres, such as Ottawa, can be 1 to 3°C warmer than its surrounding rural areas, and include hot spots that are even warmer. In the evening, as surfaces release their heat into the environment, the air temperature difference can be as high as 12°C.<sup>21</sup> Climate change is expected to exacerbate the urban heat island effect as average temperatures increase. Environment Canada projects that by mid-century, the average number of days per year where the temperature exceeds 30°C in Ottawa will double from the current 22 days per year to over 40 days. In addition, warm night time temperatures will increase fourfold by the end of the century.

Prolonged exposure to high temperatures and humidity for people who are not acclimatized can create health risks where mitigating resources (air conditioning, cool breezes) are not available. The most vulnerable to extreme heat are young children, people with chronic illnesses, the marginally housed or homeless, isolated seniors, occupational groups that work outdoors, and physically active people.<sup>22</sup> The short term and long term health impacts can include heat cramps, heat exhaustion, and heat stroke, and in extreme cases death. Each year in Ottawa there are approximately 77 emergency room visits that are directly related to the exposure of extreme heat.

The impact of the urban heat islands on human health will increase as the built environment grows and intensifies. Increasing urban forests and trees reduces the impact of urban heat islands because a healthy urban tree canopy protects the urban landscape from rising temperatures. Trees also cool the air by releasing water vapour during their breathing process. Ultimately, trees increase the ability for people to withstand the health effects of extreme heat.

Studies show that urban trees have a superior ability to provide thermal comfort and relief from heat when compared to artificial shade structures or open green spaces. The cooling impact of urban forests and trees is influenced by the ambient temperature, plant type and density, wind and shape.<sup>23</sup> A tree can be a natural air conditioner. The evaporation from a single tree can produce the cooling effect of 10 room size air conditioners operating 20 hours a day.<sup>24</sup>

#### **5. Air Pollution Filtration**

With larger Cities and industrialization, humans have created and released chemicals in the air that have decreased the air quality. There are many different types of air pollutants. Some sources of pollution are from household products<sup>25</sup>, motor vehicles, industries and forest fires.<sup>26</sup> The most critical pollutants that impact health include particulate matter, ground level ozone, nitrogen dioxides.



This air pollution contaminates both indoor and outdoor environments and can affect health. Some people are at greater risk. These include older adults, children, pregnant woman, people with chronic diseases, and people of lower socio-economic status. Those at risk may develop more severe health effects more quickly when exposed to air pollution. Breathing air pollution can lead to a wide range of health impacts),<sup>27,28</sup> which includes the following:

- tiredness, headache or dizziness,
- more mucous in the nose or throat,
- dry or irritated eyes, nose, throat and skin,
- wheezing, coughing, shortness of breath,
- exacerbation of asthma symptoms, allergies, and chronic obstructive pulmonary disease and other respiratory conditions,
- premature death,
- heart attack, stroke and other cardiovascular diseases,
- Increased risk for certain types of cancers, and
- low birth weight and infant mortality.

In Ottawa, it is estimated that air pollution is responsible for 503 acute premature deaths per year.<sup>29</sup> The Ontario Medical Association estimates that across Ontario, it is responsible for 9,500 deaths per year along with 4,597 hospital admissions, over 39,500 emergency room visits and 262,315 doctors' office visits.

Outdoor air quality is expected to decline with climate change due to higher levels of ground-level ozone and airborne dust (including smoke from wildfires), as well as increased production of pollens and spores by plants, and the burning of fossil fuels.<sup>30</sup>

Trees have varying capacity to capture and/or filter air pollution, depending on the density and species. The leaves from trees clean the air by capturing and filtering the pollution. There is evidence that some tree species contribute small amounts of harmful volatile organic compounds that can contribute air pollutants. Increasing the tree cover in urban areas leads to greater absorption of pollution and helps improve the air quality in urban areas.<sup>31</sup> They are effective at removing ozone, fine particulate matter, nitrogen dioxide, sulphur dioxide and carbon monoxide. Urban trees have also been shown to remove micro pollutants including cadmium, chromium, nickel and lead from the air.<sup>32</sup> Twelve trees will absorb 1.9 tonnes of carbon which is the same amount produced by an SUV travelling 20,000 km.<sup>33</sup> A 10km x 10km area with a 25% tree cover can remove 90.4 tonnes of particulate matter which was estimated to prevent two deaths and two hospitalizations per year.<sup>34</sup>

Computer modeling shows that for each 1% improvement in air quality from tree filtration, there is an associated avoidance of more than 850 deaths and 670,000 incidences of acute respiratory symptoms in the United States.<sup>35</sup>

## **6. Protection from Ultraviolet Radiation, Wind, Noise and Storm Water Runoff**

Prolonged exposure to the sun (UV radiation) induces changes to the skin which can lead to skin cancers.<sup>36</sup> It has been linked to sunburns, premature skin aging, skin cancer, eye problems, and weakening of the immune system.<sup>37</sup> Melanoma skin cancer is one of the fastest rising cancers directly caused by UV radiation and the most serious form of skin cancer. The direct cost of skin cancer in Canada is about \$532 million per year.<sup>38</sup> Reducing overall exposure to sunlight is the most important way to prevent skin cancer and other health effects of UV radiation. Communities that are designed

with shade trees provide residents with shelter from the sun and decreases health risks associated with sun exposure.<sup>39</sup>

Additionally, trees are also important to buffering the effects of wind. Increased wind speeds at street level are created in cities when wind becomes accelerated as air hits a building and doesn't have anywhere else to go. This can increase human comfort in the summer months by decreasing the temperature but in the winter months can reduce the temperature by producing a windchill. Planting trees strategically can act as a wind buffer and reduce the air speed at street level.

Trees are also useful tools in mitigating land-use compatibility issues in protecting against noise. Urban environments can foster high levels of background noise that is known to have health impacts (e.g. from traffic). Planting trees close to the noise source reduces noise levels. Trees scatter the sound and the ground absorbs it. Noise reductions between 5 to 8 decibels have been achieved with tree and vegetation planting along roadsides.<sup>40</sup> Wide belts (30 meters) of tall dense trees combined with soft ground surfaces can reduce noise by 50% or more.<sup>41</sup>

Trees and urban forests play an important role in mitigating urban surface water management and runoff. Cities have more paved surfaces and less vegetation and soil to absorb the water. This can lead to more water runoff, and can create flooding conditions that could lead to health concerns and hazards (e.g. poor indoor air quality and structural damage). Urban forests and trees intercept and retain or slow the flow of precipitation reaching the ground. They are an important part of a comprehensive storm water management strategy because they can reduce the rate and volume of storm water runoff, decrease flood damage, reduce storm water treatment costs, and enhance water quality.<sup>42</sup>

## Conclusion

Urban forests and access to them are a key component to reducing health risks and maximizing community well-being. Planning communities that incorporate urban trees and forests that are accessible, well maintained and safe provides significant public health benefits. Access to urban trees and forests is not equal among the different socio-economic groups and therefore there is also limited access to their associated health benefits. Exposure to nature helps address the growing burden of mental health and chronic diseases in Ottawa, and help create safe and comfortable conditions for vibrant, socially connected communities.<sup>43</sup> This includes planning for communities with a robust tree canopy network in order to maximize potential health benefits.

## Ottawa Public Health Programs and Policies related to Healthy Built Environments and Access to Nature

Ottawa Public Health (OPH) seeks to improve and advocate for health and well-being through advancing health protection and promotion. As part of the [Ottawa Public Health Strategic Plan](#), OPH is committed to contributing to building healthy, complete communities. To help with this OPH developed a [framework](#) for addressing health through the built environment. This framework identifies the land use and transportation elements that contribute to creating health-promoting, complete communities. The potential for urban design to have significant impact on health through improving local air and water quality, lessening the impact of extreme weather events and climate change, promoting social cohesion, and lower health inequities is recognized. OPH seeks to build awareness of the health benefits of access to green spaces and trees so that they are valued, promoted, and enhanced.



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